# Analysing The Effect Of Housefly Maggot Rearing Using Municipal Solid Waste On Npk Level At Chidambaram

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**Abstract - Chidambaram generates around 35 MT of waste every day at a rate of 606 grams per capita per day. Other than residential sources, commercial and institutional establishments also contribute significantly to the total waste generated by the town. 56 per cent of solid waste was generated from residential area followed by commercial establishment and market. To reduce the environmental burden and improve public health, new and financially attractive waste management strategies should be explored and fostered. Hence an attempt has been made to identify the effect of housefly maggot rearing using municipal solid waste. The present study analyses the methods to reduce municipal solid waste by rearing house fly maggots in different trails. Various minerals were estimated using diluted samples. From the results, it was observed that the weight of the maggot was increasing as days pass. Further, it could be seen from the results that the minerals like phosphorus and potassium showed an increasing trend except nitrogen which shows a decreasing trend. However, the levels of all minerals were within the permissible limit only. The results of ANOVA said that among minerals, nitrogen level varied significantly in trails and between days and phosphorus & potassium had significant variation when duration of rearing increased.**

**Key Word - Municipal solid waste, Housefly, Maggot, NPK, Waste reduction index**

## INTRODUCTION

Municipal Solid Waste (MSW) is commonly known as trash or garbage in the United States and rubbish in Britain, is a waste type consisting of everyday items that are discarded by the public. Garbage can also refer specifically to food waste, as in a garbage disposal; the two are sometimes collected separately. MSW can be broadly categorized into five broad categories (a) Biodegradable waste: Food and kitchen waste, green waste (vegetables, flowers, leaves fruits), paper (can also be recycled). (b) Recyclable material: Paper, glass, bottles, cans, metals, certain plastics, etc (c) Inert waste: Construction and demolition waste, dirt, rocks, debris. (d) Composite waste: Waste clothing, tetra packs, and waste plastic such as toys. (e) Domestic hazardous waste (also called "household hazardous waste") & toxic waste: Medication, e-waste, paints, chemicals, light bulbs, fluorescent tubes, spray cans, fertilizer and pesticide containers, shoe polish (Shekdar, 2009)

Chidambaram generates around 35 MT of waste every day at a rate of 606 grams per capita per day. Other than residential sources, commercial and institutional establishments also contribute significantly to the total waste generated by the town. Managed by the health department of the local body, on an average 33 MT of waste is being collected from all the health zones and disposed off through dumping by the agency, which shows a collection efficiency of 95%. The major contributors to municipal solid waste are outlined in table 1.

**Table 1**
**Sources of Solid Waste in Chidambaram**

| S.No. | Source | Generation % |
|---|---|---|
| 1 | Residential | 56 |
| 2 | Lab | 1 |
| 3 | Commercial Establishment & Market | 31 |
| 4 | Industrial | 0 |
| 5 | Hospital & Nursing homes | 12 |

**Source: Chidambaram Municipality Final Report April 2008**

It could be seen from the table that 56 per cent of solid waste was generated from residential area followed by commercial establishment and market. The solid waste generation in Chidambaram is given in Table 2.

**Table 2**
**Status of Solid Waste Management in Chidambaram**

| Particulars | Units | Values |
|---|---|---|
| **Generation** | | |

| | | |
|---|---|---|
| Daily Waste Generation | MT | 35 |
| Daily Waste Collection | MT | 33 |
| Per capita waste generation | Grams | 641 |
| Collection efficiency | % | ~ 95 % |
| **Compost Yard / Dumping Yard Particulars** | | |
| Dumping / Compost Yard area | Acres | 4.58 |
| Yard as per norms | Acres | 8.62 |
| New land acquired | Acres | 5.34 |
| Distance from Town | Km | 2 |
| Composting in place? | No | |
| **Collection** | | |
| Door-to-Door collections | Wards | 31 |
| Privatization of collections | Wards | Only market |
| **SWM Vehicles/Equipment details** | | |
| Tippers | Nos. | 3 |
| Dumper placers | Nos. | 2 |
| Lorry | Nos. | 1 |
| Earthmover | Nos. | 1 |
| Sullage lorry | Nos. | 1 |
| Push carts | Nos. | 33 |
| Dumper Bins | Nos. | 10 |

