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Comparative Study of Vermicompost and Vermiwash of *Eisenia fetida* and *Perionyx excavatus* and their Effect on Growth and Yield of Okra (*Abelmoschus esculentus*)

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Abstract : *The application of vermicompost + vermiwash of Eisenia fetida yields better results than those of Perionyx excavatus as far as stem height and number of leaves in okra plant are concerned. But the use of vermicompost + vermiwash of Perionyx excavatus resulted in greater stem circumference, number of buds, flowers and yield of okra. Plants treated with vermiwash made them more disease-resistant than the untreated ones.*

Keywords: *Eisenia fetida, Perionyx excavatus, Vermicompost, Vermiwash, Okra.*

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Introduction :

The excessive use of chemical fertilizers and pesticides has deteriorated the fertility of soil and nutritional value of agronomic products (Davis et al., 2004).Chemically grown foods have pesticide residues (Bhatnagar et al., 1993) which cause serious diseases and developmental disorders .Millions of tons of animals, agro and kitchen wastes are produced annually and cause bad odour and pollution problems (Gupta et al., 2005; Garg et al., 2006).

Vermicompost is the faecal matter of the earthworms. As the earthworms are offered a variety of organic stuff serving as their food, they take them in the alimentary canal where it is subjected to digestion, absorption and then elimination. The eliminated matter (casting) is called the vermicompost, obtaining of vermicompost in this manner is called vermicomposting. Inorganic farming , inorganic fertilizers are replaced by organic ones, such as, vermicompost. Vermicompost is rich in NPK and micronutrients (Ansari et al., 2010). While increasing soil organic matter, it improves soil fertility with increase in nutrients and micro-

diversity in soil. The epigeic earthworm, *Eisenia fetida*, is a suitable species for management of wastes by vermicomposting. *Perionyx excavatus* is also an epigeic earthworm species found commonly over a large area of tropical Asia. During the vermicomposting process, a leachate is produced, called vermiwash. It contains several plant growth hormones like auxins, gibberellins, cytokinins as well as micronutrients and macronutrients (Zambare et al., 2008) and used as a foliar spray. These vermiproducts can be utilized as biofertilisers and have been applied for various crops, such as, rice, kharif crops, vegetables like tomato, okra, spinach etc.

Okra is one of the most commonly consumed vegetables containing proteins, fats, vitamins and minerals. Many studies have been done on the effect of vermicompost and vermiwash of *Eisenia fetida* (Hatti et al., 2010; Manyuchi et al., 2013). The present study has been undertaken to evaluate the efficacy of the vermicompost and vermiwash of *Eisenia fetida* and *Perionyx excavatus* on the okra plant as far as its growth and yield are concerned.

Materials and Methods :

The two earthworm species used for the research were *Eisenia fetida* and *Perionyx excavatus*.The earthworm species were cultured separately. Two-week old cow dung (urine free and odour free) mixed with soil was used as feeding material for the earthworms. 30 Kg of vegetable wastes, excluding citrus fruits, fats, odour-producing vegetables like onion, garlic, was mixed with soil and left to decompose aerobically for 3 weeks (till the colour and texture changed).

The vermicompost and vermiwash units were setup (Ansari et al. and Sukhraj et al., 2010) in the eco farm,Patna Women's College. Earthen pots were used for vermicomposting and plastic containers with tap at the bottom were used for vermiwash setups. The basal layer comprised broken bricks, followed by coarse sand. It was followed by a layer of pre-decomposed vegetable wastes and cow dung in the ratio 2:1 (w/w) for both (vermicompost and vermiwash) setups. 25 adult earthworms for vermicomposting and 50 adult earthworms for vermiwash setups were introduced after one day. In case of vermiwash, an earthen pot with a hole at the bottom was hung over the container so that water would come out dropwise in order to keep the surface wet and moist during the whole process.

