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# Utilization of Bittern on Green Chilli Plants Growth

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***Abstract*** **- The growth of green chilli plants and the yield was influenced by bittern. It clearly indicated that increased in addition of bittern (lower concentration) which is enriched with secondary nutrients and micro nutrients served as a fertilizer by enhancing the fertility of the soil and inturn the yield. The plants were healthy at lower concentration. Bittern act as a promoter and induce for breaking dormancy in magnesium demanding crop such as green chilli plants.**
***Keywords:*** **Bittern, Secondary Nutrients, Yield, Promoter**

## I. INTRODUCTION

Bittern is the mother-liquor formed during the separation of sodium chloride in the solar salt-works. This bittern which was earlier considered to be an unavoidable toxic material is tried as a fertilizer, because it contains large amount of secondary nutrients like calcium, magnesium and sulphur in the form of sulphates. It also contains a marginal percentage of trace elements like iron, copper, manganese, zinc normally called micro nutrients. In a short, as it contains all the cations and anions needed for healthy growth of plants. Plants can synthesize their food by photosynthesis using atmospheric carbon di oxide and water absorbed from the soil in the presence of sunlight with the help of chlorophyll present in them. As the plants have their tissues built out of carbohydrates, fats, proteins and nucleoproteins, they need large quantities of carbon, oxygen, hydrogen, nitrogen, phosphorous, potassium, magnesium, calcium and sulphate are also required for plant growth almost similar quantities of iron, manganese, zinc, copper, boron, molybdenum, cobalt are also necessary to have a healthy growth (T. Wallace, 1961). The requirements of various elements are different depending upon the soil conditions. Most plants depend on 16 elements for proper growth and development. These elements are essential for plant growth and a deficiency of any one of the above nutrients affects the growth. So these elements are termed as 'essential nutrients'.

The calcium is required for cell elongation and cell division (H. G. burstrom 1968). Magnesium is an important mineral constituent of chlorophyll molecule, which is responsible for photosynthesis.

Magnesium is also required for activation of many enzymes concerned with carbohydrate metabolism (N. E. Balke and T. K. Hodges, 1975). A key reaction of magnesium is the activation of ribulose biphosphate carboxylase. Sulphur plays a predominant role along with nitrogen and phosphorus to have healthy yield (A. Mehlich, 1970). Sulphur is an essential constituent of many proteins and it is necessary for the synthesis of sulphur containing protein such as cystine and methionine which help the plant growth. It is also present in the oils produced by certain plants (K. C. W. Venema, 1962).

Zinc is an essential trace element and it plays a vital role in metabolic activities. A higher concentration of zinc i.e., 7ppm is toxic to plants (R. S. Ambasht and P. K. Ambasht, 1992). Zinc is very closely involved in the nitrogen metabolism of plant. In zinc deficient plants, the protein synthesis and protein levels are markedly reduced, and amino acids and amides are accumulated (Price C. A. *et al.*, 1972). An early stage of zinc deficiency is indicated by a sharp decrease in the levels of RNA and ribosome content of cells. Zinc has possible role in plant metabolism involved in starch formation (K. Jyung *et al.*, 1975).

Copper is in chlorophyll synthesis act as a catalyst for respiration and carbohydrate and protein metabolism. Deficiency leads to the terminal leaves and buds die, and the plant as a whole becomes stunned. Presence of copper in plants has great importance, but it is also toxic in higher quantities.

Chloride in the soil not adsorbed by minerals and is one of the most mobile ions, being easily lost by leaching under freely drained conditions. Chloride uptake is sensitive to both to variations in temperature and metabolic inhibitors (K. Mengal and E. A. Kirkby, 1999).

