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GROWTH OF *VIGNA RADIATA* AS AFFECTED BY APPLICATION OF COMPOST AND BIOGAS SLURRY

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ABSTRACT

To feed the ever-increasing population, crop productivity should be increased. It will consume more and more chemical fertilizers which will pollute our environment at great risk. Besides chemical fertilizers, essential plant nutrients can be supplied through Bio-digested slurry, compost and biochar. In the present study, *Datura stramonium*, *Jatropha curcas* and *Lantana camara* plants were degraded anaerobically, aerobically and mechanically to produce Bio-digested slurry, compost and biochar. These products were analysed for their plant nutrient status and applied in different combinations to grow *Vigna radiata* in pots having nutrients deficient soil. At 20, 40 and 60 Days After Sowing, plants were analysed for various growth parameters and found that root length, shoot length, leaf number, nodule number and dry & fresh weight of roots, shoots and leaves were found statistically significant in treatment receiving compost prepared from *Jatropha curcas* + *Lantana camara* + *Datura stramonium* and Mixed Biochar at 20, 40 and 60 Days After Sowing. The study concludes that application of compost may be a good substitute of chemical fertilizers to *Vigna radiata.*

Keywords: Biogas slurry, Compost, Plant growth, *Vigna radiata*

INTRODUCTION

As we know globally people are trying to find a better alternative of chemical fertilizers. Biogas production is a renewable source that is highly in demand on a global scale. Biogas production helps to reduce the consumption of fossil fuels **[1]**. Biogas is produced from agro-waste, sewage sludge, and industrial waste of various capacities. Biogas slurry is widely used in agricultural fields as liquid fertilizer. Biogas slurry significantly improved plant growth **[2-4]**. Biogas slurry mixed with the different microbial consortiums gives quality crop nutrients as well as yield. A global-level investigation has proven that biogas slurry has been cost-effective for farmers. Long-term usage of the slurry may change the soil microbial community from low-to highly active-performing microorganisms. Aerobic digestion (composting) of organic waste and its utilization in the agricultural field is the oldest practice in the agricultural field. Compost application has also shown a significant impact on the control of plant diseases. For a few years, researchers found the inhibition effect of compost on soil-borne pathogens **[5-8]**. High-nutrient-value compost stays stable for longer periods and releases available nutrients for the crop. Plants' growth parameters are highly dependent on the dosage of slurry. The *Vigna radiata* crop is most usable in India as well as other countries. It is rich in protein and other nutrients. *Vigna radiata* plants require nitrogen (20 kg/ha) and phosphorus (40 kg/ha). The present study was carried out with aim to investigate the effect of chemical as well as organic fertilizers viz. biogas slurry and compost application on plant growth parameters **[9-12]**.

MATERIALS AND METHODS

Separate anaerobic and aerobic degradation of *Datura stramonium*, *Jatropha curcas*, *Lantana camara*, and buffalo dung produced Biogas-digested slurry and compost, respectively. Simultaneously biochar was also produced from *Datura stramonium*, *Jatropha curcas*, and *Lantana camara* with the traditional kiln method based on the pyrolysis principle. **Table 1** shows the nutritional properties of biogas-digested slurry, compost and dung analysed by standard methods viz. pH **[13]**, EC **[13]**, available nitrogen **[14]**, available phosphorus **[15]**, total organic carbon **[16]**, available potassium **[15]**, available sodium, micronutrient Zn **[17]**, and Cu **[17]**.

To keep the experimental error minimum by keeping effect of other sources constant except treatments, in completely randomized design, a homogenous nutrient deficient farm soil was used for pot experiment. Physico-chemical properties of soil analysed by standard methods viz. available nitrogen **[14]**, and available phosphorus **[15]** is listed in **Table 2**.

Biogas-digested slurry and compost were mixed with soil as per the treatment combinations followed by sowing of seeds of *Vigna radiata*.

Treatments detail-

The experiment was carried out with nine treatments in three replications, as follows:

T_1- Control

T_2- Chemical Fertilizer

T_3- Biogas slurry prepared from *Datura stramonium*

T_4- Biogas slurry prepared from *Datura stramonium*, *Lantana camara* and Dung

T_5- Biogas slurry prepared from *Datura stramonium, Jatropha curcas* and *Lantana camara*

T_6- Biogas slurry prepared from *Datura stramonium, Jatropha curcas, Lantana camara* and Dung

T_7- Biogas slurry prepared from *Jatropha curcas, Lantana* camara and Dung

T_8- Compost prepared from *Jatropha curcas, Lantana camara, Datura stramonium* and Mixed Biochar

T_9- Compost prepared from *Jatropha curcas* and Dung.

