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A Comparative Study on the Effect of Fertilizers on Growth of Algae in Pond Water Samples

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Abstract:

The effect of two different fertilizers [Urea(U), Diammonium Phosphate, DAP(D)] with varying concentrations on algal growth produced in pond H₂O samples from 3 different areas viz., 3rd mile area (1), Seithekema area (2) and Medziphema area (3) under Nagaland state were investigated and also a comparative survey based on algal growths under the influence of fertilizers were analysed. Comparative survey was done using 4 different concentrations of both the fertilizers viz., Urea from 600 ppm (U1a-3a), 540 ppm (U1b-3b), 480ppm(U1c-3c), 420ppm (U1d-3d) and DAP(PO₄³⁻ concentration) from 950ppm (D1a-3a), 855ppm(D1b-3b), 760ppm(D1c-3c), 665ppm(D1d-3d) respectively. Results showed that Medziphema pond H₂O exhibiting pH around 6 with lowest hardness provided the most amount of algal growth, while 3rd mile pond H₂O was found to favor algal growth in almost all samples containing varying concentrations of DAP. DAP was found to be the most favoured medium for algal growth and concentration containing 600ppm urea and 950ppm phosphate was found to be most suitable for algae.

Keywords: Fertilizers, algal growth, Urea, Diaamonium phosphate, Comparative survey

1. Introduction

Algae are aquatic photosynthetic organisms which flourish in fresh water places such as the wetlands. High levels of agricultural runoff can cause large quantities of nitrogen, phosphorous, and potassium to enter aquatic systems [1]. When added to a water body, these nutrients can cause large fluctuations in environmental conditions. The most common water pollutants are fertilizers like nitrogen and phosphorus compounds. In water, they contribute to pollution through rapid multiplication of bacteria and algae and as a result, when these organisms die the oxygen gets depleted killing fish and other aquatic life. Nitrogen as nitrates works very well as a plant fertilizer and for this purpose they are produced in large quantities. Phosphorus, like nitrogen is also an important nutrient element. When the washed off chemicals are introduced into a natural water source, such as ponds, they cause ecological imbalance causing some organisms such as algae to flourish at the expense of others such as fish.[2] Because the influence of the human activities, excessive nitrogen, phosphorus and other nutrients are loaded into water bodies like lake, reservoirs, embouchure and bay, which could cause negative ecological consequences on aquatic ecosystem structures, processes and functions, result in the fast growth of algae and other plankton, and deteriorate water quality. Fertilizers though enriched with nutrients, when excess amounts enter the aquatic ecosystems it results to algal blooms and the algae die off more rapidly. As algae decompose, they remove oxygen from the water and lack of oxygen then kills off fish and other aquatic life. The fertilizers can also leach into groundwater and contaminate drinking supplies.

Holland Korbitz et al. observed the effects of different concentrations of fertilizers on algae samples. The results showed that the phosphorous rich fertilizer caused the most growth, while the nitrogen and potassium based fertilizers did not provide sufficient nutrients to keep the algae living. This superfluous growth can use up nutrients in the pond and end up being detrimental to the ecosystem [3]. Stefii fried et al. evaluated the effects of nine different combinations of nitrate and phosphate concentrations on algal growth and concluded that both nitrates and phosphates have positive effects on algal growth and these variables affect algal growth independently of each other and there is no interaction between the two [1].

This study surveyed the effects of four different concentrations of nitrogen (Urea) and nitrogen-phosphorous(DAP) on algal growth. It was hypothesized that if fertilizers rich in nitrogen, potassium, and phosphorus were added to algal samples, then phosphorous rich fertilizers will cause the most algal growth [1,4].

2. Materials and Methods

The pond H₂O samples were collected from three different areas viz., 3rd mile (Dimapur), Seithekema and Medziphema in Nagaland. Fertilizers urea (mukta) and Diammonium phosphate were prepared with varying concentrations i.e., Urea from 600 ppm(U1a-3a),540 ppm (U1b-3b),480ppm(U1c-3c),420ppm(U1d-3d) and DAP (PO₄³⁻ concentration) from 950ppm (D1a-3a),855ppm(D1b-3b),760ppm(D1c-3c),665ppm(D1d-3d) respectively where U=Urea, D=DAP and 1=3rd mile pond H₂O water sample, 2=Seithekema pond H₂O sample and 3=Medziphema pond H₂O sample. Initial concentration for fertilizers were estimated based on the work done by David B. Whyte [5]. Estimated initial concentration was 0.01M for Urea/DAP i.e.,600ppm for urea and 950ppm for phosphate in DAP which was further diluted in total of 4 different concentrations. The sampling was carried out on500ml conical flasks, where their mouths were covered with cotton loosely for as oxygen inlet. These were kept in open space with sufficient sunlight (Fig 1(a)).Each fertilizer contained 15 samples including 4 different concentrations on 3 pond H₂O area samples(4x3)and 3 controls respectively (without any fertilizer).