VERMICOMPOST UNIT: DIAGRAMMATIC

VERMIWASH UNIT: DIAGRAMMATIC

Table 1. Okra *(Abelmoschus esculentus)* was grown with the following treatments:

S. No.	Treatment	Abbreviation	No. of pots	No. of Okra seeds/ pot
1.	Control	[CON]	5	5
2.	Vermicompost *(Eisenia fetida)*	[VC-E]	5	5
3.	Vermicompost *(Perionyx excavatus)*	[VC-P]	5	5
4.	Vermicompost+ Vermiwash *(Eisenia fetida)*	[VC+VW-E]	5	5
5.	Vermicompost+ Vermiwash *(Perionyx excavatus)*	[VC+VW-P]	5	5

25 seeds of okra were sown in 5 pots for each treatment. For VC+VW treatment (of both species of earthworms), 25 seeds (each) were soaked overnight in diluted vermiwash (1:10 v/v in water). For the remaining 3 treatments, 25 seeds each were soaked overnight in water. 50gm of vermicompost/pot was added before seeds were sown,3 weeks after seed germination and before flowering (approximately 6 weeks after seed germination). Spraying of diluted vermiwash (1:10 v/v in water) was started after 5 weeks of seed germination till the fruit harvest. After observing seed germination (for 16 days), only one healthy seedling in each pot was allowed to grow for further study and the remaining seedlings were removed. The following growth parameters were recorded:

*Seed germination, rate of survival of seedlings

*Vegetative growth – stem height (cm); number of leaves; stem circumference (cm)

*Yield parameters – flower bud initiation; flower formation; number of buds, flowers and fruits.

Results and Discussion :

The result includes the effect of vermicompost and vermiwash of both the earthworm species in comparison to soil (as control) on stem height, stem circumference, number of leaves, number of buds, number of flowers and number of fruits of the okra plant.

Table 2. Impact of various treatments on germination of seeds and survival rate of seedlings till the 16th day :

Treatment	Seed germination in days						Survival rate (%)upto
	3th day	4th day	5th day	6th day	7th day	8th day	16th day
[CON]			3	9	17	22	68
[VC-E]	5	13	19	25			88
[VC-P]	4	11	18	23			80
[VC+VW-E]	9	15	25				100
[VC+VW-P]	7	16	25				92

Table 3. Impact of various treatments on height (cm) of Okra plant [Mean±S.E ,n=5]

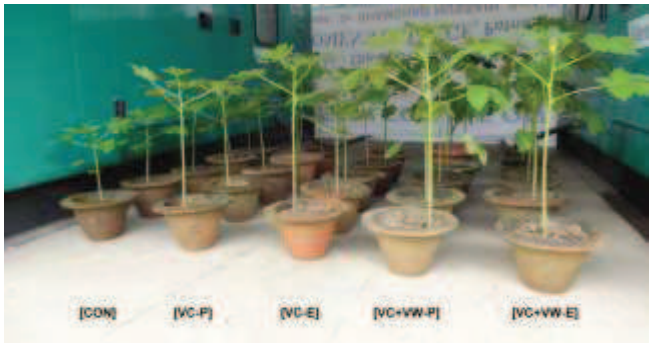
Treatment	20th day	40th day	60th day
[CON]	9.76±0.27	17.64±0.96	22.78±0.47
[VC-E]	18.02±0.37*	34.32±0.35*	41.86±0.36*
[VC-P]	16.72±0.33*	32.02±0.70*	39.00±0.45*
[VC+VW-E]	23.32±0.42*	43.10±0.47*	54.26±0.39*
[VC+VW-P]	24.40±0.78*	41.92±0.41*	51.28±0.53*

Table 4. Impact of various treatments on number of leaves of Okra plant [Mean±S.E, n=5)

Treatment	20th day	40th day	60th day
[CON]	3.6±0.31	5.2±0.22	6.6±0.27
[VC-E]	4.0±0.79*	7.2±0.59*	11.4±0.57*
[VC-P]	4.8±0.42*	6.6±0.76*	12.2±1.10*
[VC+VW-E]	5.2±0.71*	8.2±0.58*	14.2±0.80*
[VC+VW-P]	4.4±0.67*	8.2±0.86*	14.4±0.82*

Table 5. Impact of various treatments on stem circumference (after 60 days), number of buds and number of flowers of Okra plant [Mean±S.E , n=5]