Sampling and observations recorded-

Plant samples were collected at 20DAS (days after sowing), 40DAS and at harvesting time. Plant growth parameters viz., number of leaf and nodule, length of shoot and root, and fresh and dry weight of shoot, root and leaf were recorded.

Statistical analysis

Obtained data were analysed statistically following Completely Randomized Design and significance was recorded at 1 and 5% levels of significance as per the method suggested **[18]**.

RESULTS

Table 1 represents the data of physic-chemical parameters of biogas digested slurry, compost and dung used in the experiment. It is clear that all the three fertilizer sources used viz. biogas-digested slurry, compost and dung have alkaline pH. Data further shows that content of all the physico-chemical properties was found higher in compost, except EC values, compared to other two sources.

To find out nutrient-deficient soil for experimentation, 10 soils from different locations of Gujarat were collected and screened for available nitrogen and phosphorus content. Data shows **(Table 2)** that the soil sample collected from Ahmedabad, Gujarat, was deficient in nitrogen and phosphorus; hence the required amount of soil for the pot experiment was collected from this site, homogenized and used for pot experiment.

Table 3 demonstrates that all treatments showed good growth at 20 DAS of the experiment. Leaf numbers, shoot length, leaf and shoot fresh and dry weight were non-significant at CD1% and CD5% at 20 DAS. Number and fresh & dry weight of leaf were found maximum in T_8 whereas length and fresh and dry weight of shoot was recorded highest in T_5, although statistically all the treatments were at par among themselves for these parameters.

Root length, root fresh weight, root dry weight, and nodule number were significant at 1%, in which for root length, except T_8 all other treatments were non-significant between themselves. Furthermore, in root fresh weight, T_1 and T_2 were observed non-significant between themselves. The highest root length, root fresh weight, root dry weight, and nodule number were found in T_8. The lowest root length, root fresh weight, root dry weight, and nodule number were found in T_5 as 3.8cm, T_1 0.93g, T_1 0.31g and T_7 0.7. For dry weight of root T_2, T_3, T_4, T_9 were determined non-significant between themselves, and for nodule number T_1, T_2, T_3, T_4, T_6, T_7, and T_9 treatments were found non-significant between themselves.

At 40 DAS, the leaf number of all treatments was non-significant at 1% and 5% levels **(Table 4)**.

Fresh and Dry weight of leaf were significant at 5% and 1% levels, respectively. Moreover, for leaf fresh weight treatments T_1, T_3, T_4, T_6, T_7, T_9 and for dry weight treatments T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_9 were recorded non-significant between themselves. The lowest fresh and dry weight of leaf observed in T_9 was 4.0g and 1.8g, respectively. The highest leaf fresh and dry weight found in T_8 was 5.7g and 3.0g, respectively. The shoot length and fresh weight of shoot were found significant at 1% level. Shoot dry weight was significant at a 5% level and non-significant at a 1% level. For shoot length treatments T_1, T_3, and T_7, for shoot fresh weight treatments T_1, T_3, T_9 and for shoot dry weight treatments T_1, T_3, and T_9 were found non-significant between themselves.

The root length, root fresh and dry weight, and nodule number were significant at a 1% level. For root length treatments T_1, T_2, T_3, T_4, T_5, T_6, T_7, and T_9 were found non-significant between themselves. For root fresh weight treatments T_1, T_2, T_3, and T_4 and for root dry weight treatments T_1, T_2, T_3, T_4, T_7, and T_9 were observed non-significant between themselves.

Biochar-amended compost helps plants uptake nutrients from the soil. Root growth and nodule numbers are an important part of crop because it is directly connected to the soil. In comparison to other treatments, T_8 showed significant changes viz., 10.6cm (root length), 3.50g (root fresh weight), 1.77g (root dry weight) and 16.3(nodule number), respectively. For nodule number treatments T_1, T_2, T_3, T_5, T_6, T_7, and T_9 were observed non-significant between themselves.

