UTILIZATION OF VERMIWASH POTENTIAL ON CERTAIN SUMMER VEGETABLE CROPS

GORAKH NATH AND KESHAV SINGH*

*- Department of Zoology D.D.U. Gorakhpur University Gorakhpur, Email- keshav26singh@ rediffmail.com

Manuscript received: October 28, 2008; Reviewed: October 7, 2009; Accepted for publication: October 21, 2009

ABSTRACT

The study was carried out to evaluate the impact of vermiwash on the growth, flowering and productivity of okra (Abelmoschus esculantus), lobia (Vigna unguiculata) and radish (Raphnus sativus). Vermiwash was extracted from different vermicompost which was composted from different animal agro and kitchen wastes through earthworm Eisenia foetida. It was observed that treatment of vermiwash shows significantly increased in growth and productivity and decreased flowering period. The maximum significant growth was observed in 30 mg/m^2 concentration of combination of buffalo dung with rice bran 38.0±1.3 cm. in case of okra, 30 mg/m^2 concentration of combination of buffalo dung with gram bran (seed of Cicer arientinum) 215.5±5.2 cm., in lobia crops and 30 mg/m^2 concentration of buffalo dung with gram bran 20.4±1.4 cm. The significant early starting of flowering and increased in productivity was found in all treated groups with respect to control.

Key words: Organic wastes, Eisenia foetida, Vermicompost, Vermiwash, Vegetables, Plant growth, Productivity

INTRODUCTION

Although not much of calorific value, vegetables are important source of essential vitamins and minerals needed for human system. The plants are the source of a large number of vegetables; hence it is essential to protect the vegetable plants from disease, created from deficiency of nutritional requirement. Okra (Abelmoschus esculentus) is a warm season crop belonging to family Malvacae and thrives best on a moist friable, well mannered soil having pH between to 6.0 to 6.8. Lobia is belonging to family Leguminaceae and warm weather drought resistant crop. It is usually grown as rain fed crop. The dry seed of lobia contains 24.6% protein, 55.7% carbohydrate, 1.3%fats, 3.8%fibers, and 3.2% minerals. Radish is belonging to family Brassicaceae. It used in salad. The nutritional value of the crops estimated as 3.4% carbohydrate, 0.7% protein, 0.1 fats, 0.6%minerals, and 0.8% fibers along with vitamin A, thiamine, riboflavin, nicotinic acid and vitamin C [33].

Vermiwash is the watery extract of Vermicomposts, extracted in the presence of rich population of earthworms. It contains several enzyme, plant growth hormones, vitamins along with micro and macronutrients [29] which increases the resistance power of crops against various diseases and enhance the growth and productivity of crops [1, 24, 34, 36, 37]. Karuna et al. [17] have studied the stimulatory effect of vermiwash on crinkle red variety of Andurium reanum. The treatment of vermiwash of vermicompost has been shown to reduced disease by necrotrophs as well as biotrophs [13, 5] and significantly decreases in soil born pathogens and various pests [31, 21, 22, 25]. Generally, foliar spray of vermiwash of vermicomposting would offer a method of supplying nutrients to higher plants more rapidly than methods involving soil and root application [18]. In dry condition with a lack of water in the top soil and corresponding decline in nutrients available foliar application of nutrients is much more effective than soil application [14].

Foliar spray containing nutrients can also compensate for the decline in nutrients uptake by roots with the onset of the reproductive stage a result increase in number of fruit [6]. It was demonstrated that growth of ornamental plant after adding vermiwash showed similar growth pattern as with addition of auxines, gibberellins and cytokinines through the soil [15, 35].

MATERIALS AND METHODS

Collection of wastes:

Different animal (cow, buffalo, sheep, horse, goat dung) and agro waste were collected from rural and urban parts of Gorakhpur districts. Partially decomposed mixture of animal, agro/kitchen wastes were use for enhancement of vermicomposting efficiency. After the collection the mixture of organic wastes sprayed in a layer of 1-2 feet and exposed to sun light for 5 to 10 days to remove the various harmful organism and noxious gases.

Collection of earth worm:

Earth worms Eisenia foetida an epigeic species were collected from U.P. agro states industrial area, Gorakhnath, Gorakhpur. The collected earthworms were cultured in laboratory conditions, temperature (20 to 30 ^{0}C) and moisture were maintain up to 40% to 60% (w/w) for proper growth and survival of earthworms.

Experimental setup for Vermicomposting

The experimental for vermicomposting were conducted on cemented earth surface. The combination of different animal, agro/ kitchen wastes was used in 1:1 ratio for each vermibed of size 3m × 1m × 9cm. After formation each vermibed was moistened it and inoculated with 2 kg of cultured Eisenia foetida in each. This bed was covered by torn and useless jute pockets and moisted the bed daily up to 40 to 50 days for maintaining the moisture content and after one week interval the mixture of bed was turned manually up to 3 weeks. After 45 to 50 days granular, brownish vermicompost appeared on the upper surface of vermibeds. These vermicomposts with earthworms uses for extraction of vermiwash.

Extraction of vermiwash

Vermiwash extracted from vermiwash collecting device. The apparatus made from plastic or metals drum having capacity of 2litre and a tap at the bottom the drum filled with broken breaks, about 10 cm thickened which is followed by sand layer of 2-3 cm thickness lastly filled with vermicompost with heavy population of earth worms simultaneously added fresh water in to drum and a container kept bellow the tap of drum. The watery extract of vermicompost, vermiwash drained out off drum. The colure of vermiwash ranges from yellowish to black. After 1 to 2 days the process of extraction has been completed and used for foliar spray on crops.

Experimental designs

There are six experimental fields of 1 m^2 for each treated concentration of different combination of vermiwash on the each crops. The seeds of all these three crops were directly planted in it. The first treatment was given at 20 day in case of radish and 30 days in case of Okra and Lobia just after planting. After 10 days we observed the growth and gave second treatment, again we observed the growth before third treatment; each observation used 10 days of time interval. Flowering period was observed

Table - 1. Effect of different concentration of vermiwash of different vermicomposts of different combinations of animal, agro and kitchen wastes on the growth (cm) of Okra (*Abelmoschus esculantus*).

