Influence on Growth of Pea Seedlings in Different Dilution Ratios of Biogas

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Keywords:biogas slurry, pea seedling, growth states

Abstract. In this paper, Edible Podded Pea seed is taken as the test plant to explore the influence on growth of pea seedlings in different dilution ratio of biogas slurry. The study shows that the biogas slurry with dilution ratio being 1:50 contributes significantly to the emergence rate and seedling length but not to germination rate of pea seedlings grow hydroponically in. Excessive low dilution ratio probably causes low germination rate or irregular seedling length.

Introduction

Biogas slurry, the anaerobic fermented liquid residue of various organics such as human and animal manure and crop straw, is a high quality organic fertilizer [1]. Different from biogas residue, biogas residue is liquid contains complex organics, rather difficult in storage and transportation so it turns into a major topic of the disposal and reuse technique of biogas [2].

The content of Ca, P and Te in biogas slurry reaches up to 0.02%, 0.01% and 0.01% respectively. Even though the content of Cu, Zn, Mn, Co is lower than 0.001%, each of them can effectively infiltrate into plant cells making the plants grow and develop as normal [3]. Presoaking in biogas slurry can improve germination percentage, accelerate seeds physiological metabolism, and power the seedling from its embryo with strong disease resistance, insect resistance and stress tolerance which lay a sound foundation for high yield [4]. But if discharged directly into nature without disposal, it may cause severe contamination in air, earth and water sources, turn into the source of livestock infection disease, parasite and zoonosis which will give rise to vastly detrimental effects on human survival environment and seriously impact the sustainable development of animal husbandry [5]. Therefore, disposal of biogas slurry has drawn more and more attention [6].

Pea seedling is a nourishing food which contains rich useful amino acids. With faint scent in flavor, tender in taste and refreshing smooth taste, pea seedling is of high look and taste. It is rich in multiple nutrients and pollution-free and tastes smooth with faint scent, is favored by the customers [7]. At present, pea seedlings on the market are mainly grew hydroponically with clean water. In this research, influence on growth of pea seedlings in different dilution ratio of biogas slurry is studied, aiming at enlarging biogas slurry's utilization approaches as a large-scale resource, providing scientific data and environmental basis for conjoining development of hydroponic pea.

Test Material and Methods

Test Plant. Edible podded pea seed, bought from the flower& fish market at Qingshan District, Wuhan City, Hubei province. Biogas slurry of a pig farm, in dark brown with 807mg BOD5 per liter and ammonia nitrogen content is 614mg/L, provided by Hubei Tianmen Health Group.

Experiment Design. There are four comparative trials; T1 is cultivated in tap water while T2, T3 and T4 are cultivated in biogas slurry with a dilution ratio of 1:30, 1:40 and 1:50 respectively. Numbers of peas for experiments are 115, 75, 101 and 145 respectively. Experiments are conducted in potted hydroponic culture.

Experimental Method. The experiments carried out at microbiology lab of Resources and Development College of Hubei University, July 13th 2015. Firstly, prepare 100ml biogas slurry for each kind of dilution ratio and place the peas in relevant slurry soaking for 2 hours. Then, lay peas

on gauzes wetted with relevant dilution ratio biogas slurry after presoaking, randomly arranged, and then transfer to relevant cultivating pots. To ensure there are sufficient nutrients and water needed, cultivating pots shall be replenished with new biogas slurry at 8 o'clock and 20 o'clock each day thereafter. At 8 o'clock every morning, record relevant data on germination rate, emergence rate and seedling length after observation of the growth situation.