Table 5 represents the data regarding plant growth parameters at harvest time. The leaf and nodule number, leaf fresh and dry weight, shoot length, shoot fresh weight, root length, root fresh and dry weight all were found significant at 1%. Furthermore, for leaf number treatments T_1, T_2, T_3, T_4, T_6, and T_7; for leaf fresh weight treatments T_1, T_2, T_3, T_4, T_6, T_7, and T_9; for leaf dry weight treatments T_1, T_2, T_3, T_4, T_6, T_7, and T_9; for shoot length treatments T_1, T_3, T_7; for shoot fresh weight treatments T_1 and T_3; for root length treatments T_1, T_2, T_3, T_4, T_6, and T_7; for root fresh weight treatments T_1, T_2, T_3, T_4, T_6, T_7, and T_9; for root dry weight treatments T_1, T_2, T_3, T_4, T_6, T_7, and T_9 and for nodule number treatments T_1, T_2, T_3, T_6, T_7, and T_9 were observed non-significant between themselves.

Shoot dry weight was the only parameter significant at the 5% level, but treatments T_1, T_3, and T_9 were found non-significant between themselves.

Overall, all the treatments affect plant growth. Treatment T_8 shows either highest or at par with highest values for all the plant growth parameters at 20DAS, 40DAS and at harvesting. The lowest results were noted in T_1 and T_2: Control and chemical fertilizer-amended soil.

Biogas slurry and compost-amended soil stored the nutrients for longer periods. The difference between control, compost, and biogas slurry applied to pots was clearly noticed. Biochar's hollow characteristics help microbes find habitat.

Table 1: Physico-chemical properties of biogas slurry, compost and dung

Fertilizer sources	pH	Electric conductivity (ms/ppt)	Available Nitrogen (%)	Available phosphorus (%)	Total organic carbon (%)	Available potassium (%)	Available sodium (%)	Zn (ppm)	Cu (ppm)
BS 1	7.4	1.40	0.70	0.0058	3.43	0.063	0.053	0.117	0.09
BS 2	8.0	1.49	0.77	0.0064	0.90	0.088	0.081	0.185	0.11
BS 3	8.3	1.99	1.01	0.0071	1.98	0.069	0.076	0.161	0.15
BS 4	8.1	1.79	0.95	0.0087	2.35	0.073	0.076	0.186	0.10
BS 5	8.2	1.94	0.96	0.0090	1.98	0.069	0.074	0.180	0.22
Compost 1	8.7	0.30	1.47	2.0975	70.97	2.065	2.055	21.67	5.34
Compost 2	8.1	0.15	0.32	2.5179	22.88	0.980	0.975	7.27	1.67
Dung	8.1	2.08	0.66	0.4012	40.56	0.704	0.351	-	-

BS-Biogas Slurry

Table 2: Screening of soil

Nutrients (kg/ha)	S.S-1	S.S -2	S.S -3	S.S -4	S.S -5	S.S -6	S.S -7	S.S -8	S.S -9	S.S -10
Nitrogen	128.6	155.2	126.1	82.8	23.2	16.9	43.9	19.4	146.8	106.3
Phosphorus	28.8	30.5	38.2	31.4	29.7	32.2	33.9	33.9	35.6	51.7

S.S-Soil Sample, S.S-1-4: Farm soil collected from various locations in Sadra, Gandhinagar, Gujarat; S.S-5- the soil of river bank area collected from Sadra, Gandhinagar, Gujarat; S.S-6, 9 and 10- Farm soil collected from various locations of Ahmedabad, Gujarat; S.S-7- Near-by campus soil collected from Sadra, Gandhinagar, Gujarat; S.S-8- waste-land soil collected from Ahmedabad, Gujarat