**Source: Chidambaram Municipality Final Report April 2008**

Feeding waste to larvae has been shown to inactivate disease transmitting bacteria, such as Salmonella sp. This implies that the risk of disease transmission between animals and humans is reduced when using this technology at farm level or when treating waste of animal origin in general (e.g. chicken manure or slaughterhouse waste). However, risk reduction is achieved mainly through waste reduction (80%) rather than through pathogen inactivation. To reduce the environmental burden and improve public health, new and financially attractive waste management strategies should be explored and fostered. Hence an attempt has been made to identify the effect of housefly maggot rearing using municipal solid waste.

## MATERIALS AND METHODS

### Collection of Sample

The house fly maggots were collected from decaying material which is available in fish market. The initial wet weight of each larvae was observed. The age of larvae was 4-5 days after egg hatching (Newton et.al., 2005 and Jack et.al., 2017).

### Experimental Setup

The experiments were conducted in trays. The size of tray was 1m x 1m x 9 inches and which is locally available in the market. Six trials were conducted to observe the growth of larva in specific intervals viz., 1$^{st}$day, 3$^{rd}$ day, 5$^{th}$day and 7$^{th}$day. First two trails were conducted with three and five numbers of maggots; next two trails were carried out by rearing seven and nine maggots; last two trails were done by adding eleven and thirteen maggots. In each trail, minerals like nitrogen, phosphorus and potassium were tested.

### Estimation of Nitrogen Level

Total N includes organic N, ammonium N and nitrate N. Nitrogen level was identified using kjeldhal's method (TKN method). The TKN method will analyse for organic N and ammonium N, but not nitrate N. Nitrate can be recovered by modifying the TKN method.

### Mineral analysis

Minerals like Calcium, Phosphorus, Potassium, Magnesium, Sodium, Nitrogen and Lithium contents were analysed for diluted sample using flame photometer, spectrophotometer and kjeldhal method. The only way to measure Phosphorus element is converting Phosphate (PO4) into Phosphorus (P). Therefore, the Phosphorus value was identified by multiplying the value of 0.3261 with the calculated value.

### Estimation of Waste Reduction Index

To take into account not only the overall material reduction but also the time the larva require to reduce the amount of solid waste, the waste reduction index was calculated using the overall degradation (D), divided by the number of days the larvae fed on the material

$$WRI = (D/t) \times 100$$

$$D = (W-R)/(W)$$

Where W is the total amount of solid waste applied during the time 't' and 'R' is the residue after time 't'. The factor (100) is used to give the index a practical value. High 'WRI' values indicate the good reduction efficiency.

### Statistical Analysis

The results of the experiments were analysed statistically by conducting a two-way analysis of variance (ANOVA) when more than two treatments were considered and examined the variation. The estimated parameters were considered as dependent variable. Days and trails with different number of maggots were taken as independent variables. P value of $< 0.05$

was considered to indicate a significant difference between the values compared. The difference was considered as significant if the calculated value of F will be either equal or more than its table value.

## RESULTS AND DISCUSSION

The experiment was done using two trays under aerobic condition (Fig.7). Three analyses were carried out for different numbers of housefly maggots. Therefore, totally six trails were done and identified different parameters

First analysis
- Rearing three maggots in first tray (T1)
- Rearing five maggots in second tray (T2)

Second analysis
- Rearing seven maggots in third tray (T3)
- Rearing nine maggots in fourth tray (T4)

Third analysis
- Rearing eleven maggots in fifth tray (T5)
- Rearing thirteen maggots in sixth tray (T6)

### Nitrogen

The level of nitrogen in the sample was estimated for various trails and days using kjeldhal method and results are presented in Table 3.

