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RESEARCH ARTICLE

Management of infestation of pod borer (*Lucinodes orbonalis Guenee*) and productivity enhancement of brinjal (*Solanum melogena*) through vermiwash with biopesticide

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Abstract

Lucinodes orbonalis is common pest of brinjal vegetable crops causing 70-80% loss of crop productivity in eastern Uttar Pradesh. Foliar spray of water extract of single and binary combinations of vermiwash with biopesticides checks the infestation of the *Lucinodes orbanalis* and increases the crop productivity. Significant decrease in *Lucinodes orbanalis* population was observed after foliar spray of vermiwash with neem oil followed by aqueous garlic and annona leaf extract. The combination of neem oil with vermiwash caused complete removal of the *Lucinodes orbanalis* infestation. Vermiwash obtained from municipal solid wastes and animal dung with neem oil was found to be most effective against *Lucinodes orbanalis*. The use of vermiwash of buffalo dung and municipal solid wastes with neem oil or garlic extract is better alternative to manage the pod borer infestation of *Lucinodes orbanalis* in brinjal.

Introduction

Brinjal, *Solanum melogenum* family Solanacaeae is a common and most important nutritious vegetable crop and commonly known as egg plant. Brinjal fruit have 93% water, 40% carbohydrate, 1.4% protein, 0.3% minerals, 1.3% fibres, potassium, sulpher and phosphorous as well as vitamin A and C. *Lucinodes orbanalis*, is a common pest of brinjal and commonly known as shoot and fruit borer, which has high reproductive potential, rapid turnover of generation in both wet and dry season (Purohit and Khatri 1973; Allam et al., 1982*).* After hatching the larvae bore tender shoot and affect the translocation mechanism of nutrient resulting into drooping and withering of shoots. Whereas, caterpillar also bore flower buds and developing fruits as cause economic loss of their production (Alam and Sana, 1962; Butani and Jotwani, 1984; Patil, 1990). A single larva of *L. orbonalis* is enough to damage 4-6 healthy fruits (Anonymous, 2010). In India the average 60-70% loss of brinjal productivity was caused by *L. orbonalis* infestation.

The synthetic insecticides have widely used for control of *L. orbonalis* infestation. In Bangladesh the farmers sprayed 180 times with chemical pesticides during a year to protect their egg plant crop against, *Lucinodes orbonalis* (SUSVEG- Asia, 2007). Chemical fertilizers and pesticides were altered the soil quality and changed its physico-chemical nature as well as contaminated the fruits (Gupta, 2005; Devi, 2007). The pesticides of chemical origin have also affect the diversity of non-target organism and leads various health hazardous (Ahmad, 2007). The management of huge amount of municipal solid wastes generated in metropolitan cities is major challenge for the society in the absence of proper technology of their management (Sellanduria, 2009). The animal wastes are also a serious problem for society because their noxious and odor problems (Garg et al., 2005)

The vermicompositing is the better way for the proper management of these wastes (Crescent, 2003). The vermiwash is liquid bio-fertilizer, extracted from the vermicompost with earthworms. The vermiwash of municipal solid wastes is full of organic matter, plant nutrient and soluble salt which increase the soil nutrient and moisture content (Astaraei and Ivani, 2008). The biopesticides are more toxic against survival of insects pest, eco-friendly, non-hazardous, less expensive and easily pre-parable (Rajasckaran and kumarswamy, 1989). Neem (Azadirachta indica A. zuss) and garlic extract have larvicidal, toxic, repllent, ovicidal, antifeedent and anti-oviposition effect on insect pest (Zhu et al., 2001; Amonkar and Banerji, 1971; Cavallito and Balley, 1944). Leaves, bark and seed extract

of *Anonna squamosa* have pesticidal and insect antifeedent property (Alali and McLaughlin 1999). Application of potent plant pesticide with vermiwash is the best alternative of chemical fertilizer and pesticides (Ma et al., 2000).

The aim of the present study was to observe combined effect of vermiwash obtained from municipal solid wastes and animal wastes with different bio-pesticides on the growth, flowering and productivity of brinjal crop as well as management of *Lucinodes orbanalis* infestation.

2. Material and Methods

(a). Collection of wastes:

Municipal solid wastes were collected from the local municipality. Animal wastes viz. cow, buffalo, horse and goat dung was collected from different farm houses of Gorakhpur city. Municipal solid wastes and different animal dung (cow, buffalo, goat, and horse dung) were sprayed in layer of about 1-2 feet. This was sprinkled with water and also exposed to the sunlight for 5 to 10 days to remove the various harmful organisms and noxious gases.