Table 3: Biogas slurry and compost effect on plant growth parameter at 20 DAS

Treatment	Leaf number	Leaf fresh weight (g)	Leaf dry weight(g)	Shoot length (cm)	Shoot fresh weight (g)	Shoot dry weight (g)	Root length (cm)	Root fresh weight (g)	Root dry weight (g)	Nodule number
T_1	6.3	2.7	1.2	14.1	4.5	2.2	4.5^{ab}	0.93^{a}	0.31	0.7^{a}
T_2	7.8	3.9	1.7	14.9	4.9	2.5	4.3^{ab}	1.20^{ab}	0.62^{ab}	1.0^{a}
T_3	7.3	3.2	1.5	13.0	4.2	2.2	5.2^{ab}	1.28^{b}	0.57^{a}	0.8^{a}
T_4	8.5	4.0	1.7	15.8	5.6	2.7	5.2^{ab}	1.42^{b}	0.55^{a}	1.5^{ab}
T_5	8.0	3.8	1.8	17.0	7.4	3.8	3.8^{a}	2.12^{e}	1.03^{d}	3.7^{bc}
T_6	7.8	3.5	1.5	17.0	6.2	3.2	4.8^{ab}	1.84^{de}	0.86^{cd}	1.8^{ab}
T_7	7.3	3.0	1.2	15.8	6.7	3.2	4.4^{ab}	1.74^{cd}	0.76^{bc}	0.7^{a}
T_8	9.5	5.3	2.6	14.5	5.8	2.7	6.8^{c}	3.00	1.70	4.5^{c}
T_9	8.0	3.7	1.6	16.3	5.4	2.9	5.7^{bc}	1.45^{bc}	0.63^{ab}	1.0^{a}
SEM (±)	1.1	0.8	0.4	1.3	1.2	0.7	0.5	0.11	0.07	0.9
CD5%	NS	NS	NS	NS	NS	NS	1.1	0.23	0.15	1.8
CD1%	NS	NS	NS	NS	NS	NS	1.5^{**}	0.31^{**}	0.20^{**}	2.5^{**}

Note: The same alphabet denotes that the treatments are non-significant between themselves. NS- non-significant. **- Significant at 1% level

Table 4: Biogas slurry and compost effect on plant growth parameters at 40 DAS

Treatment	Leaf number	Leaf fresh weight (g)	Leaf dry weight (g)	Shoot length (cm)	Shoot fresh weight (g)	Shoot dry weight (g)	Root length (cm)	Root fresh weight (g)	Root dry weight (g)	Nodule number
T_1	12.3	4.6^{ab}	2.4^{ab}	27.8^{ab}	7.6^{a}	3.7^{a}	8.5^{ab}	1.36^{a}	0.62^{a}	6.2^{a}
T_2	14.3	5.2^{bc}	2.3^{ab}	42.3^{cd}	12.1^{c}	6.1^{bc}	6.2^{a}	1.36^{a}	0.65^{a}	6.8^{ab}
T_3	11.8	4.1^{a}	1.9^{a}	25.2^{a}	6.9^{a}	4.6^{ab}	6.2^{a}	1.37^{a}	0.66^{a}	7.5^{ab}
T_4	14.0	4.6^{ab}	2.1^{a}	35.7^{bc}	11.6^{bc}	5.9^{bc}	7.1^{a}	1.47^{a}	0.67^{a}	10.2^{b}
T_5	14.8	5.2^{bc}	2.6^{ab}	39.2^{cd}	13.3^{c}	6.4^{c}	8.6^{ab}	2.97	1.17^{b}	15.8^{c}
T_6	13.2	4.0^{a}	1.9^{a}	45.2^{d}	13.4^{c}	6.5^{c}	7.0^{a}	2.30	1.23^{b}	8.7^{ab}
T_7	13.8	4.3^{ab}	1.8^{a}	33.2^{ab}	11.6^{bc}	5.7^{bc}	6.8^{a}	1.78^{b}	0.79^{a}	7.7^{ab}
T_8	16.2	5.7^{c}	3.0^{b}	44.8^{d}	13.4^{c}	6.5^{c}	10.6^{b}	3.50	1.77	16.3^{c}
T_9	13.2	4.0^{a}	1.8^{a}	35.9^{bc}	9.1^{ab}	4.6^{ab}	8.8^{ab}	1.79^{b}	0.76^{a}	8.5^{ab}
SEM (±)	1.4	0.5	0.3	2.8	1.0	0.8	0.9	0.09	0.07	1.3
CD5%	NS	1.0^{*}	0.6	5.9	2.1	1.7^{*}	2.0	0.19	0.15	3.9
CD1%	NS	NS	0.8^{**}	8.1^{**}	2.9^{**}	NS	2.7^{**}	0.26^{**}	0.21^{**}	5.3^{**}

Note: The same alphabet denotes that the treatments are non-significant between themselves. NS- non-significant. **- Significant at 1% level, *-Significant at 5% level.