**Table3. Nitrogen Level in the Sample (in mg/lit)**

| | 1day | 3 day | 5 day | 7 day |
|---|---|---|---|---|
| **T1** | 1.18 | 1.1 | 1.07 | 1.02 |
| **T2** | 1.19 | 1.13 | 1.06 | 1.01 |
| **T3** | 1.2 | 1.15 | 1.1 | 1.05 |
| **T4** | 1.18 | 1.09 | 1.06 | 1.02 |
| **T5** | 1.18 | 1.1 | 1.07 | 1.02 |
| **T6** | 1.19 | 1.13 | 1.09 | 1.06 |

It could be seen from the table that the nitrogen level was around 1.01mg/l to 1.19mg/l and in all trails, it was decreased as day passes. This result is picturised in Fig 1.

**Fig1. Level of Nitrogen in the Sample**

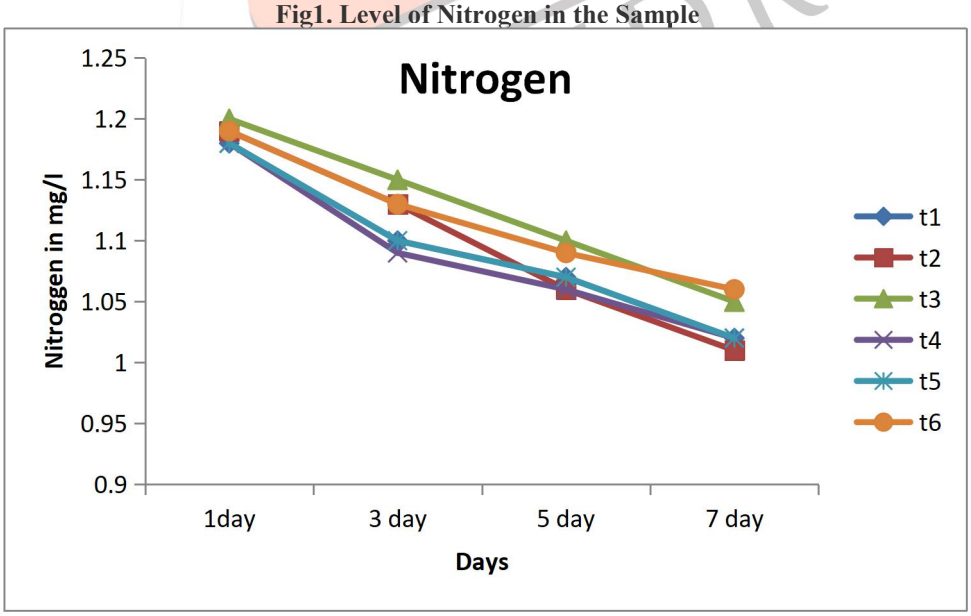



**Table4. Results of ANOVA for Nitrogen Level**

| Source of Variation | SS | df | MS | F | P-value | F critical |
|---|---|---|---|---|---|---|
| **Rows** | 0.004721 | 5 | 0.000944 | 8.351351 | 0.000605 | 2.901295 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Columns** | 0.079779 | 3 | 0.026593 | 235.2211 | 7.84E-13 | 3.287382 |
| **Error** | 0.001696 | 15 | 0.000113 | | | |
| **Total** | 0.086196 | 23 | | | | |

ANOVA table showed that there was significant variation in nitrogen level between trails and between days. Though the level of nitrogen was in decreasing trend, it shows variation as maggot grows.

