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Effects of Liquid Amla Curd Organic Bio manure (LACOB) on Growth and Yield of Turnip *(Brassica rapa)*

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ABSTRACT

Crop cultivation is a most important sector of Indian economy. It gives growth to occupation and overall economy of India. The need of increased food production in most developing countries like India becomes an ultimate goal, to meet the dramatic expansion of their population. Biomanure increases the soil fertility naturally and does not affect the soil like chemical fertilizers. In this study, the relative effect of Liquid Amla Curd Organic Biomanure (LACOB) on the growth and yield of Turnip *(Brassica rapa subsp. rapa)*" was studied. The seeds of Turnip were treated with LACOB and their result was recorded after intervals. It was obsereved that plants treated with Liquid Amla Curd Organic Biomanure (LACOB) showed exceptional results in the morphological parameters as compared to controlled plants. The results further showed that the plant enactment with respect to biomass components such as Mean number of leaves, fruits weight, fresh shoot and root weight, dry shoot and root weight, shoot length and plant height were expressively influenced by used Biomanure. The total plant biomass was found to be higher with application of LACOB, DAP and control as compared to combination of them. Similar trend was noticed with respect to fruit weight Fresh shoot weight, Dry shoot weight and plant height which were found to be significantly higher 10.34gm/ fruit, 8.70gm/plant, 3.94gm/plant and 60cm/plant respectively. Bio-organic formulation LACOB has increasing level of growth than other treatments. So it can be concluded that LACOB can be best substitute for chemical fertilizer, which has proven positive effects on various crops with environmental sustainability.

KEY WORDS: *Bos indicus*, LACOB, Turnip, Amla, Environmental sustainability.

INTRODUCTION

Increasing population of the world has doubled the food demands and inundated the available land sources [1]. The need of increased food production in most developing countries becomes an ultimate goal, to meet the dramatic expansion of their population [2]. Among the major food crops, vegetables are the most important one by cultivation and consumption. The nutritional content of vegetables varies considerably as they contain a great variety of phytochemicals and antioxidant properties. Generally, vegetables are cultivated in all part of the world by using different inputs like chemical fertilizers, pesticides, organic fertilizers, Biomanure and bio-pesticides, etc. In recent days, the use of different organic fertilizers, Biomanure and bio-pesticides are being recommended not only to minimize the use of hazardous chemical inputs but also for sustainable crop production particularly in vegetables' cultivation [3].

Biomanure, in strict sense, is not fertilizer, which directly give nutrition to crop plants. These are cultures of microorganisms like bacteria, fungi, packed in a carrier material. Thus, the critical input in Biomanure is the microorganisms. They help the plants indirectly through better Nitrogen (N) fixation or improving the nutrient availability in the soil. In early 1900's, Hellriegal and Wilfarth demonstrated clearly that fixation of atmospheric nitrogen takes place in legumes. Although earlier in 1980s, Boussingault, a French agriculturist, provided the data to show that legumes are superior to cereals in furnishing the nitrogen to plant. Beijerinck, a Dutch scientist, in 1888 isolated root nodule bacteria, (*Rhizobium*) from root nodules of legumes. The cultured microorganisms packed in some carrier material for easy application in the field are called Biomanure. Biomanure is living microorganisms of bacterial, fungal and algae origin. Their mode of action differs and can be applied alone or in combination**.** The term "Biomanure" or more appropriately a "Microbial inoculants" can generally be defined as preparation containing live or latent cells of efficient strains of Nitrogen fixing, Phosphate solubilising or cellulolytic microorganisms used for application to seeds, soil or composting areas with the objective of increasing the number of such microorganisms and accelerate those microbial process which augment the availability of nutrients that can be easily assimilated by plants. Bio-fertilizer can provide an economically viable support to small and marginal farmers for realizing the ultimate goal of increasing productivity. Bio-fertilizer is low cost, effective and renewable source of plant nutrients to supplement chemical fertilizers. Microorganisms, which can be used as bio-fertilizer, include bacteria, fungi and blue green algae. These organisms are added to the *rhizosphere* of the plant to enhance their activity in the soil. Sustainable crop production depends much on good soil health. Soil health maintenance warrants optimum combination of organic and inorganic components often soil. Repeated use of chemical fertilizers destroys soil biota. In nature, there are a number of useful soil microorganisms that can help plants to absorb nutrients. Their utility can be enhanced with human intervention by selecting efficient organisms, culturing them and adding them to soils directly or through seeds [4].