Table 5: Biogas slurry and compost effect on plant growth parameters at harvesting

Treatment	Leaf number	Leaf fresh weight (g)	Leaf dry weight (g)	Shoot length (cm)	Shoot fresh weight (g)	Shoot dry weight (g)	Root length (cm)	Root fresh weight (g)	Root dry weight (g)	Nodule number
T_1	13.5^{a}	5.3^{a}	2.7^{a}	30.1^{a}	9.0^{ab}	5.0^{ab}	9.5^{ab}	1.77^{a}	0.69^{a}	6.3^{a}
T_2	15.8^{ab}	7.7^{a}	3.8^{a}	43.9^{cd}	13.3^{cd}	6.1^{cde}	7.1^{a}	1.62^{a}	0.55^{a}	7.3^{ab}
T_3	14.2^{ab}	5.4^{a}	2.7^{a}	29.5^{a}	7.2^{a}	4.7^{a}	7.6^{a}	1.75^{a}	0.82^{a}	7.7^{ab}
T_4	16.8^{ab}	7.3^{a}	3.5^{a}	42.7^{cd}	11.7^{c}	5.9^{bcd}	8.4^{a}	1.72^{a}	0.78^{a}	10.5^{b}
T_5	22.3^{cd}	11.7^{bc}	5.8^{b}	46.2^{d}	14.4^{d}	6.9^{e}	12.8^{c}	3.15^{bc}	1.37^{bc}	16.0^{c}
T_6	16.8^{ab}	7.8^{a}	3.5^{a}	45.2^{d}	13.5^{cd}	6.6^{de}	8.1^{a}	2.44^{ab}	1.04^{ab}	9.5^{ab}
T_7	15.8^{ab}	6.5^{a}	3.0^{a}	35.3^{ab}	11.6^{bc}	5.7^{bcd}	8.6^{a}	1.85^{a}	0.93^{ab}	8.3^{ab}
T_8	25.2^{d}	15.3^{c}	7.4^{b}	47.7^{d}	15.3^{d}	7.9	13.5^{c}	3.70^{c}	1.82^{c}	16.5^{c}
T_9	18.8^{bc}	8.8^{ab}	3.8^{a}	38.7^{bc}	11.7^{c}	5.2^{abc}	11.6^{bc}	2.05^{ab}	1.04^{ab}	9.0^{ab}
SEM (±)	1.7	1.3	0.6	2.2	0.9	0.3	1.0	0.42	0.17	1.1
CD5%	3.5	2.8	1.4	4.6	1.9	0.7^{*}	2.1	0.88	0.36	2.7
CD1%	4.8^{**}	3.8^{**}	1.9^{**}	6.3^{**}	2.6^{**}	0.9	2.9^{**}	1.20^{**}	0.50^{**}	3.7^{**}

Note: The same alphabet denotes that the treatments are non-significant between themselves. NS- non-significant. **- Significant at 1% level, *-Significant at 5% level.

DISCUSSION

Significant effects of composting of *Lantana camara* weed plant on plant growth and soil health is reported earlier **[19]**. Higher seed germination, chlorophyll level, and seed growth in composted *Ageratina adenophora* was observed compared to un-composted one **[20]**. Significant growth of *Vigna mungo* in treatment receiving composted fruit wastes was observed **[21]**. Similarly highest crop yield in treatment receiving biogas slurry, compared to other chemical fertilizers was also reported **[22]**. The root length of *Vigna radiata* at 20 DAS **[23]**, plant height at 40DAS and at harvesting time **[24]**, and shoot length, root length, number of leaves, and number of root nodule are in tune with previous results **[25]**.

CONCLUSION

Based on the experiment, it can be concluded that the application of treatment receiving compost prepared from *Jatropha curcas, Lantana camara, Datura stramonium* and Mixed Biochar for crop growth, showed the highest growth of the

Vigna radiata crop at all the three stages of crop growth. Compost and biogas slurry provide additional nutrient support for plant growth. At the harvesting time, it was noticed that compost application showed maximum growth.

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CONFLICT OF INTEREST

The authors are declaring that we have no conflict of interest.

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