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Phaseolus Vulgaris (Bush Beans) Growth under Different Types of Biogas Slurries and application Methods

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Abstracts:- Solid waste is a big issue to many countries. Energy problem, is also a critical issue with the declining of the useable fossil-fuels and world is now moving toword the reniverble ennergy. Feeding the ever increasing world population through sustainable crop cultivation is a challenge and biogas units give great solutions for them. Biogas slurry is a by-product of biogas production, containing abundant nutrients, so this may be good for use as a fertilizer or same times as organic fertilizer. Biogas effluent (slurry) is lower in pollution potential, has less odor, contains fewer viable weed seeds, has fewer pathogens than the input and is an excellent bio-fertilizer. But still not much information are available on biogas slurry use as fertilizer in Sri Lankan condition, so research was forcused to find out the way to use biogas slurry as a fertilizer, in effective and efficant manner. Different type of biogas slurry (A- Kitchen waste slurry, B- Cow dung slurry, C- Herbal waste slurry, D-Hotel waste slurry and E- Recommended fertilizer mixture) was applied to Bush Bean ("*Phaseolus vulgaris*") plants and observe crop growth and yield differentiations. Slurry application methods were changed (B-bulk application, S-Split application, L-Liquid fertilizer spray weekly) to discover the differentiations in performance. Randomize Complete Blog Designing (RCBD) was employed to carry out field experiment. Shoot-length, Root-length, Leaf area, Shoot dry weigh, Root dry weigh, Leaf dry weigh were measured. Two Factor Factorial model and Analysis of variance (ANOVA) are used for the analysis. Crop growth are significantly different to each other according to the, Shoot length (P=0.001), Root length (P=0.002) and Shoot dry weigh (P=0.00) considering the 95% confident interval. Even though shoot length, root length, and shoot dry weigh change with time those parameter are not significantly varied with the sub-Treatment (P=0.84, 0.664 and 0.68). Root dry weigh (P=0.01), Leaf dry weigh (P=0.00), Shoot to root ratio (P=0.00) and Leaf area (P=0.00) also significantly change with the slurry type but only the shoot to root ratio is significantly affected (p=0.03) by the slurry application method. Type of biogas slurry significantly affects to the crop growth. Cow dong slurry can replace the recommended fertilizer mixture effectively and Hotel waste slurry also capable of replacing the inorganic fertilizer to some extent. But Herbal waste slurry is week in this parameter. Slurry application method does not significantly affect to the all most all parameters excluding shoot to root ratio. Even though there are not much prominent different with application methods still Bulk application and Split application methods are superior to liquid (spring) application. Most suitable method is Bulk application method.

Keywords:- *Biogas-slurry, Organic-Fertilizer, Solid waste management. Crop growth, Phaseolus vulgaris.*

I. INTRODUCTION

Biogas slurry is a by-product of biogas production (Lee & Brenda, 2003), which contains abundant nutrients and Phyto-beneficial substances (Wen et.al.,2011). Therefore the slurry should not to be wasted, since this biogas by-product or slurry contains abundant amount of nutrient (Wen Ke liui, 2011), amino acids and bioactive substances (Lee & Brenda, 2003), this may be good for use as fertilizer. According to (Frost & Gilkinson, 2011) biogas digested effluent (slurry) is lower in pollution potential, has less odor, contains fewer viable weed seeds, has fewer pathogens than the input and is an excellent bio-fertilizer. Other important point is the nutrient content of slurry could differ with feeding stuff and environmental situation of the location where biogas units are established (Lee & Brenda, 2003). However, still not much information is available on biogas slurry use as fertilizer in Sri Lankan condition.

II. MATERIALS AND METHODS

Plant nutrient requirements and slurry nutrient content was established and ten times of the plant requirement were applied as slurry to the field cultivation using different methods of application. Sampling was done weekly and the samples were analyzedas quickly as possible before samples are dried up. Different types of biogas slurry (according to the input material used) were applied to plants and the crop growth and yield were measured, to discover the differences in performance according to input material to facilitate selecting good biogas slurry type/s as fertilizer. Four types of slurry were taken for the research; A- Kitchen waste slurry, B- Cow dung slurry, C- Herbal waste slurry, D-Hotel

waste slurry and E- Control (Recommended fertilizer mixture).In addition, the application methods were changed. In here, three types of biogas slurry application methods were employed. Bush been (*Phaseolus vulgaris*) was used here as the test plant. Shoot-length, root-length, leaf area, shoot dry weigh, root dry weigh, leaf dry weigh were taken as direct measurements. Randomized Complete Block Design (RCBD) was employed to carry out field experiment. Growth of plants was weekly observed. Final yield of the plants was taken (number and weight). Minitab statistical package was used to analyze the data.

III. RESULTS AND DISCUSSION

There was a significant difference in crop growth according to the type of slurry applied to the crop. Crop growth are significantly different to each other according to shoot length, root length and shoot dry weight(Table 1).