(b). Collection of earthworms

An epigeic earthworms species *Eisenia foetida*, were cultured in the Vermiculture Research Laboratory, Department of Zoology, D.D.U Gorakhpur university, Gorakhpur. The collected earthworms were reared in laboratory condition, at temperature ranging 20-30°C with proper aeration. The moisture was maintained upto 40-60% RH for proper growth and survival of earthworms (Gupta, 2005).

(c). Method of vermicomposting

The vermicomposting was conducted on cemented earth surface by the method of Nath et al. (2009). Different combination of animal dung with municipal solid wastes viz- in1: 1, 1:2 and 2:1 ratio (w/w) was formed. The size of each vermibed was 3m x1m x 9cm After formation of vermibed, it was moist and inoculated with 2 kg of *E. foetida* in each bed. The beds were covered with discarded jute packet and the bed was moistened daily for up to 40 to 50 days to maintain the proper moisture content. The mixture of bed was manually turned upto 3 weeks at one week interval. After 50 to 60 days, granular tea like vermicompost appears on the upper surface of the beds.

(d). Extraction of vermiwash

Vermiwash was extracted from a vermiwash collecting device by the method of Ismail (1997). The apparatus was made from a plastic or metal drum having capacity of 2-L and a tap at the bottom of the drum filled with broken bricks to about 3 cm thickened which is followed by sand layer of 2-3 cm thickness. Lastly filled with vermicompost with heavy population of earthworms (400 worms/kg vermicompost). Simultaneously freshwater was added into the drum and a container kept below the tap of drum. The watery extract of vermicompost, vermiwash drainage out off drum. The colour of vermiwash ranged from yellowish to black. After 1 to 2 days, the extraction has been completed.

(e). Collection and preparation of biopesticides

1. Neem oil

Neem oil consisted of 0.03% azadirachtine, 90.57% neem oil, and 5.00% hydroxy El, 0.50% epichlorohydrine, and 3.9% aromax (Multiplex Agricare Pvt. Ltd., City, India).

2. Garlic extract

Aqueous extract of garlic was obtained from an *Allium sativum* bulb. A prepared aqueous extract (10 g/100 ml) (w/v) was mixed with diluted VW in a 1: 10 ratio.

3. Custard apple

Leaves were collected from the plant of custard apple (*Annona squamosa*). It is a native of South America and West Indies. A prepared aqueous extract (100 g/100 ml) (w/v) of leaves was mixed with diluted VW in a 1: 10 ratio.

Experimental Design:

Measurement of growth, flowering period and productivity as well as pest infestation were performed of brinjal (*Solanum melogena*) -- Pusa Kranti in the experimental field of Vermiculture Research Laboratory, Department of Zoology, D.D.U Gorakhpur University. The 40 days old seedlings planted in experimental field /square meter in each. Growth of crop was measured by auxonometer after 20 days from plantation. Flowering period and productivity (Kg/m^2) of brinjal was measured in each experimental field.

2.4. Chemical analysis

The pH was determined by using a double distilled water suspension of each waste in the ratio of 1:10 (w/v) that has been agitated mechanically for 30 minutes and filtered through Whatsmann No.1 filter paper, total organic carbon (TOC) measured by the method of Nelson and Sommers, (1982). Total Kjeldahl nitrogen (TKN) determined after digesting the sample with conc. H_2S0_4 and conc. $HClO_4$, (9:1 v/v) according to the method of Bremner and Mulvaney, (1982). Total available Phosphorus (TAP) analyzed using the colorimetric method with

molybdenum in sulfuric acid and total potassium (TK) was determined after digesting the sample in diacid mixture conc. HNO_3, conc. $HClO_4$, 4:1 (v/v) by flame photometer (Garg et al., 2005).

2.5. Statistical Analysis:

All experiments were replicated six times. Significant variance ($p<0.05$) determined by two way analysis of variance (ANOVA) was applied in between the different parameter of initial feed mixture and final vermiwash (Sokal and Rohlf, 1973).

