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Research Article

Impact of Vermicompost on Growth and Development of Cabbage, *Brassica oleracea* Linn. and their Sucking Pest, *Brevicoryne brassicae* Linn. (Homoptera: Aphididae)

Mulusew Getnet and Nagappan Raja
Department of Biology, Faculty of Natural and Computational Sciences,
P.O. Box 196, University of Gondar, Gondar, Ethiopia

Abstract: Aim of the present study was to produce vermicompost from organic solid wastes by using red earth worm, *Eisenia fetida* and to check growth promoting and pest suppression properties on cabbage, *Brassica oleracea*. The mass of 100 kg of various organic waste sources were collected from Gondar and used to prepare vermicompost. The vermicompost was prepared in the month of June-August 2011 and tested on cabbage, *B. oleracea* from October 2011 to February 2012. Vermicompost was applied at the rate of 25, 50, 100 and 200 gm/plant individually. Each application 10 plants were selected and vermicompost application was continued on bimonthly basis. Totally 40 plants were used for control group in which 10 plants were selected randomly. Total number of leaves per plant; leaf length and width; plant stand height and root length; cabbage head round distance and weight and aphid population built-up were the parameters studied in experimental and control cabbage plants. Significant differences ($p<0.05$; LSD) were observed in the growth and development and pest infestation level between vermicompost applied and control plants. The number of plant stand height, cabbage head, leaves of cabbage were also significantly different ($p<0.05$; LSD) in experimental cabbage compared to control. Maximum number of cabbage plant was infested by aphid in control than experimental groups. In conclusion vermicompost have significant impact on cabbage growth promotion and reduce the aphid infestation. In future using vermicompost to all kinds of crops and adopting it as commercial fertilizer may create job opportunity to small scale farming society. Also, in this ever escalating cost of chemical fertilizers, the use of vermicompost seems to be quite reasonable in agro-management and should be inclusive as one of the elements of poverty alleviation strategies in such as Ethiopian context.

Keywords: Aphid, *Brassica oleracea*, *Brevicoryne brassicae*, cabbage, earthworm, *Eisenia fetida*, pest suppression, vermicompost

INTRODUCTION

Global movement for the second "Green revolution" ought to emphasize on composting, particularly vermicomposting (Buchanan *et al*., 1988). Vermicompost are produced through the interactions between earthworms and microorganism in the breakdown of organic wastes and to convert into nutritional rich humus. The organic fraction from municipal solid waste, farm, forest, poultry, dairy and market wastes are contains plenty of NPK and other micronutrients which is a good source of soil nutrients. It is wisdom to recycle in nature as much as possible wastes in to vermicompost that is a gain-gain fair game (Edwards and Burrows, 1988a). The importance of earthworm in growth promoting activities was not new in scientific studies; it was indicated by the ancient Indian scientist Surpala as early as in the 10th century A.D. in his epic 'Vrikshayurveda' (Satchell, 1983). The earthworms have over 600 million years of experience in land management, soil improvement and farm production. Hence, Charles Darwin called them as the 'unheralded soldiers of mankind and farmer's friend' working day and night under the soil (Martin, 1976; Satchell, 1983).

Earthworms excreta is a rich nutritive organic fertilizer due to rich in humus, NPK, micronutrients, beneficial soil microbes- 'nitrogen fixing and phosphate solubilizing bacteria' and actinomycetes and growth hormones 'auxins', 'gibberlins and 'cytokinins'. The vermicompost promote growth from 50-100% over conventional compost and 30-40% over chemical fertilizers (Sinha *et al*., 2010). The application of vermicompost showed maximum yield in potato (Patil, 1995; Saikia and Rajkhowa, 1998); positive effect on the yield of bhendi, *Abhelmoschus esculentus* (Ushakumari *et al*., 1996); improve all plant characters and greater number of fruits per plant in Chilli (Javirsingh *et al*., 1997; Abburi and Haripriya, 2003); increased dry pod yield in Byadagi Chilli (Sashidhara,

Corresponding Author: Nagappan Raja, Department of Biology, Faculty of Natural and Computational Sciences, P.O. Box 196, University of Gondar, Gondar, Ethiopia

1999); green pod per plants, green grain weight per plant, percentage of protein and carbohydrates content and green pod yield was higher in vermicompost applied garden pea, *Pisum sativum* as compared to chemical fertilizer (Meena *et al*., 2007); total chlorophyll contents in leaves, dry matter production, flower appearance, length of fruits and fruits per plant, dry weight of 100 seeds, yield per plot was significanlty higher in hyacinth beans, *Lablab purpureas* (Karmegam and Daniel, 2008).

