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Research Article

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Synthesis of magnesium based fertilizer from bittern of the salt-pans of Kanyakumari district and its applications to magnesium demanding crop *"Allium cepa"*

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ABSTRACT

Sodium chloride normally called common salt is mainly produced by solar evaporation of sea brine, subsoil brine and backwater brine. After the separation of NaCl in the salt pans, the left out mother liquor is called bittern. Bittern being an unavoidable, toxic and abundantly available by-product in salt-pans, which can be converted into fertilizers to get maximum growth and yield in plants. Bittern is having enriched levels of magnesium and so it is possible to convert in to magnesium content fertilizer of magnesium ammonium orthophosphate. This paper explain the synthesis of magnesium fertilizer from bittern and its application to the magnesium demanding crop onion (Allium cepa).

Keywords: Bittern, Fertilizer, Magnesium.

INTRODUCTION

India produces about 70 lakh tons of salt, a year and an equal amount of bittern is also available. In the salt pans of kanyakumari district discharge approximately 17,000 $m^3$of bittern during each salt production. This bittern presents a much desirable source of chemicals. The major elements which are needed by the plants in substantial quantities are Sodium, phosphorous, potassium, calcium, magnesium and sulphur. As bittern consists of all these nutrients, so it can be used as fertilizers. The fertilizer is the substance that is added to soil to supply one or more plant nutrients and intended to increase the plant growth. Magnesium ions are essential to the basic nucleic acids and thus are essential to all cells of all known living organisms and it is the central core of the chlorophyll molecule in plant tissue, which is responsible for photosynthesis. It also helps to activate specific enzyme systems. If Mg is deficient and the shortage of chlorophyll results in poor and stunted growth of plants.

STUDY AREA

Kanyakumari district is a southern tip of India. Here the salt pans are located at puthalam and swamithoppu. In puthalam, subsoil brines are used and in swamithoppu backwater brines are used.

Chemistry of salt-pans

The evaporation of brines are conveniently divided into four distinct phases. The first phase is from 3- 13 degree Baume, when iron, magnesium and calcium precipitate as their carbonates. Carbonates of iron and magnesium crystallize only up to 90%, the remaining 10% precipitates at 15^0Be ie, in the next stage. The second phase extending from 13-25.4^o Be,centers around gypsum. The third phase extends between 25.6-30^0Be, the NaCl is precipitated out in this phase. At the end of this phase, when the concentration is 30 ^{o}Be, the liquor is called bittern,because of its characteristic bitter taste.

EXPERIMENTAL SECTION

The bittern samples were collected from our study area and it is filtered through a Whattman filter paper (40) for the removal of impurities like sand, mud, coarse particles etc, then the synthesis of fertilizers like Magnesium ammonium orthophosphate [Mg (NH_4) PO_4] , using bittern as a raw materials were carried out based on standard procedures.

SYNTHESIS OF MAGNESIUM AMMONIUM ORTHOPHOSPHATE FERTILIZER

Method – I

To 20 ml of bittern, added 15 ml dilute hydrochloric acid. Then added, 3ml of orthophosphoric acid and 70ml of ammonia solution with constant stirring. A white solid of magnesium ammonium orthophosphate was formed and was filtered and dried.

Method-II

To 20ml of bittern, added 15ml dil.HCl and 3ml of orthophosphoric acid. Instead of ammonia solution as in Method-I, 50ml of saturated solution of ammonium chloride was added with constant stirring. A white solid of magnesium ammonium orthophosphate was formed and filtered and dried.

Method-III

To 20ml of bittern, added 20ml of ammonium hydroxide and 50ml of saturated solution of ammonium chloride. To this added, 10ml of a saturated solution of disodium hydrogen phosphate with constant stirring. A white solid of $Mg(NH_4)PO_4$ was formed and was filtered and dried.

For the study of the fertilizer value of the fertilizer synthesized by using bittern as the raw materials, the biomass production of crop “onion” was studied.

EXPERIMENTAL SET-UP

Horticulture techniques were used for the study ie, soil, sand and organic mixture were mixed thoroughly in the ratio 1:1:1 and was filled 3/4th in all three pots. This mixture gives the necessary basic nutrients for the plant growth. These three pots were labeled as A , B and C

“ A” is the control pot having the above mixture and “B” is having above mixture with 20ml of raw bittern and pot “C” is having the above mixture with 20gm of synthesized fertilizer (from any one of the method of synthesis) of magnesium ammonium orthophosphate .