Results

The binary combination of vermiwash with biopesticide viz neem (*Azadirachta indica*) oil, aqueous extract of garlic (*Allium sativum*) and leaves extract of custard apple (*Annona squamosa*) caused a significant ($p<.0.05$) reduction in pest infestation and increase in plant growth, with early flowering and productivity of *Solanum melogena*. The significant reduction in number of *Lucinodes orbonalis* population was observed after spraying of vermiwash with biopesticides (Table 1-4). The different combinations of vermiwash with garlic extract caused maximum reduction in *Lucinodes orbonalis* population while neem oil with vermiwash caused complete removal of *L. orbonalis* population (Table 3-4).

Growth of brinjal in control group was 8.58, 11.15 and 17.49 cm. at 30, 40 and 50 days after plantation, respectively. The foliar spray of vermiwash of different animal dung and municipal solid wastes with bio-pesticide caused significant increase in plant growth. Vermiwash of buffalo dung and municipal solid wastes with different bio-pesticide result in significant growth of brinjal plant (Table1-4). The highest growth of brinjal was (29.05 cm) was observed after spraying of vermiwash of buffalo dung and municipal solid wastes with neem oil followed by vermiwash of buffalo dung and municipal solid wastes with aqueous extract of garlic bulb (Table 3). Vermiwash of buffalo dung and municipal solid wastes with garlic extract and leaf extract of custard apple (*Annona squamosa)* caused significant growth of 28.96 and 28.24cm, respectively (Table 2-3)

The flowering period of brinjal in control group was 73.25 days. Significant early flowering was observed in single and binary combinations of vermiwash of different animal dung and municipal solid wastes with different bio-pesticide. The earliest flowering period of brinjal was 63.06 and 63.21 days was observed after spraying of vermiwash of buffalo dung and municipal solid wastes with garlic extract (Table 3-4). The significant increase in productivity of brinjal was observed in all the combination of vermiwash obtained from different animal dung and municipal solid wastes singly and in binary combination of buffalo dung and municipal solid wastes with aqueous extract of garlic. The maximum productivity of brinjal (6.86 Kg/m^2) was observed in the combination of buffalo dung and municipal solid wastes with neem oil with respect to all the combinations of vermiwash with bio-pesticides (Table 3).

The per cent pest infestation was also reduced after spraying of different bio-pesticide in combination with vermiwash of different animal dung and municipal solid wastes. Population of the shoot and fruit borer (*L. orbonalis*) was significantly reduced by the foliar application of the vermiwash with bio-pesticides. The complete removal of pest infestation was observed in the combination of buffalo dung and municipal solid wastes with neem oil.

Table 1- Effect of different combinations of vermiwash of different animal dung with municipal solid wastes on growth, flowering, productivity of brinjal plant and percent pest infestation of L. orbonalis (Fruit and shoot borer)

Vermiwash	Combination Ratio	Growth (cm) Spray periods after planting			Flowering in days	Productivity (gm/m^2)	% Pod pest infestation Spray periods after planting		
		30	40	50			80	90	100
Control	---	8.58±0.86	11.15±0.62	17.49±0.65	73.25±0.17	1.96±0.018	22.15±0.68	25.38±0.74	27.78±0.76
MSW	---	12.18±0.17	19.25±0.28	21.65±0.30	71.54±0.97	2.15±0.036	20.24±0.59	18.26±0.55	15.17±0.47
Goat Dung	---	#12.58±0.17	15.37±0.28	19.26±0.30	65.32±0.97	3.24±0.036	21.26±0.59	17.15±0.55	14.46±0.47
Dung+ MSW	1:1	13.84±0.82	16.52±0.78	20.57±0.86	64.92±0.27	3.52±0.011	20.78±0.51	16.64±0.42	13.86±0.37
	1:2	14.38±0.38	17.54±0.49	21.43±0.86	63.97±1.52	3.87±0.013	21.57±0.40	15.45±0.34	12.79±0.28
		14.75±0.23	18.22±0.47	22.89±0.96	63.32±0.27	4.26±0.010	20.68±0.37	15.07±0.27	12.24±0.20
Horse Dung	---	13.78±0.17	17.39±0.28	23.58±0.32	68.12±0.51	3.58±0.021	20.68±0.64	16.28±0.54	14.28±0.48
Dung +MSW	1:1	14.87±0.29	18.78±0.51	24.12±0.87	67.84±0.27	3.67±0.018	21.56±0.54	15.76±0.48	13.26±0.38
	1:2	15.13±0.26	19.22±0.42	24.85±0.94	66.13±0.18	4.85±0.021	20.84±0.47	14.43±0.31	12.17±0.32
	2:1	15.84±0.33	19.87±1.20	25.28±0.95	65.82±0.07	5.02±0.023	21.72±0.42	14.14±0.29	11.69±0.24
Buffalo Dung	---	14.38±0.35	17.42±0.26	22.84±0.29	70.28±0.48	3.87±0.018	21.28±0.56	15.76±0.49	13.62±0.40
Dung+MSW	1:1	16.24±0.36	19.38±0.54	24.86±1.40	66.24±0.19	4.84±0.014	20.64±0.51	15.18±0.46	14.87±0.37
	1:2	16.93±0.40	19.89±0.42	26.54±0.87	65.58±0.17	5.18±0.023	20.78±0.42	14.10±0.31	11.48±0.26
	2:1	**17.38±0.28**	**20.23±0.57**	**27.98±0.86**	**63.25±0.10**	**5.54±0.018**	**21.12±0.33**	**13.45±0.20**	**10.84±0.19**
Cow Dung	---	14.03±0.15	17.06±0.25	22.34±0.29	68.21±0.49	2.52±0.025	20.61±0.58	14.84±0.46	13.81±0.40
Dung +MSW	1:1	15.84±0.29	18.84±0.45	23.97±0.79	67.78±0.17	3.18±0.018	20.73±0.49	15.84±0.38	13.46±0.35
	1:2	16.36±0.26	19.37±0.59	25.62±0.80	66.87±0.21	4.28±0.024	20.15±0.39	13.21±0.30	10.23±0.34
	2:1	16.85±0.34	19.94±0.62	26.03±0.89	65.24±0.31	4.87±0.035	21.84±0.36	12.84±0.25	9.89±0.17