According to Sunitha (2000), application of recommended dose of fertilizer and vermicompost was significantly superior in increasing growth performance and lower pest incidence in Chilli nursery. Significantly lower number of leaf hoppers and thrips (Ramesh, 2000) *Spodoptera litura* and *Helicoverpa armigera* (Rao *et al*., 2001; Rao, 2002) and their damage in field crops. The application of vermicompost prevents built up of aphids and leaf hoppers on bhendi (Surekha and Arjunarao, 2000). Yardim *et al*. (2006) reported substitution of 20 and 40% vermicompost rate have decreased damage caused by adult striped cucumber beetle (*Acalymma vittatum*) and spotted cucumber beetles (*Diabotrica undecimpunctata*) on cucumber and larval hornworms on tomatoes (*Manduca quinquemaculata*). The vermicompost have significant suppression effects on mealy bug attacks (*Pseudococcus*) on cucumbers and tomatoes, two-spotted spider mite attacks (*Tetranychus urticae*) on bush beans and egg plants and attacks by aphids (*Myzuz persicae*) on cabbages by low application (Arancon *et al*., 2005, 2007; Edwards *et al*., 2010).

In Ethiopia, headed cabbage, *Brassica oleracea* belongs to the family Brassicaceae is one of the widely growing vegetable crops throughout the country. Cabbage crop is infested by wide variety of insect pests in which aphid, *Brevicoryne brassicae* belongs to the order Homoptera and family Aphididae is one of the serious pest affect the quality of cabbage (Birhanu *et al*., 2011). In an untreated plant due to pest activity, damage and yield loss can reach up to 70-80% (Wrzodak, 2009) and also reduces the market value (Liu *et al*., 1994; Costello and Altieri, 1995). Therefore, in order to produce healthy cabbage and efficient utilization of local resources, present study was conducted with the following objective.

Objective: To produce vermicompost and to check their influence on growth promoting and pest suppressing activity against cabbage aphid, *Brevicoryne brassicae* under field condition.

MATERIALS AND METHODS

Experiments were conducted from June 2011 to March 2012. During the rainy season (June 2011-August 2011) vermicompost preparation was completed and from October 2011 to March 2012 influence of vermicompost on cabbage growth promoting and pest suppression properties were evaluated.

Description of the study area: The vermicompost was produced at Amhara Regional state, Gondar town, North East adjacent side of Gondar town agricultural office demarcated by pedestrian. Its altitude is about 1850 masl with moderate climate and annual mean rain fall ranging from 1100 to 1400 mm and with mean temperature of 15-23°C. The effect of vermicompost on cabbage (*Brassica oleracea*) was completed at Kabale 18, Gondar town, with about 1800 masl of altitude but with the same rainfall and temperature as vermicompost garden.

Vermicompost preparation: Vermicompost was prepared by using locally collected red earthworm *Eisenia fetida* and the procedure was followed as per the recommendation of Sultan (1996). Different raw materials were used to prepare vermicompost as shown in (Table 1).

Establishment of cabbage: *Brassica oleracea* seedlings were raised on 2×2 m area of nursery bed. The seedlings were watered every morning and evening for 32 days (October 2-November 4) until the seedlings attends an average height of 9.2 cm or 4-5 leaves. The seedlings were transplanted from the nursery bed to plantation bed, each of which two beds measured by 4×1.5 m size. Experimental cabbage (40 seedlings) was categorized in to four groups each with 10 cabbage receiving 25, 50, 100 and 200 g of vermicompost. The remaining 40 was used as control without any treatment in which 10 cabbages were randomly selected for data collection. Each cabbage was planted with 40×40 cm distance left to right forth to back placement for better management, watering, thinning weeds and tilling the soils. The control group (placebo) 40 cabbages