Option of Biomanure is getting very popular as a choice for the replacement of synthetic fertilizer lowering the cost of crop production, enhancing the growth, development and crop yield by supplying and increasing the nitrogen availability and by producing certain substances like auxin, cytokinin and gibberellins, which are helpful in the growth of plants Microbial activity have vital role in agriculture because they are very important in the movement and availability of minerals essential for plant growth and ultimately lower the requirement of synthetic fertilizers [5].

Early humans recognised the edible value of many of *Brassica* species and through selection modified nearly every plant part to suit their needs. Such modifications include the compacting of the leaves to form a head, the root or stem to form a bulb, the inflorescence to form a curd or bunch and the seed to provide both oil and condiment. Species grown as oilseeds include *B. napus, B. juncea, B. rapa and B. carinata*. The vegetable *Brassicaceae* includes *B. napus* (rutabaga, Siberian kale), *B. Rapa* (Chinese cabbage, bok choy, pai-tsai, mizuna, Chinese mustard, broccoli raab and turnip), *B. oleracea* (cabbage, broccoli and cauliflower, Brussels sprouts, kohlrabi, collards and kale), *Raphanussativus* (radish), *Lepidiumsativum* (garden cress) and Nasturtium officinal (watercress). The condiment crops include B. juncea (brown and oriental mustard), Sinapis Alba (yellow mustard), *B. nigra* (black mustard, but now little used), Armoracia rusticana (horseradish) and *Eutrena japonica* (wasabi). There are a number of other minor potherbs and salad vegetables. There are numerous weedy species, but those of greatest interest with regard to cross-pollination with *B. napus* are *Sinapisarvensis* (wild mustard or charlock), *Raphanusraphanistrum* (wild radish), *B. rapa* (wild or bird rape) and *Hirschfeldiaincana* (hoary mustard) [6]. The fermented turnips (Ruebenkraut), belonging to this family, used to be a very important winter foodstuff. The importance of turnips in Alpine countries is shown by the fact that they were even shown on the coat of arms belonging to noble families. The domestication of the turnip has very ancient origins. The word laptu in ancient Assyrian dates back to 1800 BC [7].

The turnip is a very well-known vegetable in the entire Middle East (Arab: lift, Persian: salgham). In Ancient Greece and Rome the turnip was an important domesticated crop plant. The Greek philanthropist Theophrast (371 - 285 BC) called it gongylis and the roman sociologist Columella (35 - 65 AD) distinguished between the cultivation and conservation by lactic acid fermentation of *napus* and *rapa*, saying that *napus*only forms a tender root, whereas rapa has a thick stomach. *Plinius* (23 - 79 AD) described the varieties in ancient Rome, showing that the turnip was a favourite crop in mountainous regions of the Apennine and the Northern parts of Italy [8].

In present study, we focussed on effect of LACOB biomanure prepared *in-house* at Dept. of Biosciences, Shri Ram College, Muzaffarnagar with the following objectives

1. Screening and Collection of Liquid Amla Curd Organic Biomanure.
2. Production and analysis of LACOB.
3. Effects of LACOB and inorganic fertilizers on growth and yield of *Brassica rapa.*
4. To compare the phenotypic characteristic of turnip plant in normal v/s Biomanure germination/ Production.

The increasing concern for environmental safety and global demand for pesticide residue free food has induced extreme interest in crop production using eco-friendly products which are easily biodegradable and do not leave any harmful toxic residues besides conserving nature. So it is necessary to use natural products like bio-organic formulation to produce chemical residue free food crops and hence bioorganic formulation can play a major role in organic farming. The much work is needed for complete exploration of microbial flora in these formulations. The vegetables nutrients produced through Biomanure should be analyzed quantitatively as well as qualitatively. This type of study should be performed on other vegetables, fruits or crop plants to get the maximum output by maintaining soil health. Biomanure can also be a good growth booster in flowering plants as well as in shoot oriented vegetative crops. In future Biomanure can be a better substitute for organic production of medicinal plants and species for manufacturing of Ayurvedic drugs. Students can set up their own business by commercial production of LACOB by micro entrepreneurship model.