Each value is the mean ± SE of six replicates
2 way ANOVA: Significant (P< 0.05) * within column, # within row.
$- significant one way ANNOVA (P< 0.05) within row.

Table 2- Effect of different combinations of vermiwash of different animal dung and municipal solid wastes with Annona leaf extract on growth, flowering, productivity of brinjal plant and percent pest infestation of L. orbonalis (Fruit and shoot borer)

Vermiwash +1ml annona leaf extract	Combination Ratio	Growth (cm) Spray periods after planting 30	40	50	Flowering in days	Productivity (gm/m^2)	% Pod pest infestation Spray periods after planting 80	90	100
Control-	---	8.58±0.86	11.15±0.62	17.49±0.65	73.25±0.17	1.96±0.018	22.15±0.68	25.38±0.74	27.78±0.76
MSW		12.35±0.83	14.64±0.73	21.87±0.28	71.15±0.49	2.38±0.026	20.64±0.62	17.76±0.57	14.87±0.50
Goat dung		12.89±0.17	15.57±0.28	19.84±0.30	65.07±0.97	3.68±0.036	21.64±0.59	16.57±0.55	14.18±0.47
Dung +MSW	1:1	14.24±0.82	16.96±0.78	20.89±0.86	64.54±0.27	3.87±0.011	19.64±0.54	15.12±0.42	12.79±0.37
	1:2	14.85±0.38	17.97±0.49	21.96±0.86	63.25±1.52	4.84±0.013	21.87±0.47	14.96±0.34	11.84±0.28
	2:1	15.28±0.23	18.94±0.47	23.28±0.96	62.76±0.27	5.17±0.010	20.79±0.37	14.26±0.27	10.86±0.20
Horse dung	---	14.26±0.17	17.86±0.28	24.38±0.32	68.39±0.51	3.86±0.021	21.84±0.64	15.47±0.54	13.28±0.48
Dung +MSW	1:1	15.38±0.29	19.26±0.51	24.88±0.87	67.21±0.27	4.12±0.018	21.08±0.54	14.87±0.48	11.54±0.38
	1:2	15.64±0.26	19.68±0.42	25.36±0.94	65.84±0.18	4.97±0.021	20.56±0.47	13.45±0.31	9.46±0.32
	2:1	16.36±0.33	20.54±1.20	25.86±0.95	65.17±0.07	5.38±0.023	21.87±0.42	12.41±0.29	8.12±0.24
Cow dung	---	14.64±0.35	17.58±0.26	23.26±0.29	68.24±0.48	3.96±0.018	20.52±0.56	19.68±0.49	12.48±0.40
Dung+MSW	1:1	16.76±0.36	19.68±0.54	25.32±1.40	66.84±0.19	5.24±0.014	21.14±0.51	14.02±0.46	11.76±0.37
	1:2	17.32±0.40	20.56±0.42	26.87±0.87	65.18±0.17	5.38±0.023	21.54±0.42	13.84±0.31	9.18±0.26
	2:1	**17.63±0.28**	**20.87±0.57**	**28.24±0.86**	**63.54±0.10**	**5.74±0.018**	**20.21±0.33**	**11.26±0.20**	**7.98±0.19**
Buffalo dung	---	#14.64±0.15	17.39±0.25	22.87±0.29	67.87±0.49	2.83±0.025	21.73±0.58	13.87±0.46	12.12±0.40
Dung +MSW	1:1	16.22±0.29	19.37±0.45	24.68±0.79	68.32±0.17	3.47±0.018	20.58±0.49	12.24±0.38	11.14±0.35
	1:2	16.78±0.26	20.28±0.59	25.87±0.80	65.27±0.21	4.46±0.024	20.64±0.39	11.47±0.30	8.46±0.34
	2:1	17.32±0.34	20.75±0.62	26.54±0.89	64.86±0.31	5.12±0.035	21.75±0.36	10.24±0.25	6.84±0.17