**Phosphorus**

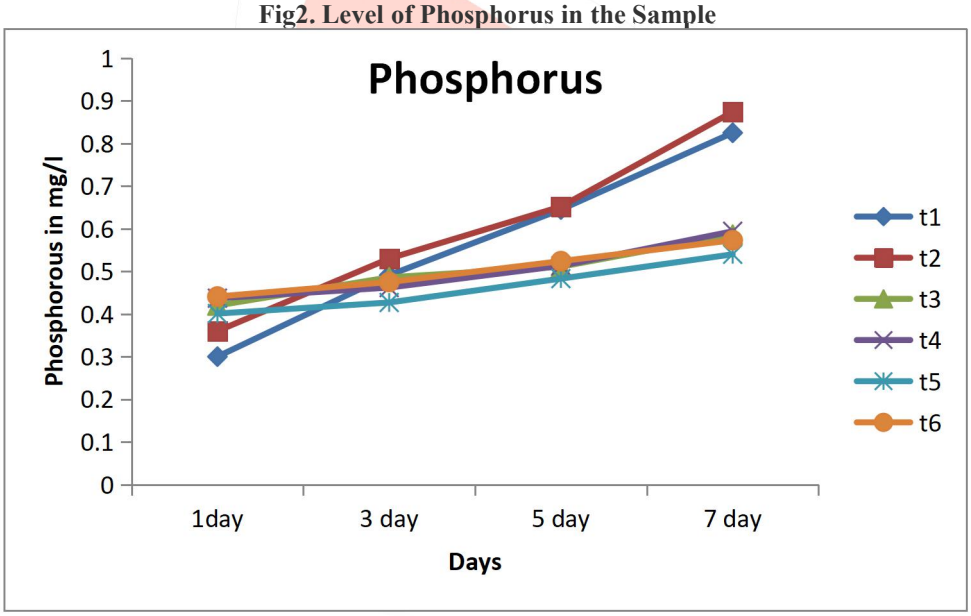
The level of phosphorus in the sample was identified using spectrophotometer for different trails. The results are furnished in Table 5 and Fig 2.

**Table5. Level of Phosphorus in the Sample(in mg/lit)**

| | 1day | 3 day | 5 day | 7 day |
|---|---|---|---|---|
| **T1** | 0.3 | 0.491 | 0.645 | 0.825 |
| **T2** | 0.36 | 0.53 | 0.652 | 0.874 |
| **T3** | 0.42 | 0.486 | 0.511 | 0.586 |
| **T4** | 0.437 | 0.462 | 0.513 | 0.594 |
| **T5** | 0.401 | 0.427 | 0.483 | 0.54 |
| **T6** | 0.441 | 0.475 | 0.524 | 0.573 |

It could be observed from the table that the level of phosphorus was less than one in all trails. The maximum value was seen in second trail at seventh day and minimum value was identified in first trail at first day. The level was increasing day by day in all trails.

**Fig2. Level of Phosphorus in the Sample**




ANOVA was also carried out for the data obtained in trails and the results are given in Table 6.

**Table6. Results of ANOVA for Phosphorus Level**

| Source of Variation | SS | df | MS | F | P-value | F critical |
|---|---|---|---|---|---|---|
| **Rows** | 0.053294 | 5 | 0.010659 | 1.610359 | 0.21738 | 2.901295 |
| **Columns** | 0.240591 | 3 | 0.080197 | 12.1164 | 0.000274 | 3.287382 |
| **Error** | 0.099283 | 15 | 0.006619 | | | |
| **Total** | 0.393168 | 23 | | | | |

The results of ANOVA showed that there was significant variation in phosphorus level between data obtained in different days.

**Potassium**

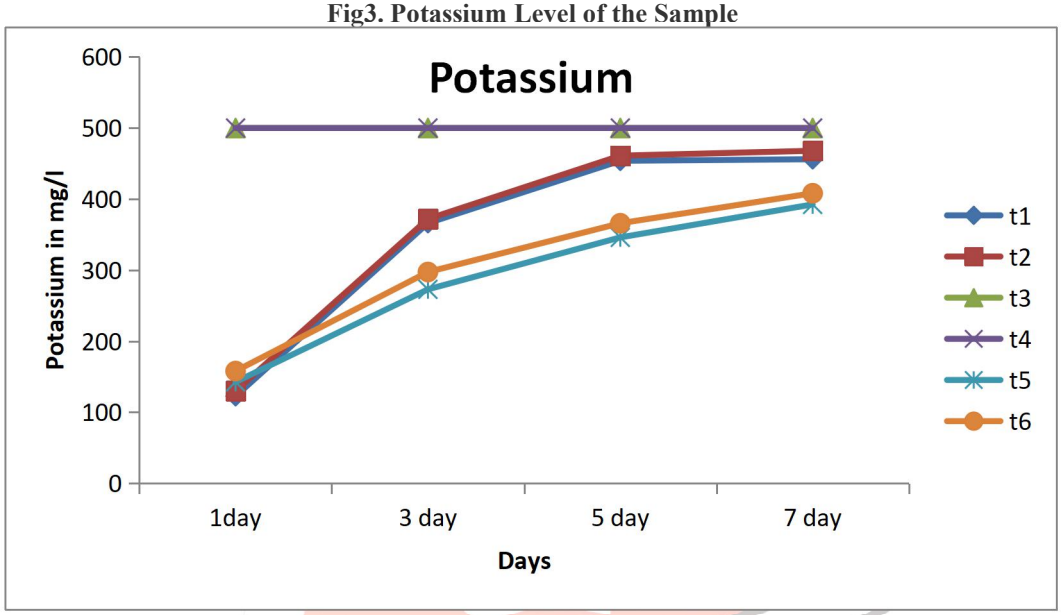
The potassium level in the diluted sample was estimated in different trails using flame photometer and the results are summarised in Table 7.