Table 1: Types and quantities of raw materials used for vermicomposting

Substrates types	Details of substrates	Amount in Kg
Dairy wastes	Fresh cattle dung, dried dung fragments	30
Fruit and vegetable waste	Rotten tomatoes, potatoes, banana peels mangoes, cabbages, onion	25
Green vegetables	Fresh leaves and stems of seasonal grasses and herbs	10
Forest droppings and trashed fodders	Leave, barks of trees and left over straws	10
Supplementary fodders of cattle left over	Niger seed oil cakes	5
Snack wastes	Ground used up coffee and tea leaf, egg shell	5
Paper	Tattered cartoon paper	1
Soil	Mixture of sandy, loam and clay soils	4
Small size scoria gravel	Inorganic component	10
Total		100

were transplanted in the same manner except vermicompost application.

Estimation of cabbage leaves: Number of leaves produced from each cabbage plant applied with 25, 50, 100 and 200 g of vermicompost/plant was recorded. The number of leaves were counted from the nursery (October 2011) and after transplantation (November 2011-February 2012). The mean number leaves per plant were calculated.

Estimation of leaf length and width: The length and width of the cabbage leaves was measured from October 2011 to January 2012. Among the 10 cabbage plants for each vermicompost application and control only one leaf was selected and tagged. Every time the same leaves were used for measurement (Length×Width) by using the measurement tape. The average length and width of the leaf for every month was calculated.

Estimation of plant height and root length: The height of the plant was measured from October 2011 to January 2012. The stand height of the plant was measured for experimental and control groups by using measurement tape. The average height of the plant in each treatment and control was calculated. Similarly, plant root length was also measured after harvesting the cabbage head. Each plant was removed and root length was measured. The average root length for each treatment and control was calculated.

Estimation of cabbage head round distance: Cabbage head round distance was measured by using measurement tape (in cm) for all the cabbage heads produced during the time of harvest (February 2012) in control and experimental groups. The mean cabbage head distance was calculated.

Estimation of cabbage head weight: Cabbage head weight was estimated after the harvest (February, 2012). Totally 10 heads for each dosage of vermicompost was collected separately and the weight was measured using balancer. In control group only 4 cabbage plants were produced head and that four was collected and measured. The mean average weight of cabbage head was calculated.

Effect of vermicompost on aphid, *Brevicoryne brassicae*: Aphid incidence was recorded on infested leaves from October 2011 to January 2012. Among the 10 cabbage plant applied with vermicompost and 10 from the control group was monitored. The first appearance of aphid from each plant with single leaf was monitored and the same leaf was tagged and observed for the population built up of aphid throughout study period. Totally 10 leaves were observed for each treatment and control plants. The mean number of aphid population was calculated.

Statistical analysis: The data collected from all the parameters were subjected to descriptive analysis and one way ANOVA for the comparison of statistical significance. Further, individual mean significant difference was calculated by using post hoc test LSD (Least Significant Difference test) and marked with different alphabet. The significant difference was calculated at 5% level ($p<0.05$). All the statistical analysis was carried out by using Microsoft Office Excel program (MS office 2003) and SPSS version 16.

RESULTS

Estimation of mean number of leaves in cabbage crops: Mean number of leaves developed from seedings to harvesting stage of the crops applied with 25, 50, 100 and 200 g of vermicompost was reported in Table 2. Results revealed that maximum number of leaves was observed in 200 g vermicompost applied plant in the month of October in nursery. The number of leaves on vermicompost treated plant varied significanlty based on dosage. One month after transplantation from the nursery bed to main land i.e., at the end of November, number of leaves developed per plant received different amount of vermicompost was varied significantly compared to control. However, lower dosage such as 25 and 50 g did not show any statistical singnificant ($p>0.05$; LSD) difference. In December 2011, cabbage plant applied with 100 and 200 g of vermicompost also did not show significant