Each value is the mean ± SE of six replicates
2 way ANOVA: Significant (P< 0.05) * within column , # within row.
$- significant one way ANNOVA (P< 0.05) within row.

Table 3- Effect of different combinations of vermiwash of different animal dung and municipal solid wastes with Garlic extract on growth, flowering, and productivity of brinjal plant and percent pest infestation of L. orbanalis (Fruit and shoot borer)

Vermiwash +1ml garlic bulb extract	Combination Ratio	Growth (cm) Spray periods after planting 30	40	50	Flowering in days	Productivity (gm/m^2)	% Pod pest infestation Spray periods after planting 80	90	100
Control	--	8.58±0.86	11.15±0.62	17.49±0.65	73.25±0.17	1.96±0.018	22.15±0.68	25.38±0.74	27.78±0.76
MSW	-	12.55±0.83	15.32±0.73	22.25±0.28	69.37±0.49	2.67±0.026	21.45±0.62	16.42±0.57	13.21±0.50
Goat dung		13.25±0.17	15.86±0.28	20.36±0.30	64.74±0.97	3.97±0.036	20.61±0.59	12.54±0.55	11.32±0.47
Dung+ MSW	1:1	14.57±0.82	17.36±0.78	21.54±0.86	64.12±0.27	4.32±0.011	20.58±0.51	11.43±0.42	10.27±0.37
	1:2	15.28±0.38	18.32±0.49	22.42±0.86	63.02±1.52	5.18±0.013	21.47±0.40	11.12±0.34	7.25±0.28
	2:1	16.78±0.23	19.46±0.47	23.78±0.96	62.76±0.27	5.63±0.010	20.37±0.37	8.45±0.27	5.32±0.20
Horse dung	---	14.54±0.17	18.32±0.28	24.62±0.32	67.65±0.51	4.13±0.021	20.48±0.64	11.87±0.54	10.25±0.48
Dung+MSW	1:1	15.74±0.29	19.84±0.51	25.28±0.87	67.03±0.27	4.56±0.018	21.52±0.54	10.41±0.48	9.12±0.38
	1:2	16.26±0.26	20.31±0.42	26.13±0.94	65.18±0.18	5.12±0.021	20.84±0.47	9.47±0.31	6.84±0.32
	2:1	16.68±0.33	20.86±1.20	26.63±0.95	64.68±0.07	5.68±0.023	20.47±0.42	7.41±0.29	4.67±0.24
Buffalo dung	---	14.97±0.35	17.88±0.26	23.84±0.29	67.85±0.48	4.18±0.018	20.31±0.56	9.84±0.49	4.87±0.40
Dung+MSW	1:1	17.32±0.36	19.89±0.54	25.64±1.40	66.28±0.19	5.84±0.014	20.13±0.51	7.25±0.46	3.98±0.37
	1:2	17.87±0.40	21.54±0.42	27.34±0.87	64.68±0.17	6.12±0.023	21.86±0.42	5.84±0.31	2.76±0.26
	2:1	**18.34±0.28**	**22.32±0.57**	**28.96±0.86**	**63.21±0.10**	**6.56±0.018**	**20.64±0.33**	**4.21±0.20**	**1.05±0.19**
Cow dung	---	15.21±0.15	17.87±0.25	23.24±0.29	67.18±0.49	3.18±0.025	21.57±0.58	10.54±0.46	9.68±0.40
Dung+MSW	1:1	16.78±0.29	19.68±0.45	24.96±0.79	67.68±0.17	3.69±0.018	20.13±0.49	9.15±0.38	8.76±0.35
	1:2	17.46±0.26	20.78±0.59	26.42±0.80	65.56±0.21	4.68±0.024	20.84±0.39	7.47±0.30	5.54±0.34
	2:1	17.89±0.34	21.52±0.62	26.98±0.89	64.16±0.31	5.45±0.035	21.47±0.36	5.84±0.25	3.13±0.17