MATERIAL AND METHOD

The seed of turnip were obtained from Prakash chowk Muzaffarnagar marketplace (India). Turnip (*Brassica Rapa*) is one of the most important vegetable plants in the world. It originated in England, and domestication is thought to have occurred in Canada. Turnip has been widely used not only as food, but also as research material. Selection is based on importance of formulation:-

1. Preparation of fermented seed healer (FSH)

A plastic container of capacity 2kg was taken with air tight lid. Cow dung (1 kg), Cow urine (1 lit), calcium hydroxide [Ca $(OH)_2$] (20 g) and water (4 lit), put in the container. Mix all the material in container with a rod. The lid was closed and the material was mixed daily with a rod. It was allowed to ferment for 24 hours after which seed healer was ready to be used for seed treatment.

Table 1: Material for seed healer preparation and seed treatment

Material	kg/l	Material	Quantity
Plastic container	2 kg	Seed healer	1 litre
Cow dung	1 kg	Seeds	45
Calcium hydroxide	0.02kg	Paper	1
Water	4 litre	Cotton cloth	0.5 Meter
Cow urine	1 Litre	-	-

i) **Treatment of seed with seed healer:** Seeds were taken in cotton cloth and soaked in seed healer. The seeds are then dried on the paper and were allowed to germinate by placing them on 6 Petri plates carrying blotting paper soaked in water. The seeds treated were also germinated. Each Petri plate carried 5 seeds. The experiment was conducted in triplicates.

ii) **Measurement of germinated seeds:** Some water was sprinkled daily in Petri plates. Germination can be seen in Petri plates after one day of sowing. After seven days seeds were fully germinated. After the germination was complete, it is seen that the seeds with treatment are better than the control seeds.

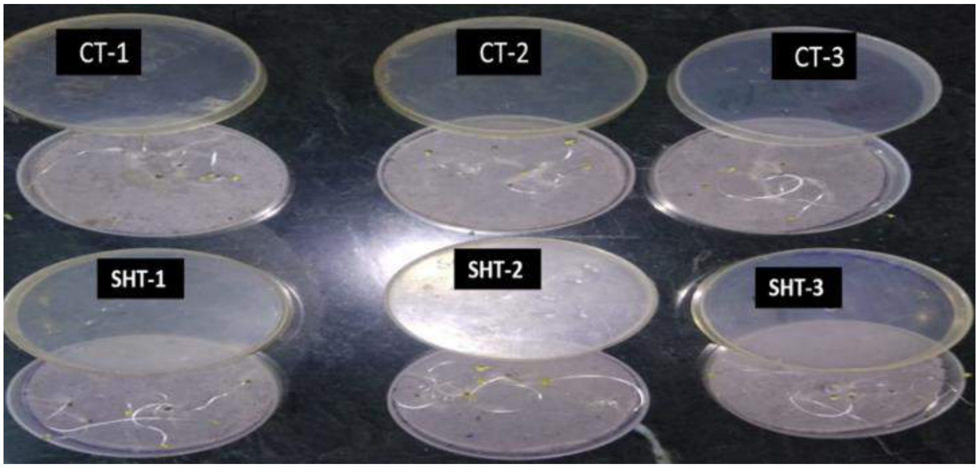

Fig 1: Germination of seeds in petri plates

Table 2: Germination of seed table

S. NO.	**Code of Petri plates**	**Total Seeds**	**Germinated Seed**
1.	Control Turnip-1	5	4
2.	Control Turnip-2	5	5
3.	Control Turnip-3	5	4
4.	Seed healer Turnip-1	5	5
5.	Seed healer Turnip-2	5	5
6.	Seed healer Turnip-3	5	4

Total percentage of germinated control turnip = 86.7

Average of Total percentage of germinated seed healer turnip = 93.3

2. Preparation of LACOB

A plastic container of 2.5kg was taken with air tight close lid. Amla slices (50 g) was taken and made into a paste.

One kg of fresh curd was poured into the container. The Indian Gooseberry paste was mixed in curd with the rod. The lid was closed and the container was labelled with date and name. The material was stirred daily with the help of a rod. It was allowed to ferment for 10-15 days and after obtaining nice sweet smell LACOB was ready to be used.

i) Preparation of pot soil and filling into the pots: Took 1/2 kg cocopite, 6 kg of soil and sand, 1kg cow dung by compost. All material was mixed with the hand and poured in the pots.

ii) Sowing of vegetable seeds in uniformly prepared pots: Seeds of turnip were sown, 2 each in 3 pots, seeds of turnip in 3 pots and into another 6 pots sow the seed from the 2-2 treatment seeds of turnip for the germination. Pour water in all pots. Now then pour water after 7 days in control turnip pots and into treatment turnip pots pour LACOB and into chemical turnip pots pour liquid urea (DAP). The pots were labelled with scientific name of turnip. Now then Mulching was done in treated turnip pots.