Vermiwash	Days after sowing								
	30			40			50		
	Concentration (mg/m^2)								
	10	20	30	10	20	30	10	20	30
Control	10.5±1.2	10.5±1.2	10.5±1.2	13.2±1.3	13.2±1.3	13.2±1.3	16.0±1.2	16.0±1.2	16.0±1.2
Cow									
Dung	# 13.2±1.9	17.2±1.6	18.8±1.7	# 16.2±1.6	20.8±2.1	24.5±1.6	# 19.4±0.6	25.2±1.630.2±1.6	30.2±1.6
Dung + Gram Bran	* 14.2±1.4	18.4±1.8	20.6±0.6	* 17.8±0.2	22.6±2.2	26.8±1.8	* 21.0±.04	26.8±1.4	33.0±0.6
Dung + Straw	15.2±1.6	19.2±1.3	20.8±0.8	18.5±0.6	23.2±1.8	26.7±1.2	21.8±1.6	27.6±0.2	32.8±0.2
Dung + Wheat Bran	17.2±1.5	20.3±1.4	22.5±1.3	20.2±0.3	24.2±1.6	28.2±1.6	24.4±1.2	28.2±1.2	34.0±1.4
Dung + Rice Bran	16.4±1.2	18.5±1.6	20.2±1.4	19.5±1.6	22.8±1.3	26.5±0.6	22.8±1.3	27.0±1.0	32.8±1.6
Dung +Vegetable wastes	13.2±1.7	15.4±1.2	17.3±1.5	16.5±0.6	19.8±1.5	23.5±0.6	19.6±1.4	24.0±0.6	29.8±0.3
Dung + Barley Bran	12.5±1.8	14.6±1.2	16.2±1.3	15.8±0.4	18.2±1.6	22.8±1.5	19.0±1.3	22.4±1.4	29.0±0.8
Buffalo									
Dung	# 16.2±1.4	18.2±1.8	20.2±1.6	# 19.6±0.8	22.8±0.2	26.8±1.3	# 22.6±1.8	27.0±1.2	32.4±1.6
Dung + Gram Bran	* 17.8±1.6	21.2±1.3	24.3±1.6	* 20.5±0.6	25.8±1.8	28.2±1.6	* 23.4±1.4	30.0±1.6	34.6±0.8
Dung + Straw	18.2±1.3	22.7±2.3	24.3±1.4	21.5±1.6	26.9±0.8	30.2±1.8	24.6±1.8	31.0±1.7	36.6±0.2
Dung + Wheat Bran	16.4±1.4	18.7±1.2	21.2±1.6	19.2±0.8	23.0±1.2	27.5±1.2	22.4±1.8	27.2±1.8	33.8±1.2
Dung + Rice Bran	18.2±1.3	20.6±1.4	22.6±1.8	21.2±1.4	24.8±1.6	28.8±1.2	24.5±1.6	29.0±1.8	38.0±1.3
Dung +Vegetable Wastes	16.2±1.4	18.5±1.6	22.6±1.8	19.5±0.6	22.8±1.8	29.0±0.6	22.6±1.4	27.0±1.3	35.4±0.8
Dung + Barley Bran	17.0±1.8	19.7±1.7	22.8±1.6	20.2±1.3	24.0±1.0	29.0±0.8	23.0±1.7	27.2±0.6	35.2±0.4
Goat									
Dung	# 12.0±1.8	14.5±1.6	16.2±1.8	# 15.4±1.3	18.8±0.8	22.5±1.6	# 18.6±1.5	23.0±0.2	28.8±1.9
Dung + Gram Bran	* 14.5±1.0	16.2±1.8	18.2±1.2	* 17.2±1.8	19.2±1.6	24.2±1.8	* 20.2±1.3	23.4±1.3	20.2±1.6
Dung + Straw	14.2±1.2	16.0±1.6	18.0±1.0	17.5±0.6	19.0±0.8	24.5±0.6	20.6±1.1	23.2±0.4	30.0±0.2
Dung + Wheat Bran	13.2±1.6	15.0±1.2	16.2±1.8	16.2±0.4	18.0±1.6	22.4±1.0	19.4±1.2	22.2±0.2	28.3±0.7
Dung + Rice Bran	13.4±1.3	15.0±1.6	16.2±1.8	16.5±0.2	18.2±1.7	22.0±1.2	19.8±1.6	22.4±0.5	28.2±1.7
Dung +Vegetable Wastes	13.5±1.2	15.2±1.8	16.6±1.0	16.8±1.8	18.4±0.6	25.0±1.0	20.0±1.0	22.8±0.6	29.0±1.8
Dung + Barley Bran	12.7±1.6	13.8±1.6	15.0±1.4	15.2±1.8	17.9±1.2	21.2±0.8	18.5±1.2	22.1±1.6	27.5±1.2
Sheep									
Dung	# 12.6±1.0	14.0±0.6	15.8±1.6	# 15.8±1.0	18.2±1.8	22.0±1.2	# 19.0±1.5	22.6±1.0	28.5±1.0
Dung + Gram Bran	* 14.2±1.3	15.4±0.8	16.4±0.8	* 17.2±1.3	19.5±1.0	22.8±1.8	* 20.4±1.6	23.8±0.2	29.0±1.2
Dung + Straw	14.5±0.8	16.6±1.6	17.2±1.6	17.2±1.4	20.0±1.2	23.8±1.2	20.4±1.3	24.6±1.4	30.0±1.2
Dung + Wheat Bran	13.2±0.6	14.5±1.0	16.0±1.0	16.2±1.6	18.2±1.8	22.2±1.6	19.4±1.0	22.2±1.6	28.8±1.6
Dung + Rice Bran	14.5±0.8	16.0±0.8	17.5±1.0	17.8±1.2	20.2±0.8	23.8±1.0	21.0±1.8	24.6±0.8	23.0±1.0
Dung +Vegetable Wastes	13.8±1.2	14.8±1.0	16.2±0.8	17.0±1.4	18.2±1.6	22.5±1.6	20.0±1.8	22.4±1.8	28.7±1.2
Dung + Barley Bran	14.2±1.3	15.5±1.6	18.0±1.2	17.5±1.3	19.6±1.6	24.4±1.2	20.8±1.2	24.0±0.2	30.8±1.6
Horse									
Dung	# 15.0±1.2	16.5±1.8	17.2±0.8	# 17.5±1.0	20.0±1.5	22.0±1.6	# 20.8±0.6	24.2±1.2	28.2±1.4
Dung + Gram Bran	* 16.5±0.4	17.8±1.6	20.2±1.7	* 19.4±1.4	22.0±1.4	26.4±1.3	* 22.8±1.2	26.6±1.6	22.8±0.4
Dung + Straw	16.0±1.0	17.5±1.2	20.8±1.6	19.0±1.3	21.8±1.6	26.8±1.7	22.4±1.6	26.0±1.2	33.0±0.6
Dung + Wheat Bran	15.5±0.4	17.2±0.2	17.8±1.8	18.5±0.2	21.5±1.3	24.2±0.5	21.6±1.3	25.2±1.3	30.5±0.9
Dung + Rice Bran	15.8±0.6	17.4±1.6	18.0±1.2	16.0±1.0	22.0±0.8	24.8±0.2	22.0±1.2	26.0±1.8	31.0±1.6
Dung +Vegetable Wastes	15.4±0.2	17.2±1.3	18.0±0.4	18.4±1.3	21.8±0.3	24.2±1.3	21.8±0.2	26.0±0.5	30.5±0.8
Dung + Barley Bran	15.8±1.3	17.0±0.6	19.2±0.8	18.2±0.6	21.3±1.3	25.2±0.8	21.2±0.6	25.8±1.6	21.6±0.5

Each value is the mean ± SE of six replicates.

2 way ANOVA: Significant ($P<0.05$) * within column, # within row.

and finely we observed the productivity of plants in kg/ m^2.