Even though shoot length, root length, and shoot dry weigh changed with the time, those parameters were not significantly different with the sub-Treatment. Root dry weight, leaf dry weight, shoot to root ratio and leaf area were also significantly changed with the change the slurry type but only the shoot to root ratio was significantly affected by the slurry application method (Table 2)

Table: 1. Analysis of Variance for variables, using Adjusted SS for Tests

Source	Shoot length		Root length		Shoot dry weigh	
	F	P	F	P	F	P
Different slurry types [Treatment (T1)]	5.23	0.001	4.84	0.002	6.56	0.00
Different application methods [Sub-Treatment (T2)]	0.17	0.84	0.41	0.664	0.38	0.68

Table: 2. Analysis of Variance for variables, using Adjusted SS for Tests

Source	Root dry weight		Leaf dry weigh		Shoot to Root ratio		Leaf area	
	F	P	F	P	F	P	F	P
T1	3.61	0.01	12.6	0.00	3.81	0.00	4.69	0.00
T2	0.11	0.89	0.22	0.80	0.03	0.97	2.94	0.06

When consider the plants growth with slurry application method, it shows that root length, shoot length, shoot dry weight are higher in the Bulk application method followed by split application method. Surprisingly liquid fertilizer (weekly spray) application ended up with inferior results(Figure 2, 3, and 4)

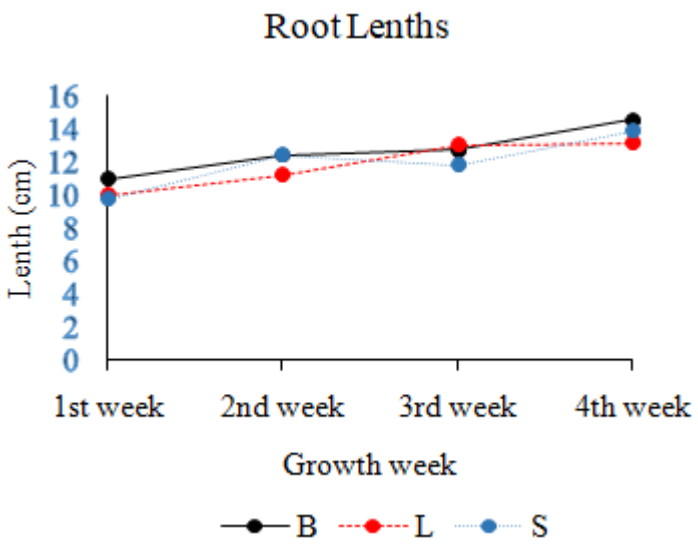

Figure: 2. Comparer the shoot length with the time among four type of slurry application methods

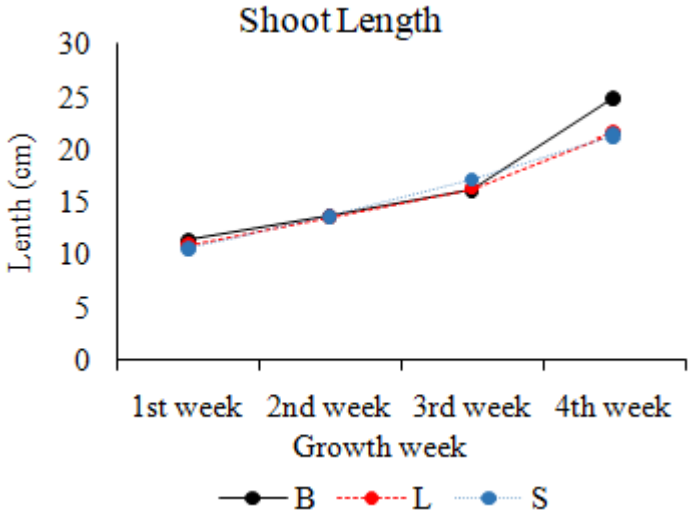

Figure: 3. Comparer the Root length with the time among four type of slurry application methods

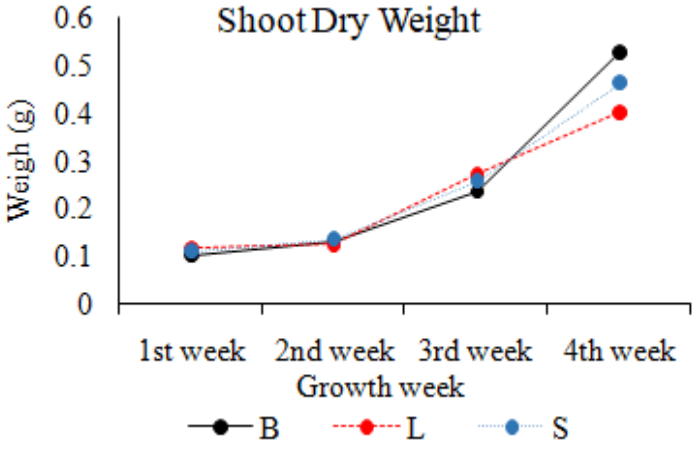

Figure: 4. Comparer the Shoot Dry weight growth with the time among four type of slurry application methods

IV. CONCLUSIONS

Biogas slurry type significantly affected the crop growth as was evident with shoot length, root length, leaf area, shoot dry weight, root dry weight and leaf dry weight. Cow dong slurry can replace the recommended fertilizer mixture effectively and Hotel waste slurry was also capable to replace inorganic fertilizer to some extent where as Herbal waste slurry was not effective. Slurry application method(Bulk, two split and liquid spraying) did not significantly affect on all direct measurements but affected the shoot to root ratio (indirect measurement). Even though there was not much prominent difference with application methods, still bulk application and split application methods are found to be superior to liquid (spraying) application. Most suitable method was the bulk application method.

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