Table 2: Effect of vermicompost on the development of leaves in cabbage plant

Dose of vermicompost applied/plant	Months of observation				
	October 2011 (nursery)	November 2011	December 2011	January 2012	February 2012
25 g	4.1^{e}±0.73	14.0^{d}±1.15	25.1^{c}±3.20	26.9^{e}±3.69	Head formed
50 g	4.4^{d}±0.84	14.2^{d}±0.91	27.5^{c}±3.93	29.3^{d}±3.36	Head formed
100 g	5.0^{c}±0.66	17.3^{c}±1.63	30.1^{bc}±3.50	32.7^{c}±3.68	Head formed
200 g	6.1^{b}±0.87	21.9^{b}±3.72	32.9^{b}±3.36	35.6^{b}±3.47	Head formed
Control	3.9^{a}±0.73	11.8^{a}±1.75	17.3^{a}±2.36	20.6^{a}±3.16	4 head formed 21.1±1.16
LSD ($p<0.05$)	0.23	1.83	3.06	2.14	Not tested

Values are mean±standard deviation of 10 replications; The values presented in February in control group was mean±standard deviation of six replication because four plants head formation completed; Similar albapets in mean values within the column are statistically not signifcant by LSD ($p>0.05$)

Table 3: Effect of vermicompost on leaf length of cabbage plant

Dose of vermicompost applied/plant	Mean length of the cabbage leaves in cm				
	October 2011	November 2011	December 2011	January 2012	February 2012
25 g	11.1^{b}±0.87	12.8^{a}±1.03	15.0^{e}±1.33	17.2^{d}±2.04	Not tested due
50 g	11.4^{b}±0.69	13.9^{c}±0.99	16.1^{d}±1.52	19.2^{c}±1.75	to harvestation
100 g	12.0^{b}±0.66	14.1^{c}±0.99	17.8^{c}±1.93	20.0^{c}±2.16	
200 g	12.4^{b}±1.17	15.6^{b}±1.42	19.9^{b}±2.33	21.9^{b}±1.79	
Control	10.3^{a}±0.94	12.4^{a}±1.57	13.8^{a}±1.31	15.6^{a}±2.01	
LSD (p<0.05)	0.77	1.07	1.51	1.71	

Values are mean±standard deviation of 10 replications; Similar alphabets in the mean value within the column are statistically not significant (p>0.05; LSD)

Table 4: Effect of vermicompost on leaf width of cabbage plant

Dose of vermicompost applied/plant	Mean width of the cabbage leaves in cm				
	October 2011	November 2011	December 2011	January 2012	February 2012
25 g	7.8^{c}±1.13	9.4^{ad}±1.50	12.6^{a}±1.95	14.7^{a}±1.86	Not tested due
50 g	8.0^{c}±1.15	10.8^{cd}±1.81	13.3^{a}±1.25	16.6^{b}±1.83	to harvestation
100 g	8.9^{b}±0.73	11.3^{c}±1.56	16.5^{b}±1.71	17.7^{b}±1.70	
200 g	9.1^{b}±1.10	13.6^{b}±1.34	17.2^{b}±2.20	18.1^{b}±1.91	
Control	7.6^{a}±0.69	8.7^{a}±1.94	12.0^{a}±2.44	15.9^{a}±1.79	
LSD (p<0.05)	0.86	1.44	1.71	1.60	

Values are mean±standard deviation of 10 replications; Similar alphabets in the mean value within the column are statistically not significant (p>0.05)

Table 5: Effect of vermicompost on cabbage plant height and root length

Dose of vermicompost applied/plant	Mean height of the plant in cm					Mean root length in cm after harvest
	October 2011	November 2011	December 2011	January 2012	February 2012	
25 g	11.4^{c}±1.57	15.8^{e}±1.75	21.7^{d}±2.21	26.7^{d}±2.94	Not tested	14.17^{e}±0.44
50 g	13.3^{bc}±0.82	17.7^{d}±1.33	23.5^{c}±2.54	29.9^{c}±3.78	"	14.50^{d}±0.32
100 g	13.6^{bc}±1.34	18.4^{c}±1.71	24.4^{c}±2.87	30.9^{c}±4.22	"	16.29^{c}±0.39
200 g	14.9^{b}±1.19	20.1^{b}±2.68	27.7^{b}±3.88	34.9^{b}±2.33	"	17.39^{b}±0.35
Control	9.2^{a}±1.87	12.5^{a}±1.58	16.2^{a}±1.87	20.9^{a}±1.96	"	11.24^{a}±0.52
LSD (p<0.05)	2.54	1.63	1.42	2.85	-	0.36

Values are mean±standard deviation of 10 replications; Similar alphabets in the mean value within the column are statistically not significant (p>0.05; LSD)

difference (p>0.05; LSD). However, compared to control results were significantly different (p<0.05; LSD). In January, all vermicompot treated plants showed significant differnce (p<0.05; LSD) compared to control.