Statistical analysis:

All the reported data are mean ± SE of 6 replicates. The two way analysis of variance (ANOVA) was used to analyze the significant growth difference between vermiwash of different combination of wastes and their concentration for observation of growth, flowering period and productivity. The test performed to identify that which combination and concentration of vermiwash is effective for growth and productivity of crops [28].

RESULTS

The significant time and dose dependent effect of vermiwash of different vermicompost of animal agro and kitchen waste observed on the growth, flowering period and total productivity of three vegetable Okra, Lobia and Redish. The significant growth observed in okra from the treatment of 10 mg/m^2concentration of combination of buffalo dung with straw (18.2±1.3) and rice bran (18.2±1.3). However 30 mg/m^2 concentration of combination of buffalo dung with gram bran (24.3±1.6). Finely the treatment after 50 days the significant growth observed in combination of buffalo dung with rice bran (38.0±1.3) and straw (36.6±0.2) table 1. In case of lobia or cowpea the significant growth find in 10 mg/m^2concentration of combination of buffalo dung with gram (120.4±5.8) and straw (117.5±3.6). The 30 mg/m^2 concentration of similar combination shows significant growth (150±8.2) and (137.6±6.3) respectively first treatment viz. 30 days after sowing. The 30mg/m^2 concentration highly significant growth observed in similar combination (215.5±5.2) and (90.4±6.2) respectively (table 2).

The significant growth observed in 10mg/m^2concentration of combination of buffalo dung with straw (15.0±0.6) and gram bran (13.2±0.4). The similar combination at 30 mg/m^2 treatment of vermiwash shows significant growth (17.0±1.0) and (17.2±1.2) respectively after first treatment. The third treatment (50 days after sowing) similar combination shows highly significant growth (30.0±0.8) and (30.4±1.4) respectively (table 3).

Significant dose dependent, decreased in flowering period observed in the crops of okra and lobia only. There was significant decreasing in flowering period of okra crops in 10 mg/m^2 concentration of combination of buffalo dung with straw (21.4±3.0) and gram bran (21.3±2.5). The highly significant decreasing in flowering period of 30 mg/m^2 concentration of (19.8±1.6) and (19.0±1.2) respectively. Lobia have the significant decreasing in flowering time observed at 10mg/m^2 concentration of combination buffalo dung with gram bran (41.4±2.6) and (42.2±1.2). The highly significant flowering period noticed at 30 mg/m^2 concentration of same combination (table 4).The significant dose dependent productivity observed in okra, radish and lobia. The significant productivity find in okra crops at 10 mg/m^2 concentration of combination of horse dung with gram bran (4.132±0.064) and buffalo dung with straw (3.926±0.098) and highly significant productivity at 30 mg/m^2 of same combination (4.532±0.126) and (4.34±0.088) respectively. In case of radish crops the significant productivity observed at 10 mg/m^2 concentration of combination of buffalo dung with straw (4.123±0.132) and horse dung with gram bran (4.042±1.132) but the 30 mg/m^2 concentration of these combination shows highly significant productivity. There was significant productivity observed in lobia crops, from the treatment at 10mg/m^2concentration of combination of buffalo dung with straw (4.124±0.084) and (4.102±0.098) but the highly significant productivity observed at 30 mg/m^2 concentration of combination of buffalo dung with gram bran (4.832±0.140) and horse dung with straw (4.821±0.120) (table 5).

DISCUSSION

From the above results it is clear that the vermiwash of different vermicomposts have time and dose dependent significant effect on the growth, flowering period and productivity of crops. In a preliminary study Edwards and Fletcher [12], Krishnamoorthy and Vajranabhiah [16] reported the microbial activity in vermicomposts could result in production of significant quantity of plant growth regulators such as IAA, gibberellins, cytokinins, by microorganisms. Large amount of humic acid were produced during vermicomposting and these had been reported to have positive effects on plant growth [9, 4, 20, 26]. Vermicomposts had been shown to influence the growth and productivity of a variety of plants, cereals and legumes [27, 8], vegetable [10, 2, 3]. Ornamental and flowering plants [10] field crops [19, 7]. Anand et al. [1] Atiyeh et al. [3], Suthar [34] have shown that vermicomposts when in bedding media had improved seed germination, enhanced the seedling growth and increased overall plant productivity. They have further shown that the greatest response from the plants could be observed only when the vermicompost was used at 10 - 40 per cent of the volume of plant growth medium. Parthasarathi and Rangnathan, [23] have reported that supplementation of N.P.K. with pressmud vermicast had enhanced the growth and yield in black gram (Vigna mungo) and groundnut (Arachis hypogaea). Vermicompost had enhanced the germination rate in seeds [11, 32]. Atiyeh et al. [3] reported that increases in the rate of germination, growth and yield of tomato. Subler et al. [30] demonstrated that

Table -2. Effect of different concentration of vermiwash of different vermicomposts of different combinations of animal, agro and kitchen wastes on the growth (in cm) of Cow pea or lobia (*Vigna unguiculata)*.