Treatments	Stem Circumference (cm)	Number of Buds	Number of flowers	Number of Fruits
[CON]	2.19±0.04	7.2±0.67	5.4±0.32	4.6±0.91
[VC-E]	3.04±0.14*	12.6±0.56*	11.6±0.89*	8.2±0.54*
[VC-P]	2.98±0.13*	11.0±0.42*	9.4±0.48*	8.8±0.07*
[VC+VW-E]	3.64±0.08*	13.2±0.09*	11.8±0.08*	10.4±0.31*
[VC+VW-P]	3.87±0.13*	18.4±0.17*	14.0±0.74*	13.0±0.65*



Height of Okra plants under different treatments (After 40 days)

[CON]	=	Soil with no other input	(17.78 cm)
[VC-P]	=	Vermicompost of *Perionyx excavatus*	(32.16 cm)
[VC-E]	=	Vermicompost of *Eisenia fetida*	(34.40 cm)
[VC+VW-P]	=	Vermicompost and Vermiwash of *Perionyx excavatus*	(41.98 cm)
[VC+VW-E]	=	Vermicompost and Vermiwash of *Eisenia fetida*	(45.67 cm):- BEST RESULT

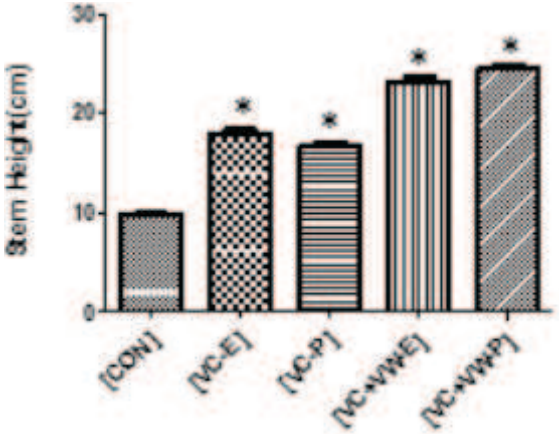


Fig 1. Impact of treatments on height of Okra plant (on the 20th day)

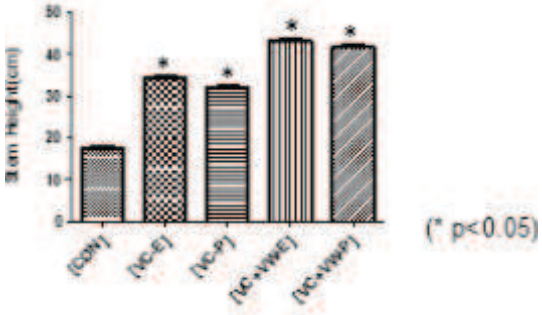


Fig 2. Impact of treatments on height of Okra plant (on the 40th day)

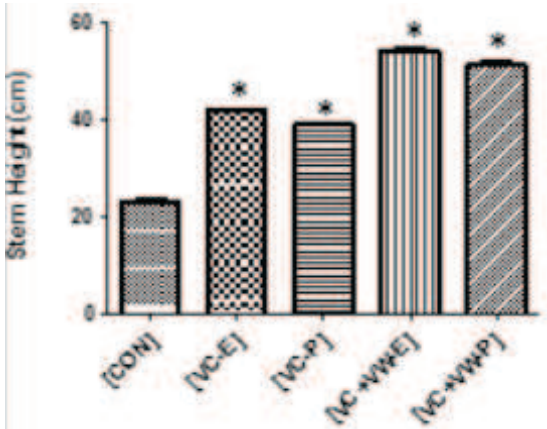


Fig 3. Impact of treatments on height of Okra plant (on the 60th day)

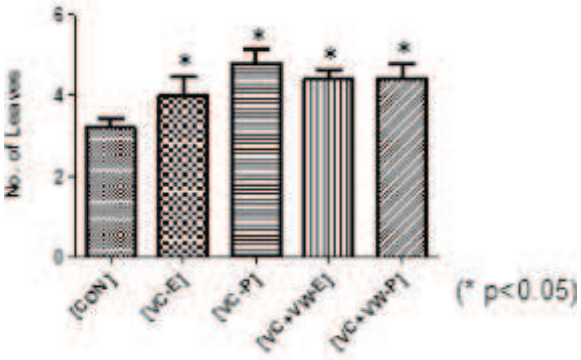


Fig 4. Impact of treatments on number of leaves of Okra plant (on the 20th day)