Each value is the mean ± SE of six replicate
2 way ANOVA: Significant (P< 0.05) * within column # within row.
$- significant one way ANNOVA (P< 0.05) within row.

Table 4- Effect of different combinations of vermiwash of different animal dung and municipal solid wastes with neem oil on growth, flowering, and productivity of brinjal plant and percent pest infestation of L. orbonalis (Fruit and shoot borer)

Vermiwash +1ml neem oil extract	Combination Ratio	Growth (cm) Spray periods after planting 30	40	50	Flowering in days	Productivity (gm/m^2)	% Pod pest infestation Spray periods after planting 80	90	100
Control	--	8.58±0.86	11.15±0.62	17.49±0.65	73.25±0.17	1.96±0.018	22.15±0.68	25.38±0.74	27.78±0.76
MSW	--	12.84±0.83	15.68±0.73	22.76±0.28	68.87±0.49	2.86±0.026	20.45±0.62	15.84±0.57	12.76±0.50
Goat	--	13.68±0.17	16.28±0.28	20.75±0.30	64.21±0.97	4.08±0.036	20.13±0.59	9.75±0.55	6.84±0.47
Dung +MSW	1:1	14.86±0.82	17.58±0.78	21.86±0.86	63.73±0.27	4.58±0.011	20.56±0.51	7.52±0.42	5.14±0.37
	1:2	15.64±0.38	18.78±0.49	22.76±0.86	62.82±1.52	5.34±0.013	21.73±0.40	6.48±0.34	4.82±0.28
	2:1	17.25±0.23	19.89±0.47	24.14±0.96	61.84±0.27	5.75±0.010	20.54±0.37	5.34±0.27	2.54±0.20
Horse	---	4.78±0.17	18.68±0.28	24.78±0.32	67.13±0.51	4.28±0.021	20.68±0.64	9.24±0.54	5.87±0.48
Dung+MSW	1:1	16.18±0.29	20.23±0.51	25.83±0.87	66.84±0.27	4.78±0.018	21.68±0.54	6.87±0.48	4.65±0.38
	1:2	16.38±0.26	20.58±0.42	26.56±0.94	64.48±0.18	5.36±0.021	20.68±0.47	5.86±0.31	3.54±0.32
	2:1	17.26±0.33	21.56±1.20	26.86±0.95	64.10±0.07	5.94±0.023	21.84±0.42	4.58±0.29	1.78±0.24
Buffalo	---	15.32±0.35	18.36±0.26	24.28±0.29	67.13±0.48	4.38±0.018	21.24±0.56	8.42±0.49	3.24±0.40
Dung+MSW	1:1	17.48±0.36	20.26±0.54	25.87±1.40	65.75±0.19	6.24±0.014	20.54±0.51	6.34±0.46	2.78±0.37
	1:2	18.32±0.40	21.87±0.42	27.58±0.87	64.24±0.17	6.37±0.023	21.86±0.42	4.28±0.31	1.32±0.26
	2:1	**18.87±0.28**	**22.75±0.57**	**29.05±0.86**	**63.06±0.10**	**6.86±0.018**	**21.54±0.33**	**3.21±0.20**	**Nil**
Cow	---	15.64±0.15	18.36±0.25	23.68±0.29	66.76±0.49	3.54±0.025	21.42±0.58	8.84±0.46	3.89±0.40
Dung+MSW	1:1	17.36±0.29	19.87±0.45	25.35±0.79	66.21±0.17	3.86±0.018	21.54±0.49	5.84±0.38	3.18±0.35
	1: 2	17.87±0.26	21.32±0.59	26.75±0.80	65.18±0.21	4.79±0.024	20.64±0.39	4.32±0.30	2.18±0.34
	2:1	21.78±0.34	27.34±0.62	27.32±0.89	63.86±0.31	5.84±0.035	21.84±0.36	3.23±0.25	0.98±0.17

Each value is the mean ± SE of six replicate
2 way ANOVA: Significant (P< 0.05) * within column , # within row
$- significant one way ANNOVA (P< 0.05) within row.