Vermiwash	Days after sowing								
	30			40			50		
	Concentration (mg/m^2)								
	10	20	30	10	20	30	10	20	30
Control	062.8±5.7	062.8±5.7	062.8±5.7	075.6±6.2	075.6±6.2	075.6±6.2	087.8±2.5	087.8±2.5	087.8±2.5
Cow									
Dung	# 077.2±6.7	088.4±6.3	098.6±6.4	# 092.5±2.5	105.5±4.2	125.4±2.3	# 107.6±6.2	130.8±3.8	156.3±6.2
Dung + Gram Bran	*112.6±2.3	124.3±6.2	135.6±2.5	* 130.5±6.5	142.2±6.2	165.2±4.3	* 145.7±3.2	168.2±4.6	198.4±4.2
Dung + Straw	108.3±5.2	117.4±3.2	126.2±6.2	125.2±3.2	137.4±2.4	153.4±4.3	147.4±4.2	165.8±4.2	190.8±2.4
Dung + Wheat Bran	098.6±6.3	107.8±6.7	119.6±5.6	112.6±4.2	125.4±4.6	147.7±4.8	127.2±6.2	150.6±3.2	180.6±6.3
Dung +Rice Bran	102.4±4.6	110.5±6.3	120.5±5.4	118.2±3.6	130.2±3.2	150.2±7.2	135.6±5.6	158.8±2.3	182.8±3.2
Dung +Vegetable wastes	100.6±4.9	110.6±8.6	120.2±7.2	115.4±5.9	128.2±3.4	149.6±8.2	130.4±4.8	148.5±4.5	180.6±3.4
Dung + Barley Bran	096.3±5.2	105.4±5.2	117.5±7.4	114.5±7.2	125.4±4.3	140.6±6.4	128.6±6.5	151.6±3.2	172.3±4. 5
Buffalo									
Dung	# 080.6±4.3	091.4±4.7	101.4±8.2	# 095.2±6.0	110.5±1.2	128.8±4.3	# 110.2±6.5	135.8±7.2	160.8±6.4
Dung + Gram Bran	*120.4±5.8	135.6±5.6	150.6±8.2	* 140.0±6.2	158.4±2.8	182.4±4.6	* 160.7±6.3	180.6±6.8	215.5±5.2
Dung + Straw	117.5±3.6	127.5±3.2	137.6±6.3	136.0±3.2	148.2±6.4	168.2±3.7	152.4±4.2	170.3±3.2	204.6±6.2
Dung + Wheat Bran	102.7±4.0	114.5±8.6	124.6±4.7	118.5±8.2	136.3±4.2	152.2±4.8	133.2±7.2	160.6±3.8	183.8±5.7
Dung + Rice Bran	112.2±8.2	123.6±3.2	135.2±1.6	130.2±6.3	145.2±4.3	170.0±5.6	148.7±6.3	172.5±3.7	200.5±5.5
Dung +Vegetable Wastes	102.5±2.5	112.5±6.3	123.5±2.8	118.2±3.2	133.4±4.7	152.5±5.3	133.6±7.3	160.2±4.3	184.3±3.2
Dung + Barley Bran	098.6±2.4	108.4±6.7	118.2±7.2	113.5±3.6	129.6±5.2	148.3±5.4	128.2±4.5	158.3±5.5	180.8±3.6
Goat									
Dung	# 084.2±5.3	096.7±6.2	110.2±5.4	# 097.4±4.8	116.2±4.2	140.4±5.7	# 113.4±6.3	135.6±4.5	172.4±2.5
Dung + Gram Bran	*098.5±8.2	108.6±8.4	118.6±4.5	* 113.4±4.6	129.4±4.5	147.8±6.7	* 128.4±5.5	158.2±3.3	180.6±8.4
Dung + Straw	094.5±8.0	102.8±5.0	115.2±5.8	108.2±2.3	132.4±2.6	143.4±7.3	123.6±6.3	162.8±4.6	188.5±6.1
Dung + Wheat Bran	088.6±3.2	096.3±6.2	105.4±5.2	102.4±3.2	115.3±3.6	132.0±7.4	117.6±2.7	148.2±5.6	164.2±2.5
Dung + Rice Bran	090.3±2.3	098.2±2.4	106.5±6.3	106.4±3.6	115.7±4.2	134.3±6.5	121.4±2.5	147.4±2.6	168.5±3.2
Dung +Vegetable Wastes	088.2±2.4	099.4±2.5	108.6±2.4	103.0±4.6	119.2±4.3	136.8±3.4	118.3±3.5	152.8±2.8	165.8±2.6
Dung + Barley Bran	092.6±3.7	100.4±2.6	112.2±2.6	106.3±5.2	120.6±5.3	140.6±3.2	122.5±3. 8	150.2±3.8	172.8±6.4
Sheep									
Dung	# 080.4±2.2	088.2±5.8	097.5±4.6	# 093.2±4.2	098.4±4.3	126.4±4.8	# 108.6±7.2	125.6±7.2	128.6±6.4
Dung + Gram Bran	* 100.2±4.3	107.4±4.5	114.2±4.6	* 115.4±2.4	120.5±4.7	145.2±4.6	* 132.4±4.5	148.6±8.2	178.8±2.4
Dung + Straw	102.4±6.2	110.4±6.3	118.3±2.4	117.2±2.7	132.4±7.2	147.5±7.3	136.6±4.8	185.2±6.0	180.2±7.7
Dung + Wheat Bran	095.2±2.8	104.0±4.2	112.5±4.3	119.2±2.8	125.6±7.4	140.2±6.2	126.8±2.6	152.4±2.4	172.5±4.2
Dung + Rice Bran	096.2±2.4	104.0±4.5	113.0±4.2	111.2±3.3	125.2±6.4	142.0±4.8	128.3±3.8	150.8±2.8	175.2±5.4
Dung +Vegetable Wastes	084.5±4.2	097.6±6.8	108.4±3.2	100.2±4.7	115.4±7.5	135.7±2.8	114.2±6.9	140.4±4.6	168.6±6.7
Dung + Barley Bran	084.6±5.6	098.2±2.5	106.2±7.3	101.0±7.2	112.5±2.4	134.7±3.2	118.4±2.9	132.2±3.7	166.4±6.2
Horse									
Dung	# 082.5±7.2	093.4±6.2	103.7±2.5	# 096.0±3.2	113.4±4.2	128.6±4.6	# 112.4±4.2	135.7±3.4	168.4±3.8
Dung + Gram Bran	* 102.6±5.8	112.4±5.8	125.2±5.8	* 116.0±4.4	135.6±2.3	150.0±2.0	* 122.6±2.8	160.4±4.2	182.3±2.2
Dung + Straw	108.2±6.2	118.7±8.3	129.2±2.4	124.4±6.4	140.3±4.2	156.2±4.5	140.2±2.4	143.6±8.6	190.0±6.4
Dung + Wheat Bran	092.4±5.2	103.0±4.3	115.6±2.4	110.5±4.6	124.5±5.6	138.5±6.2	125.4±2.2	156.5±5.2	172.7±3.3
Dung + Rice Bran	097.2±6.2	108.7±2.8	118.7±2.8	112.2±6.2	131.2±3.4	142.2±2.7	127.6±6.5	152.7±4.2	172.3±6.5
Dung +Vegetable Wastes	087.2±4.6	108.6±2.8	109.5±6.7	101.2±2.4	120.5±2.4	145.4±6.2	117.2±7.2	141.6±8.2	178.8±5.5
Dung + Barley Bran	084.2±8.3	093.2±6.4	104.8±6.5	098.4±4.2	113.5±5.6	128.2±2.6	112.2±4.3	135.4±4.2	160.3±5.2

Each value is the mean ± SE of six replicates.

2 way ANOVA: Significant (P<0.05) * within column, # within row.

Table- 3. Effect of different concentration of vermiwash of different vermicomposts of different combinations of animal, agro and kitchen wastes on the growth (in cm) of Radish (*Raphanus stativus)*.