Effect of vemicompost on cabbage leaf length: The variation in the leaf length of the cabbage plant was progressively increased from October 2011 to January 2012 (Table 3). The length of leaves in the month of October did not show any significant difference (p>0.05; LSD) within the vermicompost applied plants. However, compared to control results was significantly different (p<0.05; LSD). In November, maximum leaf length of 15.6 cm was observed in plant applied with 200 g of vermicompost. The plants applied with 50 and 100 g, results was statistically not significant (p>0.05; LSD). In December, all vermicompost applied plants showed statistically significant (p<0.05; LSD) growth of leaf length. In Januray 2012, plants applied with 50 and 100 g results were statistically not signicant (p>0.05; LSD) and the remaining results were significantly different compared to contol (p<0.05; LSD).

Effect of vermicompost on cabbage leaf width: The impact of vermicompost on plant leaf width results significantly varied in vermicompost applied plants (Table 4). In October, maximum leaf width of 9.1 cm was observed in 200 g applied plants and this results was on par with 100 g applied plants. The plants received @ 25 and 50 g results were statistically not sigificant (p>0.05; LSD). In November, 50 and 100 g vermicompost applied plant did not show any significant difference. However, compared with control except 25 g applied plants remaining showed significant difference (p<0.05; LSD). In December, 25 and 50 g applied plants and 100 and 200 g applied plants respectively the results was not significantly different (p>0.05; LSD). In January 2012, results of 50, 100 and 200 g received plants did not show statistical significant difference (p>0.05; LSD) but compared to control significantly different (p<0.05; LSD).

Effect of vermicompsot on plant height and root development: The mean height of the plant results revealed that in the month of October, maximum height of 14.9 cm was observed in plants applid with 200 g of vermicompost and minimum height of 9.2 was observed in control plant (Table 5). In this same month

Table 6: Effect of vermicompost on cabbage head round measurement (circumfernce) and cabbage head weight

Dosage of vermicompost	Cabbage head round distance in cm	Cabbage head weight in g
25 g	34.4^{c}±0.49	808.00^{d}±127.34
50 g	36.3^{bc}±0.61	1383.00^{c}±90.37
100 g	40.1^{b}±0.96	1587.30^{b}±85.39
200 g	48.7^{a}±0.80	1784.40^{a}±71.39
Control	26.2±1.92 (only 4 heads formed)	483.75±129.95 (only 4 heads)
LSD (p<0.05)	4.5 (control data not included)	84.04 (control data not included)

Values are mean±standard deviation of 10 replications except control group; The values in the control groups are mean±standard deviation of 4 replication; Similar alphabets in the mean value within the column are statistically not significant (p>0.05; LSD)

Table 7: Effect of vermicompost on cabbage aphid, *Brevicoryne brassicae*

Dose of vermicompost applied/plant	Period of observation				
	October 2011	November 2011	December 2011	January 2012	February 2012
25 g	0.0±0.00	32.6^{b}±12.50	54.6^{c}±23.41	84.3^{b}±39.66	Due to harvestation of cabbge head aphid count was not undertaken
50 g	0.0±0.00	21.4^{b}±15.50	41.4^{bc}±25.86	69.4^{b}±21.98	
100 g	0.0±0.00	24.9^{b}±15.33	29.5^{b}±13.20	66.8^{b}±33.59	
200 g	0.0±0.00	23.2^{b}±17.80	31.3^{b}±16.40	59.0^{b}±15.22	
Control	0.0±0.00	72.8^{a}±20.56	129.1^{a}±32.43	212.9^{a}±70.62	
LSD (p<0.05)	Not tested	14.52	20.42	35.93	

Values are mean±standard deviation of 10 replications; Similar alphabets in the mean value within the colunm was statistically not significant by LSD (p<0.05)

there is no significant development of plant growth on 25, 50 and 100 g treated plants. However, compared to control the results was statistically significant (p<0.05; LSD). In November, progresstive results were obtained from all vermicompost applied plants compared to control. The maximum plant growth development was recorded at 200 g applied plant compared to other applications. Similar pregressive trend of plant development was continued in the month of December and January 2012. In this two month observation plant height recorded at 50 and 100 g vermicompost application did not show any statistical significant difference (p>0.05; LSD).