iii) Analysis of germinated seeds: After 1 month of sowing of germinated seeds, 4-5 small leaves were there and plant attained a height of 10-12 cm. Height and number of leaves increased and also the size of leaves increases. Seeds are grown in each pots but germinated 1-1 seed in each pots.

iv) Application of organic formulation with irrigation: Organic farms tend to be smaller on average and so their irrigation system should match their scope. It's hard to beat the simplicity of manual irrigation for a tiny organic farm- we can add water when it's needed and let the rain take care of the rest. But once our farm gets bigger, we'll almost certainly need to consider alternatives to manual labour.

RESULTS

3 Effect of different treatment based bio enhancers on the growth of turnip plant

Doses of respectively different treatment based bio enhancers labeled as (water 1, 2 and 3), (LACOB1, 2 and 3), and (DAP 1, 2 and 3) shows the effect of different doses of different waste on the growth of turnip plant. Different doses show different results with turnip plants the effect was studied in the following forms (Fig 2).The number of leaves increased and also the size of leaves increased. The plant that were grown in LACOB has better growth in comparison to plant grown in control and urea. Bio-organic formulation LACOB has increased level of growth than other treatments such as urea and control.

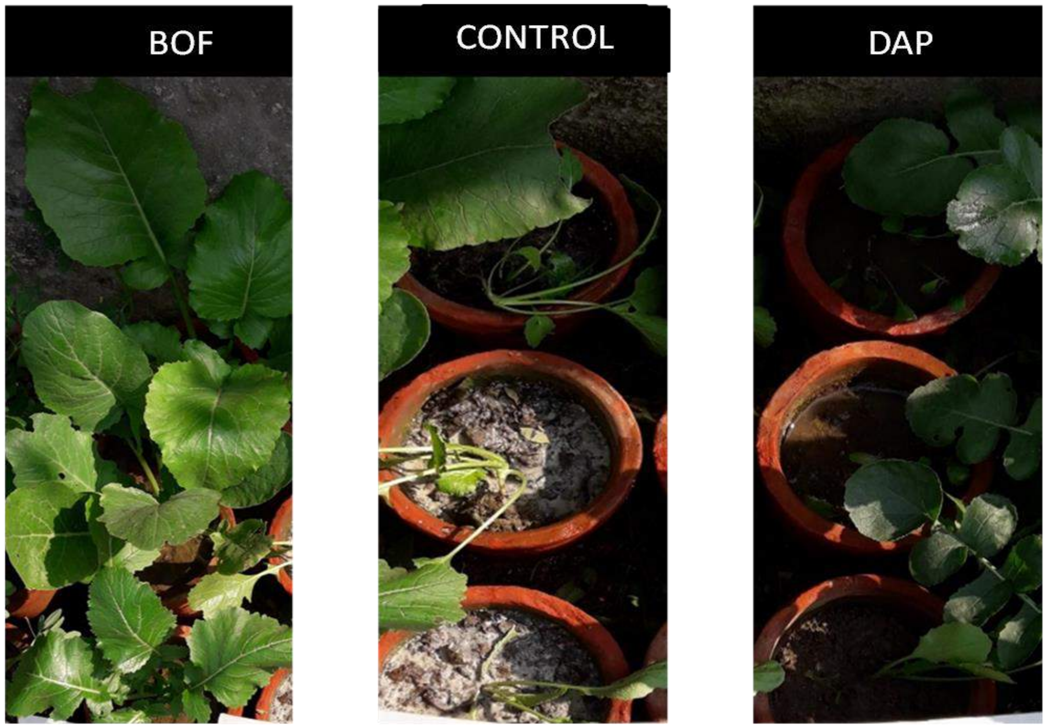

Fig 2: Growth of Turnip plant after 60 days from sowing

4. Observation of plant growth

The plant growth with different treatment tabulation of plant growth parameters on treatment with Biomanure and DAP

Table: 3 Mean tabulation of First and second observation after sowing 15 and 30 days

Sets	First observation				Second observation			
	NL	SS	GS	PH	NL	SS	GS	PH
Control	4.6	2	1	9.33	5	2	1	11.33
BOF	6.33	2	1	11.16	5.33	2	1.66	19.00
DAP	4.6	2	1	7.74	2.33	2	1.66	4.16

