Impact of Vermicompost on Production of Gotukola *(Centella asiatica)*

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ABSTRACT

Gotukola (*Centella asiatica*) is very important leafy vegetable. Farmers currently apply different chemical fertilizers and pesticides to enhance their yields. However, residues of these chemicals are very hazardous to human health and cause many threats to the environment. Hence, current trend is more towards organic farming and organically produced food has very high demand. Vermicompost is a superior bio organic fertilizer which could be used in organic farming. Therefore this study was conducted to investigate the effect of vermicompost on yield and pest and disease incidence of Gotukola. Gotukola was planted in sunken beds according to DOA recommendation and treated with different fertilizers including vermicompost. Yield, some agronomic parameters and pest and diseases of Gotukola gown under different fertilizers were monitored. Significantly higher yields, number of leaves, shoot length and leaf areas were recorded in vermicompost treated plots. No significant difference was observed in pest damage, dry weight and chlorophyll content among the treatments.

KEYWORDS: Gotukola, Organic Farming, Organic Fertilizer, Vermicompost

INTRODUCTION

Leafy vegetable is very important component in our diet. Several types of leafy vegetables are grown in Sri Lanka. Among them Gotukola received high priority due to its good taste and nutritive value with high contents of minerals and vitamins (Wahundeniya and Kurukulaarachchi 2004). In addition it has medicinal properties which are specially considered in aurvedic medicine. Gotukola is used for the treatment of Catarrh, Hemorrhoids, Bloodmucosdiarrhea, Wounds and Worminal disease (Anon 2006a). Continuous use of Gotukola is essential to get the beneficial effects in improving the mental faculties (Senevirathna and Vagira 2006). It is an annual, small creeping plant found throughout Sri Lanka. It grows well naturally in low lands such as paddy fields and also tea estates. Stem, leaves, fresh or dried whole plant can be used according to the requirement (Senevitathna and Vagira 2006).

Getting aware of importance of Gotukola among the society the demand for Gotukola is gradually increased and it is an economic crop at present. Cultivation of Gotukola is very profitable and it is major income in some farmers especially in Gampaha and Puttlam areas. Farmers prefer to grow Gotukola because it gives a good yield; 8600-9800 Kg/ha cuttings under normal conditions. The yield could be improved up to 9800-12350 Kg/ha cuttings through the good management (Wahundeniya and Kurukulaarachchi 2004).

However, farmers use different chemical fertilizers and pesticides indiscriminately to enhance their yields and to protect from various pests and diseases. Therefore, Gotukola available at the market contain high amounts of pesticide residue which are hazardous to human health. Further, people consume Gotukola with minimum preparation. Hence, it is advisable to grow Gotukola with low or no chemicals. Due to many disadvantages of use of chemicals in modern farming the current trend is more towards organic farming. Organic farming is the farming without or less use of synthetically produced inputs. It is an ecologically sustainable production system, based on animals as well as crops, in which organic wastes are recycled on the land and safeguard the environment (Smith 2002). Organically produced leafy vegetables have high demand at locally and internationally. Germany, Japan, USA and European countries have already agreed to purchase the organic products from Sri Lanka. "USA has agreed to purchase any amount of Gotukola", (Kodikara 2002). Though, it is possible to increase crop yield using various organic or biofertilizers (non chemical fertilizers), protection of crop from various pests and disease is not easy in organic farming as high pest population and very low natural enemies prevail in the existing environment.

Vermicompost is a very good biofertilizer which enhance soil fertility and crop production (Anon 2006b). Production of vermicompost is more efficient and the technology used is very simple. It is far superior to conventional compost. The worm casting in the vermicompost has nutrients that are 97% readily available to plants. Further, the castings have a mucous coating which allows the nutrients to release slowly (Anon 2006c). Further addition of vermicompost reported to be increasing the resistance of plants against pest and disease (Arancon *et al.*, 2005).

The study was designed to evaluate the performances of Gotukola under vermicompost and to compare the performances of Gotukola with different fertilizer practices, which are commonly used by farmers in this area.

MATERIALS AND METHOD

The experiment was carried out at the Regional Agricultural Research Development Centre,

Makandura, Gonawila located in the intermediate zone of north western province of Sri Lanka, from January to July 2006.

Land Preparation and Planting

Land was prepared properly. Then sunken beds were prepared. The plot size was $4m^2$. After preparing plots treatments were applied. Famous Gotukola variety Meerigama was used for the experiment. Same sized Gotukola runners were planted according to DOA recommendation with spacing 20x20 cm and 2-3 plants per one hole.

Following treatments were used in the experiment.

T1 – Chemical fertilizer (DOA recommendation: urea- 90kg/ha, MOP- 100kg/ha, TSP- 135kg/ha)
T2 – Poultry manure (2.3 kg/plot)
T3 – Vermicompost (2.25 kg/plot)
T4 – Poultry manure (1.15 kg/plot) + Chemical fertilizer (1/2 DOA)

The experiment was laid out in the RCBD with above mentioned four fertilizer treatments, arranged in four replications.