Plant root length results clearly demonstrates that increased application of vermicompost root length was also increased. The maximum root length was observed in 200 g applied plants compared to other treatments (Table 5). The root length measured from all the vermicompost applied plant was statistically significant (p<0.05; LSD) compared to control.

Impact of vermicompost on cabbage head round measurement and head weight: Effect of vermicompost on cabbage head round and also head weight measured during the month of February 2012 was presented in Table 6. The cabbage head round distance was at the maximum of 48.7 cm was recorded from the plants treated with 200 g of vermicompost. The plants received at 50 and 100 g did not show any significant difference (p>0.05; LSD). The data of control was not included for statistical analysis because only 4 plants were produced head during the time of harvest. The head round measurement recorded at 200 g treatment was significantly different (p<0.05; LSD) compared to control and other treatments.

Cabbage head weight was recorded maximum in cabbage plants treated with 200 g of vermicompost. In general, weight of the cabbage head was significantly different (p<0.05; LSD) within the dosages of vermicompost applied to individual cabbage plants. Again, control cabbage weight was not included for statistical analysis because only 4 plants produced head and the weight was also minimum.

Effect of vermicompost on cabbage aphid, *Brevicoryne brassicae*: Mean number of aphid population was higher in control plants compared to vermicompost applied plants (Table 7). In November month observation within the treated plant mean number of aphid population was statistically not significant (p>0.05; LSD). However, compared to control results were statistically significant (p<0.05; LSD). In December, mean aphid population recorded from 50, 100 and 200 g applied plants, results were statistically not significant; however, compared to control the aphid population was significanlty lower (p<0.05; LSD). In January, all the vermicompost applied plants showed significantly lower number of aphid population compared to control. Within the treatments results were statistically not significant (p>0.05; LSD).

DISCUSSION

Vermicompost is a nutrient rich compost produced by the untired activities of earthworm. The earthworm presence regenerate compacted soils and improves water penetration in such soil for over 50% (Bhat and Khambata, 1996; Ghabbour, 1973; Capowiez *et al*., 2009). According to the U.S study, 10,000 worms in farm plot provides the same benefit as three farmers working 8 h in shift all year round with 10 tons of manure applied in the plot (Li, 2005). In the present study vermicompost significantly influences various

growth parameters of cabbage plant. The total number of leaves developed for each plant, cabbage head distance, cabbage head weight, plant root length, leaf length and width significantly increased in vermicompost applied plants compared to untreated cabbage plants. This findings are in agreement with the report of Canellas *et al*. (2002). They have reported that the growth of the plant was associated with humus content excreted by earthworm which contains humic acid. The humic acid in vermicompost stimulate plant growth even in small amounts. In addition, vermicompost retains nutrients for long time than the conventional compost and while the later fails to deliver the required amount of macro and micronutrients including the vital NPK to plans in shorter time, the vermicompost does.

Growth promoting activity of vermicompost in the present study is in agreement with the report of Suhane (2007) who has reported that vermicompost has very high porosity, aeration, drainage and water holding capacity than the conventional compost and this again due to humus content. The vermicompost supply balanced nutrients to plant roots and stimulate growth; increase orgnaic matter content of the soils and thus also improve their physical and chemical properties; add useful microorganisms and thus increase their biological properties and capacity of fertility renewal (Singh, 1992). In addition, vermicompost contains enzymes like amylase, lipase, cellulase and chitinase, which continuously break down organic matter in to the soil and release the nutrients make available to the plant roots (Chaouri *et al*., 2003; Tiwari *et al*., 1989). Vermicompost also contains most nutrients in plant available forms such as nitrates, phosphates and exchangeable calcium and soluble potassium (Orozco *et al*., 1996; Edwards, 1998). Microorganism including bacteria, fungi, yeasts actinomycetes and algae are active in vermicompost applied field they are capable of producing plant growth regulators such as auxins, gibberlins, cytokinins, ethylene and abscisic acid in appreciable quantities (Frankenberger and Arshad, 1995). Tomati *et al*. (1983) observed positive effect of vermicompost on the growth of *Begonias* and *Coleus*, especially a stimulation of rooting, time of flowering, lengthening of internode. The present finding agreed with the above findings because vermicompost provide an optimum condition for the multiplication of microorganism thereby plant growth promoting substances produced by the microorganism influence the growth of the cabbage plant subsequently increase the head weight and other parameters studied.