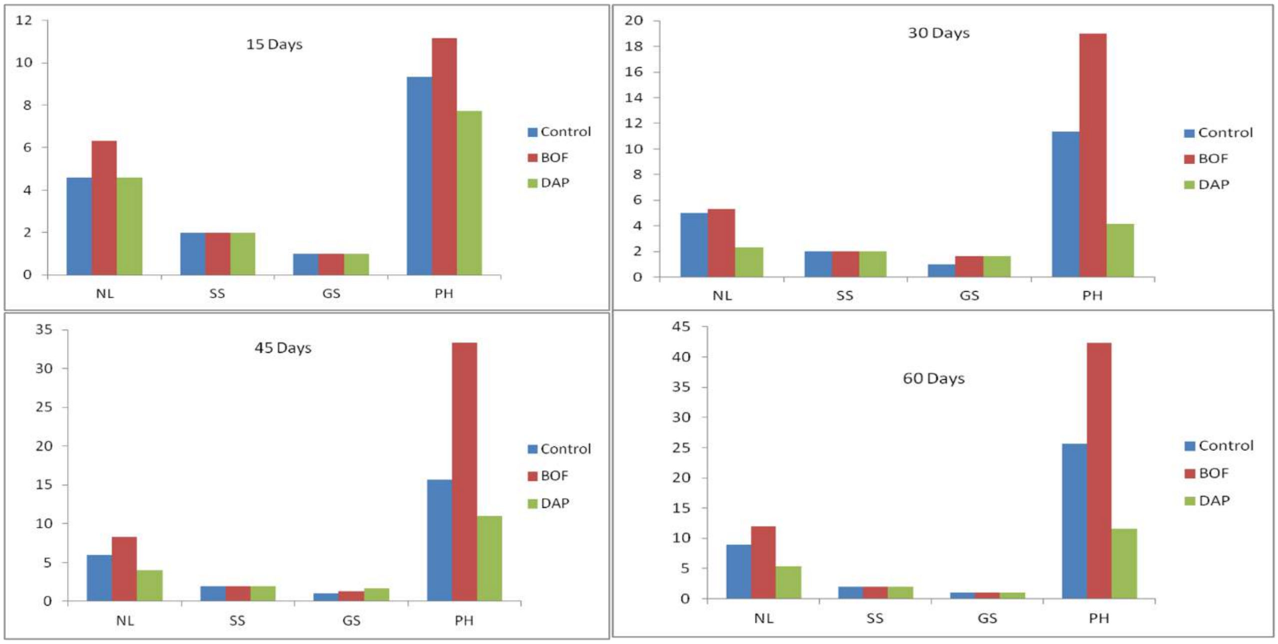

Fig.13: Bar graph representing mean of all observations

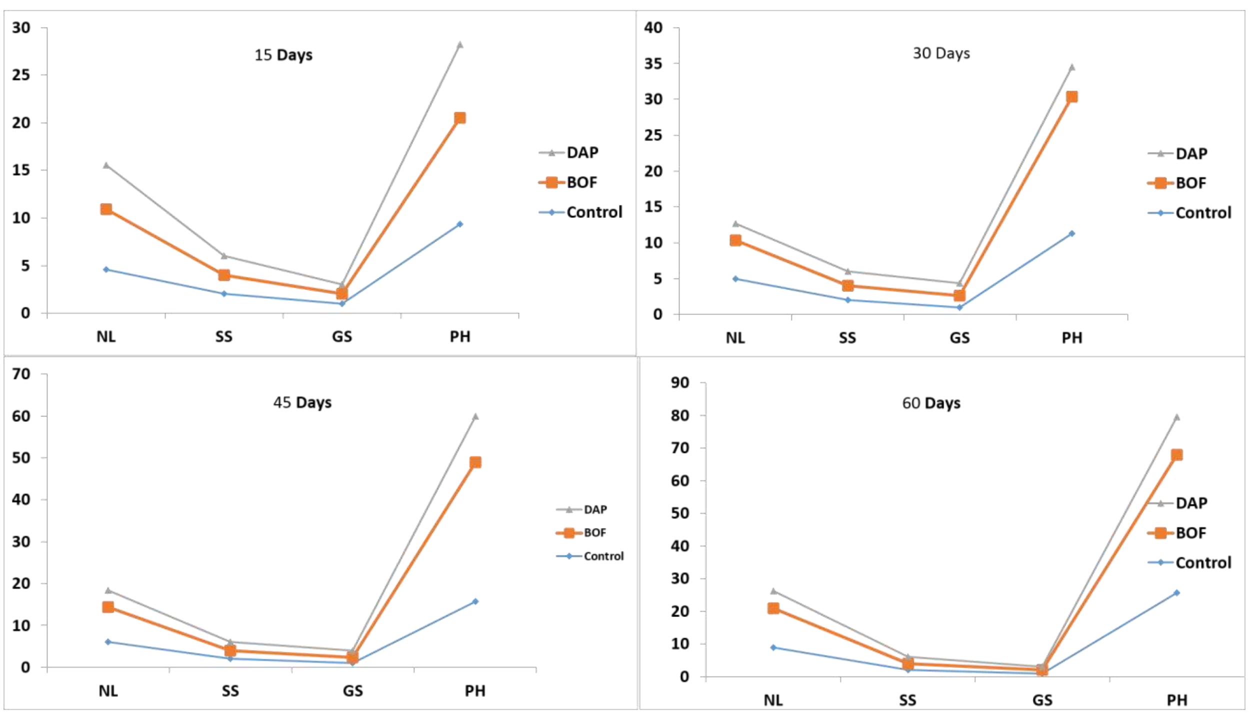

Fig.14: Line graph representing mean of all observations

Table: 9.1 Mean tabulation of third and fourth observation after sowing 45 and 60 days

Sets	Third observation				Fourth observation			
	NL	SS	GS	PH	NL	SS	GS	PH
Control	6.00	2	1	15.66	9.00	2	1	25.66
BOF	8.33	2	1.33	33.33	12.00	2	1	42.33
DAP	4.00	2	1.66	11.00	5.33	2	1	11.66

Table: 11. Final observation of fresh turnip

TREATMENTS		CONTROL	BIOMANURE	UREA(DAP)
S.NO.	**INPUT**	**Quantity**	**Quantity**	**Quantity**
1.	Leaf size	6cm	16cm	2.5cm
2.	Leaf length	25cm	45cm	13cm
3.	Arial part	9cm	25cm	5cm
4.	Root length	15cm	13cm	3cm
5.	Root hair	4	10-12	15-16
6.	Root width	6cm	1.5cm	0.4cm
7.	No. of leaf	9	13	6
8.	Full plant size	40cm	60cm	18cm
9.	Fresh weight	14.48g	136.26g	1.21g
10.	Stem weight	0.86g	8.70g	0.15g
11.	Arial part weight	0.80g	9.10g	0.18g
12.	Root weight	1.18g	10.34g	0.04g
13.	Leaf weight	1.63g	17.74g	0.36g

There is increase in fresh biomass in combined application was 14.48g, 136.26g and 1.21g in control, Biomanure and urea (DAP) respectively. Hence, we conclude that the fresh weight of Biomanure is better than the fresh weight of control and urea (DAP).