Figure 1(a): Sample arrangement in open space. 1(b): Samples after 9 days

3. Results and Discussion

Algal growth was observed after 9 days and 19 days. In Table 1, some water parameters like pH, turbidity, hardness content of the collected pond H₂O was estimated to check each water quality.

Parameters	3 rd Mile	Seithekema	Medziphema
Turbidity (NTU)	0-10	0-10	25-27
Hardness (ppm)	1425	1200	1050
Chloride (ppm)	200	120	160
Iron (ppm)	0.0	0.0	0.1
pH	6.5	8.5	6.0

Table 1: Some estimated parameters of 3 different pond H₂O

Tables 2 and 3 show the results of algal growth after 9 and 19 days respectively, where it can be seen that after 9 days, most number of algal growth were seen in pond samples from Seithekema (in 5 samples) where most growths were found to be in DAP fertilizer medium.

Name of fertilizer	Source of Pond-H ₂ O sample		
	3 rd mile (1)	Seithekema (2)	Medziphema (3)
Urea (U)	U1a	U2a, U2b	U3a, U3b
Diammonium Phosphate (DAP)	D1a, D1c, D1d	D2a, D2b, D2c	D3c

Table 2: Effect of fertilizers on algal growth in pond H₂O after 9 days

Name of fertilizer	Source of Pond-H ₂ O sample		
	3 rd mile (1)	Seithekema (2)	Medziphema (3)
Urea (U)		U2a	U3a
Diammonium Phosphate (DAP)	D1a, D1c, D1d	D2d	D3a, D3b

Table 3: Effect of fertilizers on algal growth in pond H₂O after 19 days

After 19 days, algae growth was found to retain mostly in DAP medium in pond H₂O sample from 3rd mile. Further, from Figure 2, we can observe the trend of algal growth after 19 days under the influence of fertilizer on different pond H₂O samples. Here, it followed the order as U3a>U2a>D1a>D2d>D1d>D1c>D1b>D3a>D3b based on quantity of algal growth on each sample.

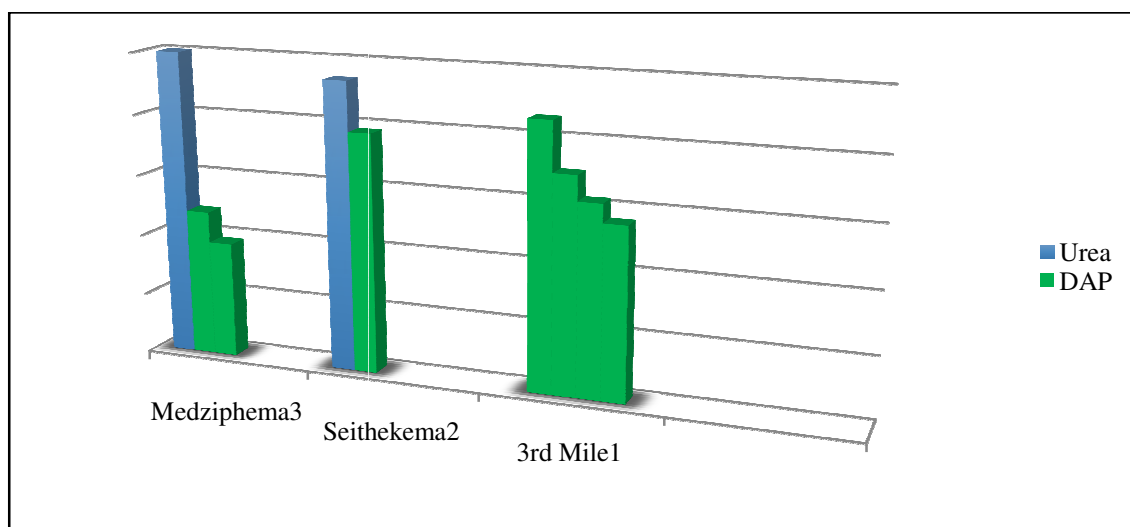


Figure 2: Trend of algal growth due to effect of fertilizers on pond H₂O samples after 19 days (U3a>U2a>D1a>D2d>D1d>D1c>D1b>D3a>D3b)

DAP was found to be the most favoured medium for algal growth and PO₄³⁻ concentration of 950ppm was found to be most suitable for algae. Medziphema pond H₂O exhibiting pH around 6 provided the most amount of algal growth, while 3rd mile pond H₂O was found to favor algal growth in almost all samples containing varying concentrations of DAP. This can be in accordance to the work done by Fried [1] and Schindler [4] where phosphorus rich fertilizer provided the most algal growth when kept in sufficient sunlight.

4. Conclusion

From the comparative survey, it can be observed that:

- Most favorable concentration for algal growth was 0.01M for both fertilizers i.e., 600 & 950ppm respectively.
- Medziphema pond H₂O exhibiting pH around 6 and having the lowest hardness provided the most amount of algal growth, while 3rd mile pond H₂O was found to favor algal growth in almost all samples containing varying concentrations of DAP.
- DAP was found to be the most favoured medium for algal growth.

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