Experimental Results and Discussion

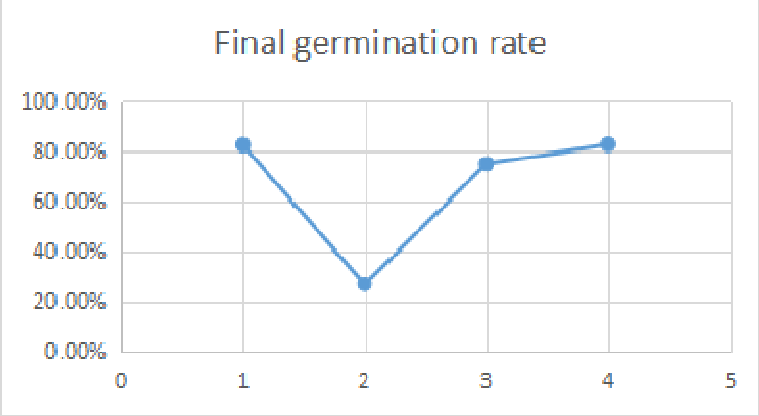
Influence on Germination Rate in Different Dilution Ratio of Biogas Slurry

The germination of the peas affects not only the seedling yield, but those not germinate or too late may be gelatinized and decay in the condition of high temperature and humidity, and even spread out to and inhibit the normal growth of the whole pot [8]. An overall consideration shall be taken in researching the influences on germination rate in different dilution ratio of biogas slurry as the experiments are carried in the summer, in a condition of high temperature and high humidity. The accumulated germination rate of the peas is showed in Table1.

Table1. Accumulated Germination Rate

Treatment	D2	D3	D4	D5
T1	57.4%	80%	82.6%	82.6%
T2	14.7%	24%	26.7%	26.7%
T3	34.7%	69.3%	75.2%	75.2%
T4	38.6%	63.4%	82.8%	82.8%

Fig1. Broken line graph of final germination rate



In the experiments, peas in No.2 (dilution ratio is 1:30) are obviously swollen by water absorption at Day 2 and the peas turn out to be moldy at Day 4 while the others in different dilution ratio show pretty normal. As showed in Table1, the final germination rate of T1 and T4 is almost the same at 82.6% and 82.8% respectively while T1's germination speed is faster than that of T4. The final germination rate of T3 and T2 is 7.4% and 55.9% less than that of T1. Combined with the curve in Fig.1 shows down first and then up which infers that the pea's germination rate is connected with the dilution rate of biogas slurry. Synthesizes the above analysis, different dilution ratio can influence pea's germination among which 1:50 dilution ratio biogas slurry is the best while 1:30 and 1:40 dilution ratio biogas slurry are less effective or even inhibit the germination.

Influence on emergence rate of pea seedlings in different dilution ratio of biogas slurry

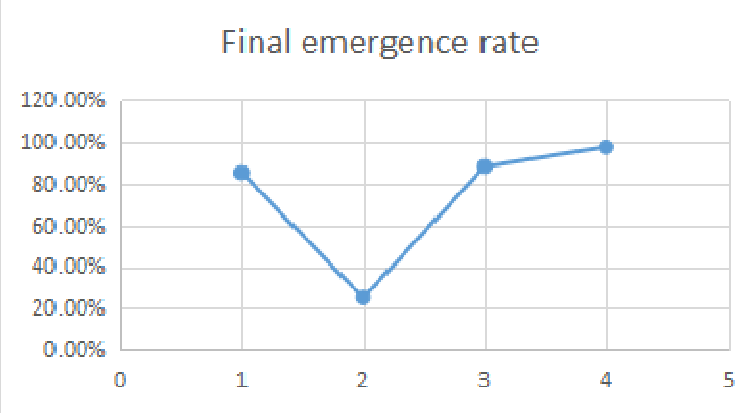
Accumulated pea emergence rate is shown in Table 2

Table2. Accumulated Emergence Rate of Pea

Treatment	D5	D6	D7	D9	D11
T1	57.9%	57.9%	80%	85.3%	85.3%
T2	10.0%	10.0%	25.0%	25.0%	25.0%
T3	26.3%	48.7%	82.9%	88.2%	88.2%
T4	31.7%	50.0%	77.5%	89.2%	97.5%

Remarks: Emergence rate =sum (emergence)/sum(germination)