Vermiwash	Days after sowing								
	30			40			50		
	Concentration (mg/m^2)								
	10	20	30	10	20	30	10	20	30
Control	08.0±0.2	08.0±0.2	08.0±0.2	10.4±0.6	10.4±0.6	10.4±0.6	13.5±0.5	13.5±0.5	13.5±0.5
Cow									
Dung	# 10.0±0.4	11.4±0.3	13.5±0.6	# 13.4±0.4	15.2±1.0	18.2±1.2	# 17.0±0.4	14.7±1.3	22.5±1.6
Dung + Gram Bran	* 12.2±0.3	13.6±0.4	15.6±0.8	* 15.6±1.2	18.8±0.3	21.4±0.4	* 21.4±1.0	24.2±1.4	28.0±0.8
Dung + Straw	12.0±1.0	13.0±1.0	15.2±0.3	15.4±1.3	18.8±0.4	21.5±0.6	21.2±0.8	24.5±1.6	28.2±0.7
Dung + Wheat Bran	10.8±0.6	12.8±0.4	14.6±0.7	14.8±0.6	17.2±0.3	22.2±1.2	20.4±0.7	23.8±1.2	27.2±1.5
Dung + Rice Bran	10.0±0.4	12.2±0.6	14.0±1.2	14.2±0.7	16.2±0.6	19.4±1.6	18.8±0.4	21.0±0.6	24.5±1.2
Dung +Vegetable wastes	10.2±0.5	12.6±0.2	14.4±1.2	14.8±0.5	17.4±0.3	20.6±0.8	19.8±0.6	22.6±1.2	26.4±1.3
Dung + Barley Bran	10.0±0.8	11.2±0.5	13.3±1.0	13.5±0.4	16.0±0.4	19.2±0.6	18.0±1.2	20.8±0.8	24.8±1.2
Buffalo									
Dung	# 10.8±0.2	12.6±1.0	14.8±1.5	# 14.5±1.2	17.6±1.0	20.2±0.4	# 19.2±0.4	21.4±0.6	25.4±0.7
Dung + Gram Bran	* 13.2±0.4	14.8±1.2	17.2±1.2	* 17.4±1.4	21.8±1.2	21.5±1.2	* 24.2±1.2	27.5±1.6	30.4±1.4
Dung + Straw	15.0±0.6	14.5±1.2	17.0±1.0	17.2±1.2	21.5±1.4	25.6±1.5	24.0±1.0	27.3±1.4	30.0±0.8
Dung + Wheat Bran	12.2±1.2	13.8±0.6	16.0±1.3	16.5±1.2	20.4±1.0	23.8±0.6	23.4±1.4	26.2±1.2	29.5±0.5
Dung + Rice Bran	12.0±1.3	13.2±0.4	15.8±1.3	16.2±1.2	20.0±0.6	24.0±1.0	23.2±0.8	27.0±1.5	31.2±0.7
Dung +Vegetable Wastes	12.0±1.4	13.0±0.7	15.2±0.8	15.4±0.6	19.6±0.4	22.8±1.2	24.2±0.6	25.6±1.2	29.2±0.7
Dung + Barley Bran	11.4±0.6	12.8±0.5	14.6±1.6	14.2±0.7	18.0±0.7	21.2±0.4	21.8±1.2	24.2±1.3	28.2±0.8
Goat									
Dung	09.2±0.7	10.6±0.4	12.2±0.3	# 11.5±1.2	13.8±0.4	16.2±0.3	# 17.2±0.8	19.2±0.6	23.4±0.3
Dung + Gram Bran	* 10.8±0.5	12.8±0.6	15.8±1.3	* 13.0±0.6	15.2±0.8	18.0±1.2	* 18.2±0.6	21.6±0.8	25.0±1.0
Dung + Straw	10.4±1.0	12.2±1.0	15.2±0.4	12.8±0.8	15.0±1.0	17.8±0.4	18.0±0.4	21.2±0.6	24.8±1.2
Dung + Wheat Bran	10.2±0.5	11.4±0.8	13.2±0.6	12.5±0.3	14.2±0.7	16.8±0.7	17.8±1.2	20.0±0.4	23.8±0.6
Dung + Rice Bran	09.4±0.5	10.8±0.6	12.4±0.5	11.2±0.2	13.6±0.8	16.4±0.4	17.0±1.2	19.2±1.6	22.8±0.4
Dung +Vegetable Wastes	10.8±0.6	11.6±0.4	13.2±0.5	12.0±1.0	14.2±1.0	17.2±1.2	18.8±0.8	21.4±1.4	25.0±1.2
Dung + Barley Bran	09.2±0.8	10.8±0.3	12.4±0.7	11.4±0.4	13.4±0.8	16.0±0.4	16.2±0.3	18.2±1.5	21.4±0.4
Sheep									
Dung	09.0±0.2	10.3±0.6	12.0±1.0	# 11.2±0.5	13.4±1.2	16.2±0.6	# 16.4±0.4	18.3±1.4	21.8±0.6
Dung + Gram Bran	* 10.8±0.4	13.2±0.4	15.4±0.8	* 14.5±0.6	17.8±1.5	21.0±0.7	* 20.2±0.8	23.4±1.8	27.2±1.2
Dung + Straw	10.6±0.3	12.8±0.6	14.8±0.6	14.0±0.8	16.2±1.0	19.2±0.6	19.4±1.6	22.6±0.6	26.2±1.4
Dung + Wheat Bran	09.8±0.6	10.8±0.4	12.4±0.4	12.0±1.2	13.8±0.4	17.2±1.4	17.0±1.0	19.2±0.3	22.4±0.8
Dung + Rice Bran	09.2±0.4	10.2±0.6	11.8±0.4	11.8±0.5	13.4±0.6	16.2±0.8	17.4±1.2	20.0±1.5	23.2±1.2
Dung +Vegetable Wastes	09.8±0.6	12.2±0.4	12.0±0.5	12.4±0.6	14.2±0.8	17.4±0.3	18.2±1.4	21.0±0.5	24.0±1.4
Dung + Barley Bran	09.2±0.4	10.6±0.2	12.0±1.0	12.3±0.4	13.5±0.7	16.2±0.5	17.2±1.4	19.4±0.7	22.2±0.2
Horse									
Dung	# 09.2±0.6	12.4±0.4	14.5±1.4	# 14.5±1.2	16.2±1.4	18.8±1.2	# 19.2±1.4	21.5±1.3	24.2±1.2
Dung + Gram Bran	* 11.0±1.0	14.2±0.6	16.8±0.2	* 17.4±1.4	20.4±0.6	23.0±0.6	* 23.5±0.6	26.5±1.4	29.0±1.6
Dung + Straw	11.4±0.4	14.8±1.0	17.4±0.8	17.8±1.6	20.6±1.2	23.4±0.8	23.6±0.8	26.8±1.0	28.5±0.8
Dung + Wheat Bran	10.5±0.7	13.4±0.4	15.6±0.8	16.2±0.8	19.5±0.5	21.8±0.4	22.0±0.7	25.6±0.8	28.2±1.2
Dung + Rice Bran	10.3±0.7	13.3±0.6	15.2±0.7	16.1±0.6	19.2±0.4	21.4±0.7	21.4±0.3	25.0±1.0	28.0±1.6
Dung +Vegetable Wastes	10.8±0.3	13.8±0.4	16.2±0.5	17.0±0.5	19.8±0.3	22.2±0.8	21.8±0.7	25.2±1.2	27.6±0.7
Dung + Barley Bran	09.5±0.2	12.8±0.6	14.8±0.9	14.8±1.2	16.6±0.7	19.2±1.2	18.2±1.2	22.0±1.6	25.6±0.5

Each value is the mean ± SE of six replicates.

2 way ANOVA: Significant ($P<0.05$) * within column, # within row.

Table- 4. Effect of different concentration of vermiwash of different vermicomposts of combinations of animal, agro and kitchen wastes of flowering period (days) of Okra and Lobia.