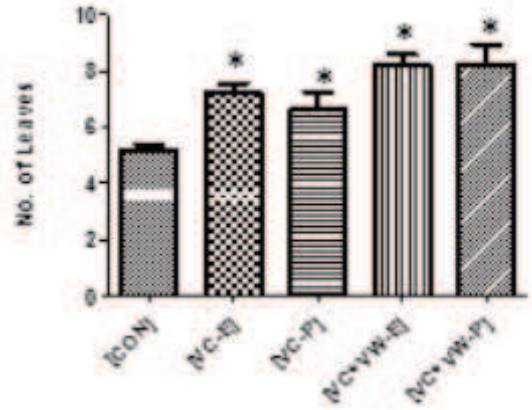


Fig 5. Impact of treatments on number of leaves of Okra plant (on the 40th day)

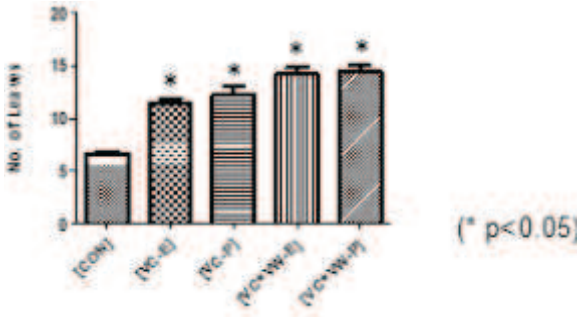


Fig 6. Impact of treatments on number of leaves of Okra plant (on the 60th day)