In the present findings cabbage head weight was significantly increased in vermicompost treated cabbage compared with control group. There are many reports highlights the improvement of crop yield by applying vermicompost. The integration of vermicompost, chemical fertilizer and biofertilizer increased the rice yield by 15.9% over the use of chemical fertilizer alone (Jeyabal and Kuppusamy, 2001). The garden pea (*Pisum sativum*) grown by using vermicompost produce higher green pods, higher green grain weight per plant (Meena *et al*., 2007). In the present study cabbage plant grown in vermicompost applied plot received all the essential nutrients thereby cabbage head weight was increased significantly compared to untreated control.

In the present findings vermicompost applied plant aphids population was reduced significantly. There are many workers reported pest suppression activity of vermicompost. Phelan (2004) reported that plant grown with organic fertilizers usually attacked by fewer arthropod pests and can resist pest attacks much better than plants received inorganic fertilizers. Rao (2002, 2003) reported vermicompost suppressing attacks of sucking insects such as jassids, aphids and spider mites significanlty in groundnuts. Bridadar *et al*. (1998) reported a clear correlation between amounts of vermicompost in a growing medium and decreased incidence of psyllids (*Heteropsylla cubana*) on a tropical leguminous tree (*Leucaena leucocephala*). Arancon and Edwards (2004) and Arancon *et al.* (2005) reported suppression of aphids (*Myzus persicae*) on cabbage by vermicomposts. Patriquin *et al*. (1995) reported more aphids, *Aphis fabae*, on plants grown with urea applications than on those in organically managed soils. Morals *et al*. (2001) reported larger populations of aphids (*Rhopalosiphum maidis*) on corn grown with an inorganic fertilizer than on organic amendments. In addition, present findings are also in agreement with many earlier reports. For example phenolic substances are distasteful to secondary decomposers in soil systems and inhibit the breakdown of dead plant materials (Edwards and Heath, 1963; Heath and Edwards, 1964). Simmonds (1998) reviewed that the modification of insect feeding behaviour by phenolics and non protein amino acids and general inhibition of insect feeding. Asami *et al*. (2003) reported that total phenolic substances were much higher in strawberries and corn grown organically than those in grown with inorganic fertilizers. It has also been shown that spraying of phenols and phenolic acids extracted from gingko plants were as effective as in contolling attacks by cotton aphids, vegetable aphids, catterpillars and thrips. Stevenson *et al*. (1993) reported that inhibition of *Spodoptera litura* development by phenolic compound from the wild groundnut. From this earlier findings it is clear that organic manure enhance the phenolic compounds which may not attract the insect to feed. It is obviously true in present findings when the vermicompost dosages increased mean number of aphid population decreased at statistically significant level.

Vermicompost known to provide a slow, balanced nutritional release pattern to plants, in particular release of plant available N, soluble K, exchangeable Ca, Mg and P (Edwards and Fletcher, 1988b; Edwards, 1998). The present study also agreed with those reports since cabbage plants growth was progressively continued from the beginning up to harvest. This is because of

slow release of nutrient from the vermicompost plants uptake required nutrient continuously for their growth without nutrients deficiency.

CONCLUSION

The study concludes that vermicompost is having plant growth promoting effect and pest suppression activity particularly in cabbage. The production of vermicompost is easily acceptable and adoptable by small scale farming community without much input cost. The vermicompost production is very much useful to make use of solid waste and other orgnaic wastes to make nutrient rich humus. The application of vermicompost is surely effective alternative nutrient for resource poor farming community to grow their crops without polluting the environment.

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