Vermiwash	Crops					
	Okra			Lobia		
						Concentration (mg/m^2)
	10	20	30	10	20	30
Control	42.4±2.6	42.4±2.6	42.4±2.6	63.2±3.2	63.2±3.2	63.2±3.2
Cow						
Dung	# 33.6±2.6	32.4±2.4	31.3±3.0	# 52.6±3.6	50.2±2.3	48.6±2.4
Dung + Gram Bran	27.4±2.8	26.2±3.0	24.3±2.6	56.2±2.4	45.6±2.8	43.2±2.6
Dung + Straw	27.3±2.3	26.8±2.1	24.2±2.7	57.3±2.8	46.4±2.5	44.2±3.2
Dung + Wheat Bran	28.4±1.5	27.3±1.5	26.3±1.5	58.2±2.1	47.2±3.0	45.2±2.8
Dung + Rice Bran	29.3±1.8	28.2±2.5	27.3±1.7	59.4±3.0	48.4±2.4	46.7±2.7
Dung +Vegetable wastes	31.4±1.6	30.4±2.0	28.5±1.5	59.3±2.4	48.5±2.6	46.2±2.8
Dung + Barley Bran	32.3±2.6	31.2±2.6	30.2±1.7	50.2±2.3	49.5±3.2	47.6±2.3
Buffalo						
Dung	# 27.4±1.5	26.4±2.6	25.3±1.4	# 46.3±2.1	45.4±2.5	43.4±3.0
Dung + Gram Bran	21.3±2.5	20.4±2.4	19.0±1.2	41.4±2.6	40.5±3.2	37.8±2.7
Dung + Straw	21.4±3.0	20.6±2.3	19.8±1.6	42.2±1.2	41.2±2.5	39.3±2.6
Dung + Wheat Bran	23.6±2.7	22.2±2.4	21.5±2.1	43.4±1.6	42.6±2.6	40.2±2.3
Dung + Rice Bran	24.4±2.6	23.6±3.2	22.6±2.4	43.2±2.5	42.8±3.2	40.4±2.8
Dung +Vegetable Wastes	25.4±2.1	24.4±3.0	23.2±1.6	45.6±2.6	44.2±2.1	42.4±1.8
Dung + Barley Bran	27.7±1.7	26.4±2.4	25.2±2.6	46.2±2.8	44.8±2.3	42.6±2.5
Goat						
Dung	# 39.4±3.0	38.2±2.7	37.6±1.7	# 57.2±2.8	55.8±2.4	53.2±2.6
Dung + Gram Bran	35.3±2.1	34.6±2.4	33.4±2.6	52.4±2.1	50.4±2.3	48.8±2.5
Dung + Straw	35.2±2.3	34.2±2.0	33.6±2.5	52.4±2.6	51.6±3.0	49.3±2.8
Dung + Wheat Bran	36.4±1.6	35.4±3.0	34.2±1.5	53.4±2.5	52.4±2.5	50.6±3.2
Dung + Rice Bran	36.3±1.5	35.6±2.4	34.4±1.4	53.4±3.4	52.8±2.1	50.2±2.6
Dung +Vegetable Wastes	37.4±1.6	36.2±2.3	35.2±2.5	56.4±3.2	54.5±2.4	52.3±3.0
Dung + Barley Bran	38.4±2.8	37.8±2.6	36.2±2.6	56.2±2.3	54.8±3.0	52.4±2.8
Sheep						
Dung	# 39.6±2.4	38.4±2.0	37.3±2.1	# 58.2±2.5	56.2±2.5	54.3±2.7
Dung + Gram Bran	33.5±1.6	32.4±2.1	32.2±1.5	51.8±3.1	50.2±2.4	48.3±2.6
Dung + Straw	34.2±1.6	33.8±1.6	32.4±2.7	52.6±2.4	51.4±3.0	49.4±1.5
Dung + Wheat Bran	35.3±2.6	34.2±2.4	33.2±2.8	53.8±2.0	52.4±1.6	50.2±2.6
Dung + Rice Bran	35.8±2.6	34.6±2.1	33.2±1.2	54.2±2.6	52.2±2.8	50.2±2.7
Dung +Vegetable Wastes	38.2±1.4	36.3±2.4	35.4±3.0	56.2±2.4	54.2±3.2	52.4±2.6
Dung + Barley Bran	39.4±1.3	37.2±2.0	36.2±2.5	57.3±2.3	55.4±2.6	53.2±2.8
Horse						
Dung	# 28.3±2.3	26.4±3.6	25.2±2.6	# 47.3±2.6	45.2±2.5	43.4±2.7
Dung + Gram Bran	22.2±2.4	20.4±2.1	19.0±2.0	42.8±3.2	40.8±2.6	39.2±2.5
Dung + Straw	22.8±2.1	20.6±1.5	19.4±2.7	43.6±1.8	41.2±3.0	39.8±3.6
Dung + Wheat Bran	24.4±1.5	22.6±2.4	20.2±3.2	45.2±2.6	43.2±2.6	41.2±2.8
Dung + Rice Bran	24.6±2.3	23.8±2.1	22.4±2.1	45.3±2.4	43.4±2.5	41.5±3.0
Dung +Vegetable Wastes	25.3±2.8	24.3±2.7	23.5±3.0	46.7±2.8	44.3±1.5	42.6±2.5
Dung + Barley Bran	26.4±2.3	25.6±2.3	24.6±2.8	46.3±2.9	44.8±2.6	42.2±2.1

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

improvement in the germination and growth of petunias, merigold, bachelor buottns, poinsettias, bell peppers and tomatoes in response to vermicompost substitution in to bedding plant container media.

CONCLUSION

From the results it was concluded that the vermiwash of different combination of animal, agro and kitchen wastes have better growth and productivity of crops. The vermiwash is less expensive than chemical fertilizers, easily producible, eco-friendly and one of the best organic manure for foliar spray on the different crops.

REFERENCES

[1] Anand J. A., Wilson M. D. P., Kale R. D., Effect of vermiwash on seed germination and seedling growth, J. Soil Biol. Ecol. (1995) 15: 90-95.

[2.] Atiyeh R. M., Subler S., Edwards C. A., Metzger J. D., Growth of tomato plant in horticulture potting media with vermicompost, Pedobiologia. (1999) 43, 1-5.

[3] Atiyeh R. M., Arnacon N. Q., Edwards C. A., Metzger J. D., The influenced of earthworm processed pig manure on the growth and productivity of marigolds, Bioresource Technology (2001) 81, 103- 108.

[4] Atiyeh R. M., Arancon N. Q., Edwards C. A.,

Table-5. Effect of vermiwash of different conc. and combinations of different animal, agro and kitchen wastes on the productivity (kg/m^2) of okra, radish, and lobia.