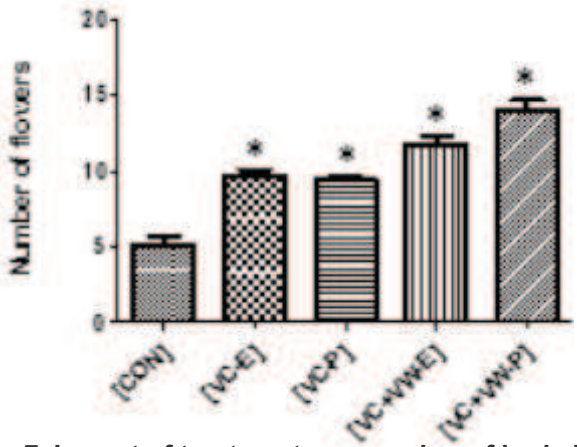


Fig 7. Impact of treatments on number of buds in the Okra plant

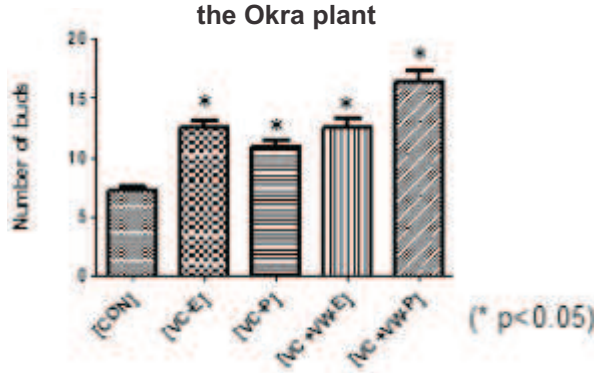


Fig 8. Impact of treatments on number of flowers in the Okra plant

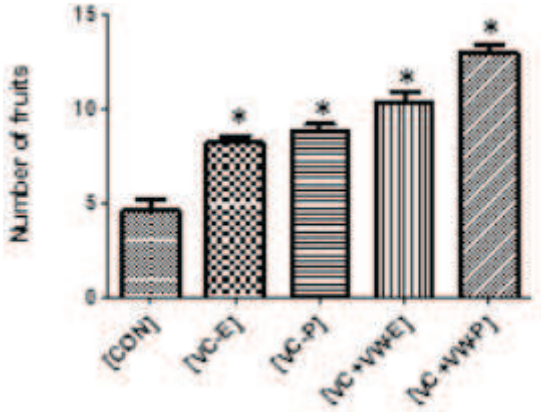


Fig 9. Impact of treatments on the number of fruits in the Okra plant

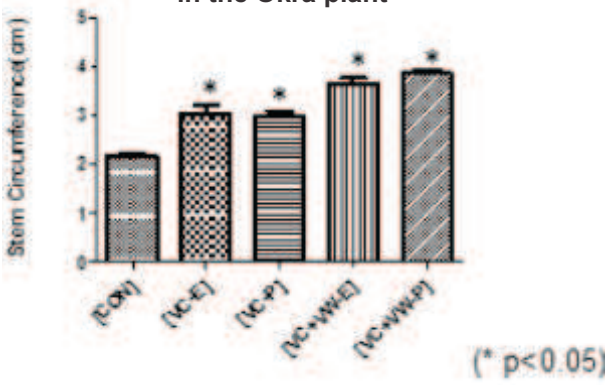


Fig 10. Impact of treatments on the stem circumference of the Okra plant

The use of bio-fertilizers (vermicompost and vermiwash) contribute macronutrients and micronutrients in the amount that is required by the plants. The rate of seed germination was highest, when the seeds were treated with vermicompost and vermiwash of *Eisenia fetida* and *Perionynx exacavatus* respectively, where all the 25 seeds sown, germinated by the 5th day (Table 2). Rajan and Murgesan 2012, also confirmed the beneficial effect of vermiwash on seed germination and yield of rice. The maximum time to germinate was taken by the seeds sown in the soil (control), followed by those treated with only the vermicompost of both the species respectively. The plants treated with vermicompost and vermiwash of *Eisenia fetida* showed maximum stem height and number of leaves when compared to plants treated with vermiwash and vermicompost of *Perionynx excavatus* (Table 3 & 4). Samadhiya (2013) also reported that when vermiwash was sprayed on the tomato plants they showed significant growth of plants i.e. increase in the length of leaves. The plants treated with vermicompost of *Eisenia fetida* and *Perionynx excavatus* showed better results respectively when compared to control (Table 3 & 4). Similar results, like positive effect of vermicompost on the growth and yield of strawberry, was reported by Arancon et. al., 2004. Kale (1998) also reported that when vermiwash was used as foliar spray it increased the growth and yield of anthuruim. The application of vermicomposts and vermiwash of *Perionyx* excavatus showed increase in the stem circumference, number of buds, flowers and fruits. It was followed by the plants treated with vermicompost and vermiwash of *Eisenia fetida*. When vermicompost of *Eisenia fetida* and *Perionynx excavatus* was added to the plant, it showed better results compared to control (Table 5). The above results were in corroboration with the earlier studies (Azarmi 2009, Ansari 2010 and Sinha 2009). Therefore, the increase in the growth and yield parameters of the Okra plants, treated with vermicompost and vermiwash (VC+VW), may be due to increase in the level of the absorbable macro and micronutrients. According to Lalitha et al (2000) application of organic fertilizer have an emphatic effect on plant growth and production. The vermicompost contained higher nitrate content which promoted better growth and yield, besides supplying plant nutrients. Vermicompost and vermiwash promotes humification, enzyme production and increased microbial activity which result in the production of plant growth regulators such as, auxins, gibberlins, cytokinnins etc. These may have promoted plant growth and yield (Zambare et. al., 2008). He also concluded that various enzymes, cocktail of protease, amylase increase and phosphatase in the vermicompost, and vermiwash stimulated the growth and yield of crops.

Conclusion :

The result of this research has indicated that the combined use of VC+VW serves to give better results when compared to [VC] of the two

earthworm species alone. However, [VC+VW-E] treated plants showed better growth in terms of seed germination, stem height and number of leaves but [VC+VW-P] treated plants showed better results in terms of stem circumference, number of buds, flowers and fruits.

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