5. Discussion:

It is evident from result that the binary combination of vermiwash of different animal dung and municipal solid wastes with biopesticides Viz- neem (*Azadirachata indica*) oil, aqueous extract of garlic (*Allium sativum*) and leaf extract of custard apple (*Annona squamosa*) have significant ($p<0.05$) effect on plant growth, early flowering and productivity of brinjal fruit (*Solanum melogena*) as well as reduction in pest infestation of *Lucinodes orbonalis.* Vermiwash of different animal dung with municipal solid wastes have significant amount of nitrogen, phosphorous, calcium, potassium, vitamins, enzymes and plant hormones (Astaraei and Ivani, 2008). The foliar spray of municipal solid wastes vermiwash causes persistence of water droplet on the leaves surface which promotes the leaf succulency, increase photosynthetic activity, internodes growth, improved plant physiology and ultimately increase the yield and quality of plant (Astaraei and Ivani, 2008; Gamaley et al., 2006). Large amount of humus produced by earthworms activity also contributed for the higher productivity in brinjal crop (Atiyeh et al., 2002). *Annona squamosa* also shows toxic effect on insect pest (Alali and McLaughlin, 1999). Aqueous extract obtained from *Annona squamosa* leaves, bark and seeds have annonaceous acetogenins which have pesticidal and insect feeding properties (Alkofahi et al., 1989; Rupprecht et al., 1990). The insecticidal activity of seed extract of *Annona squamosa* was due to the presence of annonins (i.e. annonine I= Squamocin), adjacent to bis-tetra hydrofeuron (THF) ring acetogenins (Sahani, 1994). Ghatak et al. (2009) reported that the reduction in fruit damage in the range of 71.98% to 76.94% after treatment with *Annona squamosa* extract in brinjal crop. Wondafrash, (2012) observed that the water extract obtained from neem leaf caused significant decrease in feeding and survival behavior of insect pest. Raja et al. (1999) studied that the neem oil shows desiccation effect the behavioral modification in fruit and shoot borer. There was significant reduction in population of brinjal shoot and fruit borer after treatment of neem seed extract @ 75g/l of water (Owusu et al., 2001). Neem extract obtained from different plant part have bio-active compound *Azadirachtin*, a limnoid (Tri-terpenoid) potent anti-feedant ,growth regulator, antifungal, bactericidal, antiviral effect on animals (Wondafrash, 2012; Champagne, 1992). Chitra et al. (1993) observed 69.55% control of *L.orbonalis* after spraying of 0.10% leaf extract of *Azadirachta indica*.

Fresh garlic extract have major component of diallyl di-sulphide and diallyl tri-sulphide which have antagonistic properties against pest of economic importance such as potato tuber, red cotton bug, red palm weevil, houseflies and mosquitoes (Amonker and Banerji,1997). Garlic produces a pungent alliaceous compound, allyl-epropyldisulphide, which may be responsible for its pest repellent characteristic. Early flowering was also observed in tomato plants treated with vermicompost with biopesticides it was possible due to presence of TKN and TP in vermiwash which is reason behind the early flowering .Large amount of TKN and TP causes early flowering in *Daucus Carota* and tomato plant (Mascolo et al., 1999; Satpal and Saimbhi, 2003).Which is due to presence of essential component especially humic acid in vermiwash of MSW.

5. Conclusion:

From the present investigation it can be concluded that the vermiwash with bio-pesticide is the better option for the growth, productivity as well as management of *Lucinodes orbanalis* infestation on brinjal crop. The foliar spray of vermiwash provide necessary nutrient to the growing plant for elongation, early flowering and fruiting phase. The bio-pesticide are more effective against larvae and caterpillar of fruit and shoot borer without contamination of fruits, so it is the best alternative of chemical fertilizers and pesticides for management of *Lucinodes orbanalis* population and enhancement of the productivity of fruit yield. These bio-products are easily pre-parable, biodegradable, less- expensive and most acceptable among rural areas.

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