Data Collection

The following measurements were taken.

01. Yield of Gotukola (t/ha)
02. Number of leaves per bush
03. Leaf area (cm^2)
04. Leaf chlorophyll content (mg chlp/g fresh weight of leaf)
05. Shoot length (cm)
06. Dry weight (g/bush)
07. Pest and disease severity

Gotukola yield was measured by using 25x25 cm quadrant. Three samples were taken randomly from each plot and average yield (t/ha) was calculated.

To count the number of leaves per bush, three bushes per plot were selected randomly and number of leaves in each bush was counted and average was taken.

Ten bushes per plot were selected randomly and third leaf of each plant was harvested. Leaf area was measured by using leaf area meter.

Ten bushes were selected randomly and forth leaf of each bush were plucked and used for measuring chlorophyll content. Leaves were kept in ice immediately to prevent formation of polyphenolic compounds at damaged surfaces. Fresh leaves were chopped in to small size (about 5 mm). 0.02 g of chopped leaves was put into a boiling tube and 5 ml of 80% acetone was added. Then the sample was crushed using Ultra Turrax T25 until the particles disappear. The sample was put into a centrifuge tube, centrifuged at 3500 rpm for 10 minutes and supernatant was taken. Absorbance was measured at 645, 652, 663 nm using spectrophotometer. Equation proposed by Arnon (1949) was used to calculate chlorophyll content.

$Ch_a = [(12.7xD_{663})-(2.69xD_{645})]\ 5/10^3$ x leaf weight
$Ch_b = [(22.29xD_{645})-(4.8xD_{663})]\ 5/10^3$ x leaf weight
Total chlorophyll content = $Ch_a + Ch_b$
(mg chlp/g fresh weight of leaf)

Where,
Ch_a – Chlorophyll a content
Ch_b – Chlorophyll b content
D_{645} – Absorbance at 645 nm
D_{663} – Absorbance at 663 nm

Three bushes per plot were selected randomly and shoot length was measured with ruler.

Three bushes per plot were selected randomly and properly washed giving much attention not to damage any part of the plant. Then plant was allowed to dry off under normal room temperature and put in an oven set at 70 ^{0}C until it obtained a constant weight. After that dry weight was taken by analytical balance.

After harvesting ten leaves were selected randomly from each plot. These ten leaves were ranked according to the severity of pest attack in following way.

Rank	Percentage of damage
1	< 25%
2	25 – 50 %
3	50 – 75 %
4	> 75 %

The data were analyzed using Statistical Analysis System (SAS) software package. Analysis of variance (ANOVA) procedure was carried out and followed by LSD to see the significant different of mean values of each dependant variable.

RESULTS AND DISCUSSION

1. Yield Of Gotukola

Table 1 - Mean leaf yield of three harvests:

Treatment	Yield (t/ha)
T_1	2.18^b
T_2	2.23^b
T_3	3.25^a
T_4	2.33^b
LSD	**0.4823**
CV	**2.26**

Figures denoted by different letters are significantly different by LSD ($p<0.05$)

Mean yield of Gotukola is shown in Table 1. Maximum yield were observed in vermicompost treated plots and it was significantly different from

yield of other treatments (3.25). There were no significant differences among the other treatments.

Results indicate that the vermicompost has positive impact in increasing yield of Gotukola.

2. Number of Leaves

Vermicompost treated plants showed significantly higher number of leaves per bush than the other treatments (Table 2).

Table 2 - Mean leaf number per bush:

Treatment	No. of Leaves/Bush
T_1	28^{ab}
T_2	22^{b}
T_3	32^{a}
T_4	28^{ab}
LSD	**8.2113**
CV	**2.26**

Figures denoted by different letters are significantly different by LSD ($p<0.05$)

Chemically fertilized plots (DOA recommendation: urea 90 kg/ha, MOP 100 kg/ha, TSP 135 kg/ha) and plots treated with poultry manure (1.15 kg/plot) + chemical fertilizer (1/2 DOA) gave significantly higher yield than poultry manure treated plots. The lowest yield was recorded in poultry manure treated plots and it was significantly lower than that of other treatments.

Number of leaves is one of the important parameter in governing the marketable yield. Vermicompost has positive impact on number of leaves too.

3. Leaf Area

Table 3 - Mean leaf area:

Treatment	Mean Leaf Area (cm^2)
T_1	96.525^{b}
T_2	95.950^{b}
T_3	116.533^{a}
T_4	84.350^{c}
LSD	**9.147**
CV	**2.26**

Figures denoted by different letters are significantly different by LSD ($p<0.05$)

Leaf area too is an important parameter which decides yield of Gotukola. Table 3 shows the differences in leaf area of Gotukola among the treatments. Highest leaf area was recorded in plots treated with vermicompost and it was significantly different from other treatments. Minimum was observed in plots treated with T4 (84.350). The different among T1 and T2 are not statistically significant.