Table: 11. Final observation of dry turnip

TREATMENTS		CONTROL	BIOMANURE	UREA DAP)
S.NO.	**INPUT**	**Quantity**	**Quantity**	**Quantity**
1.	Leaf size	6cm	16cm	2.5cm
2.	Leaf length	25cm	45cm	13cm
3.	Arial part	9cm	25cm	5cm
4.	Root length	15cm	13cm	3cm
5.	Root hair	0	10-12	15-16
6.	Root width	6cm	1.5cm	0.4cm
7.	No. of leaf	9	13	6
8.	Full plant size	40cm	60cm	18cm
9.	Dry weight	2.96g	62.25g	0.12g
10.	Stem weight	0.02g	3.94g	0.01g
11.	Arial part weight	10.11g	1.55g	0.00g
12.	Root weight	0.20g	3.21g	0.01g
13.	Leaf weight	10.31g	5.62g	0.02g

There is increase in dry biomass in combined application was 2.96g, 62.25g and 0.12g in control (CL), Biomanure (BM) and urea (DAP) respectively. Hence, we conclude that the dry weight of Biomanure is better than the dry weight of control and urea (DAP).

Table: 13. Mean table of turnip observation after 60 days

Sets	NL	FN	SF wt. (gm)	RF wt. (gm)	SD wt. (gm)	RD wt. (gm)	RL	NS	PH
Control	7.2	1	0.86	1.18	0.02	0.2	13	6.53	9
BOF	20.13	1	8.7	10.34	3.94	3.21	15	17.06	25
DAP	5.36	1	0.15	0.04	0.01	0.01	3	6.13	5

The plant of turnip which are treated with Biomanure have better mean no. of leaves, mean no. of shoots, fresh weight, dry weight and plant height in comparison to the plant which are treated with urea and water.