Vermiwash	Crops								
	Okra			Radish $			Lobia		
	Concentration (mg/m^2)								
	10	20	30	10	20	30	10	20	30
Control	0.514±0.040	0.514±0.040	0.514±0.040	0.641±0.080	0.641±0.080	0.641±0.080	1.456±0.062	1.456±0.062	1.456±0.062
Cow									
Dung	# 2.462±0.104	2.612±0.102	2.042±0.063	# 2.632±0.068	2.802±0.014	3.086±0.023	# 3.032±0.048	3.452±0.068	3.632±0.042
Dung + Gram Bran	3.256±0.120	3.485±0.104	3.720±0.084	3.324±0.060	3.526±0.104	3.786±0.062	3.032±0.048	3.452±0.068	3.632±0.042
Dung + Straw	3.226±0.096	3.402±0.095	3.624±0.032	3.231±0.120	3.428±0.104	3.642±0.038	3.832±0.064	4.242±0.120	4.482±0.064
Dung + Wheat Bran	2.868±0.042	3.017±0.104	3.212±0.120	2.986±0.040	3.128±0.105	3.342±0.052	3.452±0.026	3.850±0.120	4.086±0.073
Dung + Rice Bran	3.048±0.034	3.285±0.100	3.526±0.082	3.124±0.062	3.362±0.086	3.544±0.064	3.524±0.086	3.958±0.624	4.126±0.046
Dung +Vegetable wastes	2.712±0.077	2.852±0.042	3.062±0.042	2.722±0.053	2.946±0.042	3.152±0.032	3.327±0.045	3.674±0.087	3.862±0.072
Dung + Barley Bran	2.582±0.120	2.702±0.068	2.914±0.032	2.652±0.073	2.831±0.026	3.014±0.048	3.028±0.065	3.452±0.150	3.275±0.105
Buffalo									
Dung	# 2.832±0.046	3.057±0.050	3.261±0.122	# 3.014±0.050	3.216±0.086	2.437±0.078	# 3.528±0.064	3.984±0.120	4.134±0.063
Dung + Gram Bran	3.842±0.132	4.020±0.125	4.341±0.126	4.006±0.124	4.208±0.100	4.402±0.038	4.124±0.084	4.524±0.100	4.832±0.140
Dung + Straw	3.926±0.098	4.110±0.085	4.345±0.088	4.123±0.132	4.362±0.102	4.543±0.087	4.102±0.098	4.520±0.060	4.702±0.098
Dung + Wheat Bran	3.634±0.126	3.824±0.065	4.120±0.064	2.842±0.069	3.026±0.100	3.232±0.120	3.832±0.046	4.210±0.080	4.426±0.085
Dung + Rice Bran	3.246±0.115	3.472±0.075	3.678±0.046	3.124±0.120	3.342±0.089	3.522±0.062	3.624±0.062	4.020±0.052	4.232±0.082
Dung +Vegetable Wastes	3.102±0.078	3.275±0.084	3.578±0.062	3.128±0.052	3.328±0.108	3.514±0.098	3.446±0.064	3.882±0.054	4.036±0.120
Dung + Barley Bran	3.002±0.102	3.102±0.064	3.324±0.052	2.834±0.062	3.023±0.150	3.642±0.063	3.421±0.120	3.652±0.120	3.842±0.086
Goat									
Dung	# 1.132±0.046	1.425±0.048	1.682±0.068	# 1.352±0.120	1.582±0.125	3.726±0.026	# 2.143±0.046	2.526±0.126	2.732±0.046
Dung + Gram Bran	2.142±0.032	2.301±0.142	2.543±0.102	2.237±0.104	2.456±0.120	2.625±0.086	3.432±0.033	3.942±0.062	4.201±0.016
Dung + Straw	2.213±0.025	2.414±0.150	2.698±0.096	2.396±0.324	2.526±0.098	2.732±0.046	3.368±0.042	3.724±0.124	3.921±0.062
Dung + Wheat Bran	2.186±0.040	2.345±0.082	2.567±0.096	2.134±0.102	2.348±0.122	2.532±0.084	3.126±0.062	3.542±0.098	3.772±0.046
Dung + Rice Bran	2.084±0.037	2.261±0.085	2.421±0.052	1.886±0.016	2.061±0.068	2.213±0.045	3.128±0.062	3.508±0.077	3.683±0.027
Dung +Vegetable Wastes	1.898±0.063	2.004±0.120	2.206±0.082	1.842±0.025	2.002±0.096	2.202±0.025	2.426±0.042	2.852±0.068	3.083±0.042
Dung + Barley Bran	1.624±0.046	1.852±0.068	2.040±0.032	1.632±0.062	1.882±0.024	2.064±0.042	2.243±0.069	2.623±0.083	2.832±0.063
Sheep									
Dung	# 1.342±0.026	1.527±0.028	1.762±0.042	# 1.642±0.068	1.823±0.042	2.031±0.022	# 2.182±0.037	2.468±0.124	2.642±0.078
Dung + Gram Bran	2.134±0.089	2.215±0.102	2.402±0.068	2.248±0.069	2.468±0.104	2.631±0.034	3.432±0.042	3.862±0.142	4.040±0.080
Dung + Straw	2.286±0.087	2.413±0.065	2.672±0.032	2.432±0.040	2.652±0.121	2.872±0.032	3.258±0.067	3.672±0.098	3.837±0.126
Dung + Wheat Bran	1.848±0.037	2.021±0.025	2.242±0.046	2.004±0.430	2.202±0.086	2.431±0.061	3.237±0.052	3.642±0.081	3.838±0.086
Dung + Rice Bran	1.628±0.042	1.824±0.026	2.062±0.032	1.830±0.026	2.024±0.088	2.232±0.060	3.083±0.062	3.426±0.086	3.642±0.096
Dung +Vegetable Wastes	1.482±0.016	1.642±0.015	1.832±0.060	1.645±0.036	1.862±0.098	2.032±0.022	2.440±0.063	2.962±0.062	3.124±0.036
Dung + Barley Bran	1.432±0.042	1.610±0.028	1.842±0.026	1.612±0.042	1.800±0.052	1.968±0.045	2.326±0.042	2.872±0.028	3.041±0.070
Horse									
Dung	# 2.980±0.120	3.087±0.024	3.286±0.026	# 3.038±0.113	3.258±0.068	3.412±0.064	# 3.084±0.068	3.782±0.124	3.968±0.041
Dung + Gram Bran	4.132±0.064	4.380±0.128	4.532±0.126	4.042±0.132	4.226±0.032	4.422±0.120	3.996±0.082	4.402±0.086	4.663±0.062
Dung + Straw	3.862±0.026	4.020±0.048	4.212±0.146	3.542±0.104	3.862±0.088	4.060±0.098	4.045±0.098	4.505±0.062	4.821±0.120
Dung + Wheat Bran	3.634±0.014	3.864±0.102	4.002±0.062	3.244±0.098	3.524±0.068	3.824±0.128	3.862±0.102	4.267±0.102	4.452±0.126
Dung + Rice Bran	3.602±0.021	3.804±0.104	4.014±0.042	3.104±0.062	3.446±0.102	3.721±0.086	3.621±0.046	4.028±0.062	4.204±0.062
Dung +Vegetable Wastes	3.432±0.098	3.646±0.098	3.785±0.069	3.042±0.126	3.231±0.085	3.452±0.066	3.442±0.086	3.925±0.122	4.024±0.069
Dung + Barley Bran	3.301±0.066	3.502±0.162	3.712±0.014	2.839±0.092	3.021±0.085	3.214±0.133	3.202±0.098	3.812±0.116	3.972±0.047

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

Metzger J. D., The influence of humic acid derived from earthworms processed organic wastes on the plant growth, Biores. Technol. (2002) 84-147.