RESULTS AND DISCUSSION

Table I

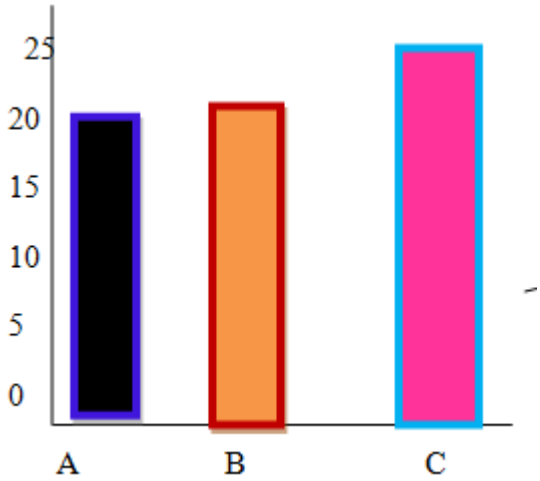
Medium	classification	Total plant height(cm)				Total number of tillers			
		16th Day	31th Day	46th Day	61th Day	16th Day	31th Day	46th Day	61th Day
Control	A	19.4	19.9	20.4	21.1	13	17	20	22
20ml of Bittern	B	21.5	22.4	23.1	23.8	16	19	23	26
20gm of Fertilizer	C	25.7	28.4	29.6	31.8	21	23	27	31

The study was carried out for a period of 60 days. The three different pots of onion were watered regularly and were observed once in every 15 days. The observations involved the plant height, the total number of tillers (leaves) and weight of product yield (onion). It was found that there was a gradual increase in all the parameters from A to C. It provides the information regularly the impact of [$Mg(NH_4)PO_4$] and it has enormous amount magnesium, ammonium and phosphate along with other micro nutrients.

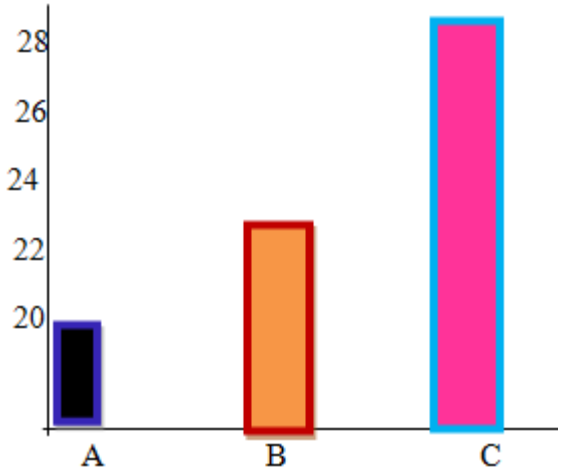
Table 2 weight of product yield (onion)

Classification	Weight(gm)
A	2.6
B	5.8
C	10.3

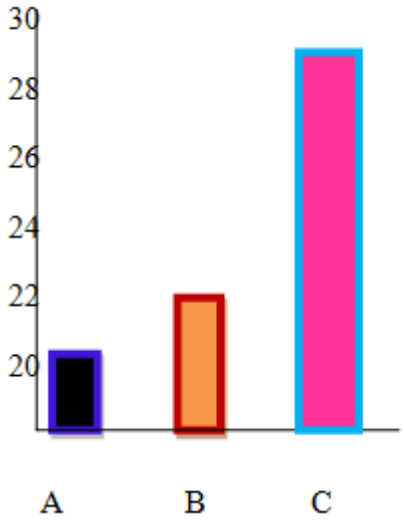
Plant Height at 16th day (cm)



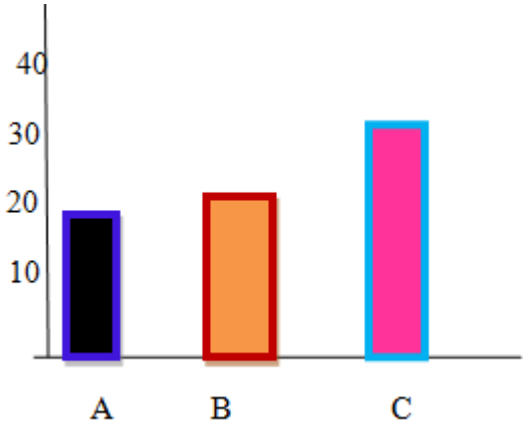
Plant Height at 31th day (cm)