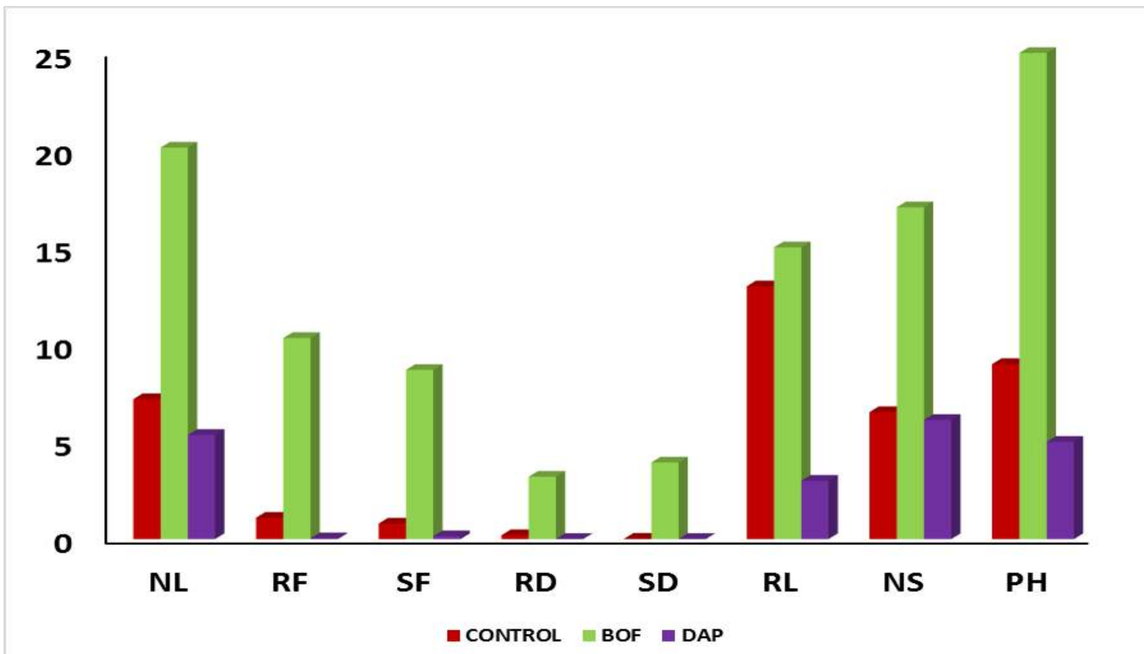

Fig.14: The following values are tabulated by taking mean of replicates on optimal concentration i.e. water (2 litre), Bio-manure (100ml) and urea (10g). Abbreviated words are as mean no. of leaves (NL), shoot weight dry (SD) and fresh (SF), root length (RL), root weight dry (RD) and fresh (RF), mean no. of shoot (NS), plant height (PH).

Mean number of leaves is better in high concentration of LACOB (20.13) other treatments urea and control. Dry shoot weight output is better in LACOB (3.94) than other treatments urea and control. Fresh shoot weight is also increasing by applying LACOB (8.70) other treatments urea and control. Root length is better in LAOB (15cm) other treatments urea and control. Number of fruits output is better in LACOB than other treatments urea and control. Dry root weight is also increasing by applying LACOB (3.21) other treatments urea and control. Fresh root weight is also increasing by applying LACOB (10.34) other treatments urea and control. Plant height is better in LAOB (25cm) other treatments urea and control.

Conclusion

From the above enumeration, it can be concluded that bio enhancers could be a potent source to improve soil fertility, crop productivity and quality. This can also be a potential alternative for fertilization which is becoming common in most of the crops. However, care should be taken that bio enhancers which are used in limited quantities cannot meet the entire nutrient requirement of the crops. These simply catalyze quick decomposition of organic wastes in to humus, hence incorporation of enough bio mass preferably combination of plant and animal product, which is prerequisite for improving soil fertility and crop productivity. Combined with manures and frequent use of bio enhancers can address many challenges of agriculture and will be surface way for sustainable agriculture through organic resources. It acts as manure for soil and plants. LACOB was best ten seed treatment as observed in comparison to other treatments. Bio-organic formulation LACOB has increasing level of growth than other treatments. Mean number of leaves is better in high concentration of LACOB (20.13) other treatments. Number of fruits output is better in LACOB than other treatments urea and control. Fruits weight is also increasing by applying LACOB (10.34) than other treatments with control. Fresh shoot weight is also increasing by applying LACOB (8.70) other treatments urea and control. Dry shoot weight output is better in LACOB (3.94) than other treatments urea and control. Plant height is better in LACOB (60cm) in comparison to other treatments.