4. Leaf Chlorophyll Content

Table 4 - Mean leaf chlorophyll content:

Treatment	Mean Chlorophyll Content (mg chlp/g fresh weight of leaf)
T_1	10.7925^{a}
T_2	10.8100^{a}
T_3	10.000^{a}
T_4	9.4450^{a}
LSD	**1.7147**
CV	**2.26**

Figures denoted by different letters are significantly different by LSD ($p<0.05$)

There was no significant difference in leaf chlorophyll content among the treatments (Table 4). This may be due to the sucking pest attack in all four treatments.

5. Shoot Length

Table 5 - Mean shoot length of bush:

Treatment	Shoot Length (cm/bush)
T_1	10.193^{b}
T_2	12.325^{b}
T_3	17.480^{a}
T_4	9.500^{b}
LSD	**3.5336**
CV	**2.26**

Figures denoted by different letters are significantly different by LSD ($p<0.05$)

Maximum shoot length was observed in plots treated with vermicompost showing the positive effect of vermicompost on growth of Gotukola (Table 5). Minimum was at T4. The differences among T1, T2 and T4 are not statistically significant.

6. Dry Weight per Bush

Table 6 - Mean dry weight of bush:

Treatment	Mean Dry Weight(g/bush)
T_1	2.540^{a}
T_2	2.865^{a}
T_3	2.830^{a}
T_4	2.820^{a}
LSD	**0.02**
CV	**2.26**

Figures denoted by different letters are significantly different by LSD ($p<0.05$)

There was no significant difference between bush dry weights of treatments (Table 6).

7. Pest and Disease Severity

There were no disease occur in the plots throughout the study. Only *Halticus tibiales* attack was observed.

Pest attack severity is shown in Figure 1. Severity of pest attack in Gotukola under different treatments was not significantly different. But it increased with time. Though it was not significant, lowest pest attack severity also found in plants treated with vermicompost at earlier stage. But, it increased with time and was recorded as highest severity at later stages. Many scientists have shown the managements of pests by addition of vermicompost through development of resistance against pest and diseases in plants (Qurals, 2001, Scheverell and Mahafee, 2002, Scheverell and Mahafee, 2004, Wickland *et al.*, 2001). However, it was not seen in our experiment. Since development of resistance is very important factor in managing pest and diseases of organic farming, it should be studied further again.

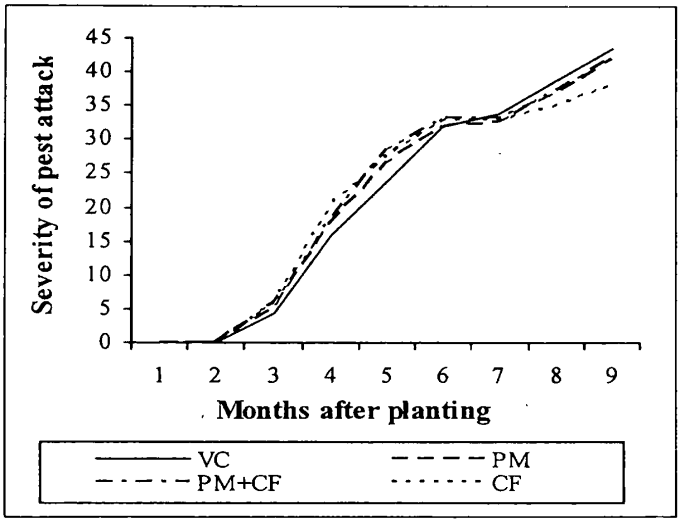

Figure7-Comparison of pest attack severity of Gotukola at different fertilizer treatments

Farmers try to enhance crop yields to maximize their income per unit area. Results of this experiment shows that vermicompost have positive impact on growth parameters and yield. Samarajeewa *et al.* (2004) also reported addition of vermicompost increases the plant height, leaf area and dry weight of root and shoot in coconut seedlings and tomato plants. Many authors suggested that plant growth regulators such as indole acetic acid, gibberellins and cytokinins in vermicompost have a significant effect on plant growth (Atiyeh *et al.*, 2000). Further positive influence of humic acid contain in vermicompost on plant growth and productivity, which seems to be concentration specific, could be mainly due to hormone like activities of the humic acids through involvement in cell respiration, photosynthesis, oxidative phosphorelation, protein synthesis and various enzymatic reactions (Vaughan *et al*, 1985). The positive impact of vermicompost on yield and growth parameters of Gotukola may be due to the hormonal effect of vermicompost other than its nutritional effect. Therefore it's important to study the concentration and the types of hormones contain in vermicompost prepared under local conditions using local earth worms. It was impossible to work out in this study as it involves very high cost.

CONCLUTIONS

Results of present experiment reveled that addition of vermicompost improves the growth of Gotukola and enhance yield. However, there were no effects of vermicompost in controlling pest attack in Gotukola. Use of vermicompost in controlling Gotukola pests through development of resistance should be studied further. Further studies should be done in evaluating hormones, enzymes and other chemicals in vermicompost produced locally using local earth worms.

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