[5] Al-Dahmani J. H., Abbasi P.A., Miller S.A., Hoitink H.A.J., Suppression of bacterial spot of tomato with foliar sprays of compost extracts under green house and field conditions, Plant Disease (2003) 87, 913-919.

[6.] Buckerfield J. C., Flavel T., Lee K. E., Webster K. A., Vermicompost soil and liquid form as plant growth promoter, Pedobiologia, (1999) 42: 753-759.

[7] Buckerfield J.C., Webster K. A., Worm work waste boosts grape yield: prospects for vermicompost use in vineyards, Australian and New Zealand Wine Industry Journal (1998) 13, 73-76.

[8] Chan P. L. S., Griffith D. A., The vermicomposting of pretreated pig manure Biol. Wastes (1988) 24, 57-69.

[9] Chen Y., Aviad T., Effect of humic substances on plant growth. In: Mac Carthy, P., Clapp, C.E., Malcolm, R.L. Bloom, P.R. (eds.); Humic substances in soil and crop sciences selected readings. ASA and SSSA, Madison, (1990) pp. 161-186.

[10] Edwards C. A., Burrows I., The potential of earthworm composts as plant growth media, in Eartwormin Environmental and Waste Management, (eds C.A. Edraeds and E.F. Neuhauser), SPB Acad. Publ., The Netherlands, (1988) pp. 211-20.

[11] Edwards C. A., Bohlen P. J., Biology and Ecology of Earthworms 3rd ed, Chapman and Hall, London (1996).

[12] Edwards C. A., Fletcher K. E., The use of earthworm in breakdown and management of organic wastes. In: Edwards, C.A.(eds.) Earthworm ecology. CRC Press Boca Raton, FI. (1998) pp. 329- 354.

[13] Fokkema, N.J., Opportunities and problems of control of foliar pathogens with microorganisms. Pesticide Science, (1993) 37, 411-416.

[14] Grundon , N.J., Effectiveness of soil dressing and foliar spray of copper sulphate in correcting copper deficiency of wheat (Triticum aestivum) in Queensland. Australian Journal of Experimental Agriculture and Animal Husbandry, (1980) 20, 717-723.

[15] Grappelli A., Galli E. Tomati U., Earthworm casting effect on Agaricus bisporus fructification, Agrochemica , (1987) 21,457-416.

[16] Krishnamoorthi R. V., Vajranabhiah S. N., Biological activity of earthworm casts: An assessment of plant growth promoter levels in casts, Proceedings of the Indian Academy of Science (Animal Science) (1986) 95,341-350.

[17] Karuna K., Patil C. R., Narayanswamy P. Kale R. D., Stimulatory effect of earthworm body fluid (vermiwash) on crinkle red variety of Anthurium andreanum lind, Crop. Res. (1999) 17(2): 253-257.

[18] Marschner H., Mineral nutrition of Higher Plants, Academic Press; London, U.K. (1995).

[19] Mba C. C., Treated-cassaca peel vermicomposts enhanced earthworm activities and Cowpea growth in field plots, Resources, conservation and Recycling (1996) 17: 219-226.

[20] Manivannan S., Standardization and nutrient analysis of vermicomposting sugarcane wastes, pressmud-trash-bagasse by Lampito mauriti (kingberg) and Perionyx exacavatus (perrier) and crop productivity, Ph. D. Thesis, Annamalai University, India, (2004).

[21] Nakasone A.K., Bettiol W., de Souza R. M., The effect of water extracts of organic matter on plant pathogens, Summa Phytopathologica, (1999) 25,330-335.

[22] Orlikowski, L.B., Vermicompost extract in the control of some soil borne pathogens. International Symposium on Crop Protection, (1999) 64,405-410.

[23] Parthasarthi K., Ranganathan L. S., Aging effects on enzyme activities in pressmud vermicasts of Lampito mauritii (King berg) and Eudrilus eugeniae (Kingberg) biology and fertility of soil, (2000) 30 (4) pp. 347-350.

[24] Pathak R. K., Ram R. A., Manual on Jai Octochaetidae: Oligochaeta vic Krishi, Central Institute for Subtropical Horticulture, Rehmankhera, P.O. Kokari, Lucknow-227107, (2004) vol.24, pp. 31-32.

[25] Rodriguez, J.A., Zavaleta, E., Sanchez, P. & Gonzalez, H. (2000). The effect of vermicompost on plant nutrition, yield and incidence of root and crown rot of gerbera (Gerbera jamesoni H Bolus). Fitopathologia, 35. 66 -79.

[26] Ramamoorthy P., Standardization and nutrient analysis of vermicomposting of sugarcane wastes, pressmud –trash-bagasse by Eudrilus eugeniae (King berg) and Eisenia foetida (Savigny) and the effect of vermicompost on soil fertility and crop productivity, Ph.D. Thesis Annamali University. Rao,R.C. 2005b; Vermicomposting. IEC CELL-KUDCEMP, Mysore, (2004).

[27] Rao B., Chandra C., Vermicomposting, IEC CELL-KUDCEMP, Mysore (2005).

[28] Sokal R., Rohlf J., Introduction to Biostatistics W.H.Freeman and Co.San Fransisco (1973).

[29] Shield, Earl B., Raising Earthworms for Profit. Shields Publication. P.O. Box 669 Eagle River Wisconsin (1982) 128p.

[30] Subler S.C., Edwards J., Metzger., Comparing vermicomposts and composts, Biocycle, July, (1998) 63-66.

[31] Szczech M., Rondomanski W., Brzeski M.W., Smolinska U. Kotowski, J.F., Suppressive effect of a commercial earthworm compost on some root infecting pathogens of cabbage and tomato, Biological Agriculture & Horticulture, (1993) 10, 47-52.

[32] Sevugaperumal R., Jainsankar K., Jayraj K., Comparative analysis of the effect of vermicompost and Azosirillum on Sorghum (Sorghun vulgar Linn.), ANJAC Journal, (1998) 15: 18-21.

[33] Singh V., Pande P.C., Jain D.K., A Text book of Botany Angeosperm, Rastogi Publication, Meerut. (2005) PP. 33-34.

[34] Suthar S., Choyal R. R., Singh S., Sudesh, Stimulatory effect of earthworm body fluid on seed germination and seedlings growth of two legumes, J. Phytol. Res. (2005) 1(2); 219-222.

[35] Tomati U., Gallii E., Earthworms soil fertility and plant productivity, Acta Zoologica Fennica. (1995) 196:11-14.

[36] Umamaheswari S., Viveka S., Vijaylakshmi G. S., Indigenous vermiwash collecting device, The Hindu, Jul. (2003) 17, 0.1-2.

[37] Yadav A. K., Kumar K., Singh S., Sharma M., Vermiwash- A liquid biofertilizer, Uttar Pradesh J. of Zoology, (2005) 25(1) 97-99.