DISCUSSION

The present study was carried out in an attempt to elucidate the effect of LACOB and study its effect on vegetative and reproductive growth of pot cultured turnip plant. LACOB showed significant and consistent improvement in vegetative growth and also significantly increased the weight of root and number of leaves at different intervals throughout the period of experiments as compared to the control indicating its potent growth stimulating activity. These evidences tempt us to speculate that apart from the aforementioned probable LACOB action, the other possible mechanism i.e. development of disease resistant in turnip might be contributed to free microbial metabolites of LACOB solution. The result is in accordance with the previous results conducted with LACOB and extract of leaves further suggesting that the available form of active principles in LACOB and higher arriving water in plant system might be contributing in the regulation of plant growth. Taken together, it can be summarized as LACOB might possess both vegetative and reproductive stimulation mechanisms in it actions and such apparent dual action of LACOB would be more advantageous to the other existing commercial organic inputs.

The results adding both levels of organic manure (Nile compost) significantly increased the different growth characters expressed as (plant length, number of leaves /plant, fresh and dry weight of leaves/plant) in 2011 and 2012 experiments, except fresh weight of leaves /plant at 2012 experiment was not significant. The highest values of the growth characters of turnip plant were resulted by adding high level of organic manure (20 m^3 /fed.). However, the differences between (10 and 20 m^3 compost/fed.) were significantly increased by high level of compost manure addition (20m^3 /fed.) compared low level (10m3 /fed.) and without addition (control). In addition, organic manure fertilizer usually improve the physical and chemical properties of soil, plant nutrition, better vegetative growth and increased quantitative and qualitative characteristics of vegetable crops. It could be concluded that, the increasing plant growth characters by increasing levels of organic manure fertilizer it might be concluded that the addition of high level of organic manure to turnip plant caused an increase of the nutritional elements in rooting zone, and also due to increased availability of nutrients especially N, P, K, Zn, Fe and Mn even from the early stage of crop growth. Consequently the more nutrients were absorbed so more and enhancement of plant growth characters. Similar results were obtained by Mokadem (2000) [10] and Heba and Sherif (2014) [11] on sugar beet, Shafeek et al (2003)[12] on Japanese radish and El-Sherbeny et al (2012) [13] on turnip plant.

In this results showed that application of Humic acid significantly influenced plant length, number of leaves /plant, fresh and dry weight of leaves /plant (Table 3). However, by increasing rate of humic acid increased growth characters in both seasons. The statistical analysis also showed that the medium and high levels of humic acid (4or 6 L/fed.) significantly increased all growth characters compared to the low level (2 L/fed.). In the same respect, the application of high level of humic acid (6 L/fed.) significantly increased all growth characters compared to the medium level (4 L/fed.). The manifold significance of humic acid application to plants is now well established. The application of humic acid has significant beneficial effect on the growth and yield of mustard David and Samule,[14]. Also, Rao et al. [15] (2002) reported such results in case of increased dry matter yields of mustard. Similarly, Albayrak [16] reported that humic acid significantly affected most of the yield components of turnip Brassica raya. In another study, Chris et al. [17] reported that both the foliar and soil application of humic acid significantly improved seed yield and oil content of mustard. However, MacCarthy et al. [18] concluded that humates enhance nutrient uptake, improve soil structure, and increase the yield and quality of various crops. Researchers also found lower dose of humic acid equally effective to their higher levels in increasing plant growth and enhancing the nutrient uptake [19]. Humic acid was influence plant growth both in direct and indirect ways. Indirectly, it improves physical, chemical and biological conditions of soil. While directly, it increases chlorophyll content, accelerates plant respiration and hormonal growth responses, increases penetration in plant membranes, etc. These effects of humic acid operate singly or in integration. The above discussion clearly validates the suitability of humic acid as a beneficial fertilizer product.

The interaction effect of adding organic compost with humic acid levels on the turnip plant growth characters Table (3) recorded that all increasing the levels of organic compost and humic acid increased all plant growth characters compared to all concentrations treatments but these increased non significant in the two studied seasons. On the contrary, the poorest turnip plant growth characters was associated with that plants received without compost manure with low level of humic acid adding (2 L/fed.). These results were consequently similar in both experimental seasons.

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