Fig.2 Broken line graph of final emergence rate of pea



As showed in table2, emergence rate of T4 is the highest among four samples, reaches 97.5%, while T3 is 88.2%, 2.9% higher than T1 (85.3%). Owing to the highest growing rate of disposal T1 during germination stage, T1 is earlier to emergence stage than other disposals with the fastest emergence speed. The lowest emergence rate is 25% happens in T2. Combined with Fig.2, it is observed that the curve firstly decrease but then increase which infers that the germination rate of pea is interrelated with the dilution ratio of biogas slurry. The peas final emergence rate is equal to emergence amount divided by total amount of pea, and the final emergence rates of T1, T2, T3, T4 are 70.4%, 6.7%, 66.3% and 80.7% respectively. In which we can find that the emergence rate of T4 ranks the first with a 10.3% high than that of T1, and compared with the emergence rate of T1, T3 is 4.1% less and T2 is 63.7% less. Based on the above analyses, different dilution ratio of biogas slurry does have influence over emergence rate of pea among which the 50 times dilution rate is the best. Although the emergence rate of peas cultivated in biogas slurry of 40 times dilution rate is higher than tap water culture, its germination rate is lower than peas cultivated in tap water. And even though the tap water culture is not effective as biogas slurry diluted for 50 times, emergence speed of peas cultivated in tap water has a significant advantage however.

Influence on length of pea seedlings in different dilution ratio of biogas slurry

To ensure economic benefit of pea seedlings, it requires the pea seedling length is longer and homogeneous. Therefore, a synthetic consideration shall be taken in the study of influence on pea seedling growth by cultivating in different dilution ratio of biogas slurry.

Table3. Growth of seedling length of pea seedlings

Disposal	D6		D10	
	Avg. seedling length (cm)	Max seedling length (cm)	Avg. seedling length (cm)	Max seedling length (cm)
T1	2.6	3.0	6.4	6.7
T2	1.0	1.1	1.2	1.4
T3	2.3	5.0	9.2	11.3
T4	3.2	3.4	10.5	10.7

As shown in Table3, there is no significant difference in seedling length all four samples by day 6 which indicates that the growth vigor on seedling length has already faded away even though T1 is superior in germination speed and emergence speed; At day 6, the average seedling length of sample T4 is 3.2 cm which is the longest and followed by T1 and T3, 2.6 cm and 2.3 cm respectively, and the seedling length of T2 is 1.0cm, the shortest one. At that moment, T3 has turned up with uneven seedling length and T1, the first one stepped into seedling emergence stage, gets no growth vigor however. By day 10, a significant difference turns up among all treatment groups; the average seedling length of T4 is 10.5cm followed with T3 (9.2cm), T1 (6.4cm) and T2 (1.2cm). There is a distinct difference in individual seedling length of T3, whose longest seedling length is 2.1cm more than the average value, reaches 11.3cm long. Synthesizes the above analysis, the best dilution ratio of biogas slurry should be 1:50, benefiting the most with long but even seedling length. Then is biogas slurry diluted for 40 times in which the average seedling length takes the second place but with uneven individual length. The group cultivated in tap water ranks the third in average seedling length and also relative evenness.

Conclusions

In researching the influence on growth of pea seedlings cultivated in different dilution ratio of biogas slurry, biogas slurry diluted for 50 times promotes the growth of germination, emergence and length of pea seedlings, and the peas cultivated in which are of better germination rate and emergence rate, longer and more regular seedling length. Diluted for 30 or 40 times however, the biogas slurry will inhibit the germination while dilution ratio being 1:40 can promote the emergence rate and seedling length but with uneven in individual seedling length. Peas cultivated in tap water show with high germination and emergence speed but is slower than that in biogas slurry diluted for 50 times, also the average seedling length of peas in tap water culture is shorter than that in 1:40 and 1:50 dilution ratio biogas slurry culture. In conclusion, the emergence rate and seedling length of peas can be improved effectively if only the cultivation is under suitable dilution ratio of biogas slurry.

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