**Table7. Potassium level in the Sample(in mg/lit)**

| | 1day | 3 day | 5 day | 7 day |
|---|---|---|---|---|
| **T1** | 122.7 | 366.2 | 453.9 | 456.1 |
| **T2** | 130.1 | 372 | 461.1 | 468 |
| **T3** | 500 | 500 | 500 | 500 |
| **T4** | 500 | 500 | 500 | 500 |
| **T5** | 142.7 | 273 | 346.1 | 392.5 |
| **T6** | 158 | 297.4 | 366 | 408.2 |

The potassium level was constant in third and fourth trails. In all other trails, the potassium level was increasing i.e., in the first day, it fell in the range of 122.7mg/l to 158mg/l and increased upto 468mg/l in the second trail. Potassium level is picturised in Fig 3.

**Fig3. Potassium Level of the Sample**




The results of ANOVA for potassium level is given in Table 19.It implied that the significant variation was found in potassium level as day passes and number of maggots increased since the calculated 'F' value was greater than critical value of 'F' in both the cases.

**Table8. Results of ANOVA for Potassium Level**

| Source of Variation | SS | df | MS | F | P-value | F critical |
|---|---|---|---|---|---|---|
| **Rows** | 174986.7 | 5 | 34997.33 | 6.586629 | 0.001971 | 2.901295 |
| **Columns** | 140789.4 | 3 | 46929.81 | 8.832368 | 0.001296 | 3.287382 |
| **Error** | 79700.85 | 15 | 5313.39 | | | |
| **Total** | 395477 | 23 | | | | |

**Waste Reduction Index**

The aim of present study was to identify the way to reduce municipal solid waste by rearing housefly maggots. Hence, the waste reduction indices were calculated using the formula given in chapter -3 and the results are presented in Table 9.

**Table9. Waste Reduction Index(in percentage)**

| Trails | Waste Reduction Index |
|---|---|
| T1 | 4.69 |
| T2 | 4.71 |
| T3 | 8.87 |
| T4 | 8.93 |
| T5 | 11.09 |
| T6 | 11.43 |

It could be observed from the table 9 that the waste reduction index was 4.69 per cent and 4.71 per cent in first and second trails respectively. In third and fourth trails, it was 8.87 per cent and 8.93 per cent respectively. The waste reduction index was high in sixth trail i.e., 11.43 per cent. However, the quantum of waste was reduced by less than 15 per cent in all trails and it was reduced effectively when the number of maggots increases

## CONCLUSION

The present study analyses the methods to reduce municipal solid waste by rearing house fly maggots in different trails. Various minerals were estimated using diluted samples. From the results, it was observed that the weight of the maggot was increasing as days pass. Further, it could be seen from the results that the minerals like phosphorus and potassium showed an increasing trend except nitrogen which shows a decreasing trend. However, the levels of all minerals were within the permissible limit only. The results of ANOVA said that among minerals, nitrogen level varied significantly in trails and between days and phosphorus & potassium had significant variation when duration of rearing increased. The waste reduction index analysis showed that the index increases when the number of maggots which are reared in different trails increases. Hence, sixth trail i.e., thirteen maggots had the highest reduction index (11.43 per cent) followed by fifth trail (11.09 per cent) which has eleven maggots. The study concluded that the using of housefly maggot reduces the municipal waste efficiently at micro level.

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