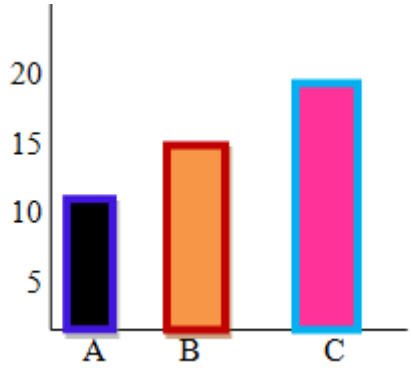
Plant Height at 46th day (cm)



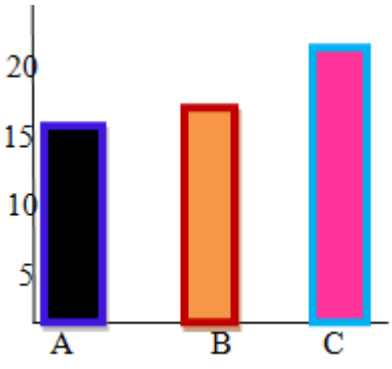
Plant Height at 61th day (cm)



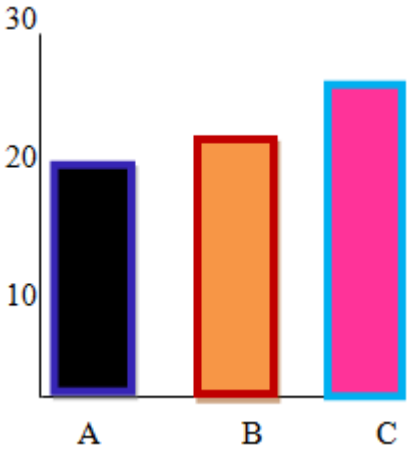
Total Number of tillers at 16th day



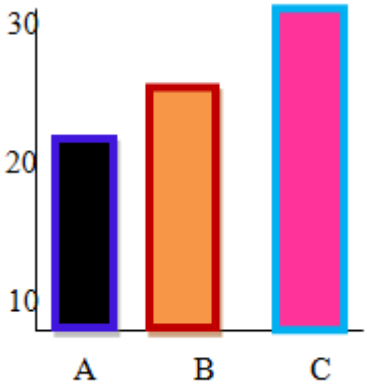
Total Number of tillers at 31th day



Total Number of tillers at 46th day



Total Number of tillers at 61th day



Onion: First monitoring on 16th day:

It was observed that the plant height gradually increased from A to C. In A, a minimum plant height of 19.4cm was observed and that of B, it was 21.5cm. Maximum plant height of 25.7cm was observed for C. The total number of tillers increased gradually from A to C. In A , the total number of tillers were 13 and in B, it was 16. Maximum number of leaves ie, 21 was observed in C.

Onion: second monitoring on 31th day:

In A, the total plant height of 19.9cm was observed and in B, it was 22.4cm. A maximum plant height of 28.4cm was observed for C. The total number of tillers in A was 17 and in B, it was 19. It was observed in C as 23.

Onion: Third monitoring on 46th day:

In A, the total plant height of 20.4cm was observed and for B,it was 23.1cm. A maximum height of 29.6cm in C. The total number of tillers in A is 20, B is 23 and in C 27.

Onion: Fourth monitoring on 61th day:

In A, the total plant height of 21.1cm was observed and for B, it was 23.8cm. A maximum plant height of 31.8cm was observed for C. The total numbers of tillers increased gradually from A to C. In A, the total numbers of tillers were 22 and in B, it was 26. But for C, it was 31.

After harvesting the maximum and minimum height of tillers in A is 24.8cm and23.9cm. In B is 30.7cm and 29.4cm. But in C, the maximum height of tillers is 41.2cm and minimum is 33.1cm.

PRODUCT YIELD:

The product yield of onion in A is 2.6gm, B is 5.8 gm and maximum yield of C is observed at 10.3 gm.

CONCLUSION

The results obtained from the present investigation will enable the salt-makers and scientists to have a thorough knowledge about the productive disposal of bittern. This toxic, corrosive and nutrients enriched waste can be converted into transportable fertilizer.

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