Potassium stimulates photosynthetic oxygen production. These observations support the view that potassium has a direct influence on electron transport in the photosynthetic electron transport chain. Potassium increased the mobilization of proteins stored in leaves and stems and also promoted the translocation of nitrogenous degradation compounds towards the grains (M. Secer 1978).The main function of potassium in biochemistry is its activation of various enzyme systems (H. J. Evans and G. J. Scorger 1966). Potassium deficiency also results in a collapse of chloroplast and mitochondria (H. P. Pissarek 1973). In the lower range of potassium concentration, sodium increased grain yields, where as the higher potassium concentration, sodium induced a slight yield depression (S. Yoshida and L. Castaneda 1969). Here the bittern was tried as a promoter for green chilli plants growth. The possible use of fertilizer was also checked. The high concentration of bittern led to scorching of leaves in green chillies. The intake of various nutrients was determined by ash sample analysis.

## II. MATERIALS AND METHODS

For the study of fertilizer value of bittern (from Vepalodai) the biomass production of green chillies was studied. The influence of concentration of bittern on the growth and yield was studied, by growing the plant in different pots.

*A. Experimental Set-Up*

All the pots were even with 30 cm height and 25cm width. Soil, sand and organic mixture was thoroughly mixed in the ratio 1:1:1 and this mixture was filled ¾$^{th}$ in all the different pots.

*Green Chillies*

Totally five pots were used and labeled as G.C-C, G.C-1, G.C-2, G.C-3, G.C-4

G.C – C - Control pot containing the above soil mixture alone
G.C – 1 - Soil mixture + 5 ml of bittern evenly mixed
G.C – 2 - Soil mixture + 10 ml of bittern evenly mixed
G.C – 3 - Soil mixture + 15 ml of bittern evenly mixed
G.C – 4 - Soil mixture + 20 ml of bittern evenly mixed

The experimental setup was kept in the open terrace of the laboratory exposure for sunlight. In each pot two green chillies seeds were sown. The selected seeds were healthy and were having approximately equal weight and water was sprinkled daily in the morning and evening.

The germination of the seeds started fourth day onwards and the entire experiment was carried out for ninety one days. The height, stem-width, maximum leaf width and total number of leaves in the plants of five different pots were recorded once in every fifteen days. A very dilute solution of meta acid i.e., 2 ml in one liter water was sprinkled using a hard sprayer once in fifteen days to eradicate the harmful pests.

After ninety one days, the total number of fruits and total weight of fruits were recorded. All the precautionary measures enabled to get maximum yield with minimum quantity of fertilizers.

*B. Ash Analysis*

The well natured leaves and dried well separately at room dried leaves, 3g of each was weighed and further dried in an oven at a temp of 110 to 140$^{o}$C and were made to ash in silica crucibles. The ash of two sets of the five different samples was then digested with triple acid i.e., $HNO_3$, $H_2SO_4$ and $HClO_4$ in the ratio 7:2:1. The contents in the crucibles were allowed to cool in a desiccator. The extract was made up in 25ml standard measuring flask with double distilled water (C.S. Piper 1966).

The five different samples were subjected to various analysis viz % of calcium, magnesium, sulphate, potassium by Standard methods (B.S. Bhargava and H.B. Raghupathi 1999). The trace metals like iron, manganese, zinc, copper were analysed by Atomic Absorption Spectrophotometer.

## III. RESULTS AND DISCUSSION

TABLE I GREEN CHILLI PLANTS GROWTH OBSERVATION

| Pot | No. of Days | Plants Height (cm) | Total No. of Leaves | Stem Width (mm) | Leaf Max Width (cm) |
|---|---|---|---|---|---|
| GC- C | 16$^{th}$ day | 5.3 | 2 | 1.3 | 1.0 |
| GC-1 | | 5.4 | 3 | 1.4 | 1.1 |
| GC-2 | | 5.5 | 3 | 1.5 | 1.2 |
| GC-3 | | 5.6 | 4 | 1.6 | 1.3 |
| GC-4 | | 5.8 | 4 | 1.7 | 1.3 |
| GC- C | 31$^{st}$ day | 7.0 | 4 | 1.3 | 2.2 |
| GC-1 | | 7.1 | 5 | 1.4 | 2.4 |
| GC-2 | | 8.0 | 6 | 1.5 | 2.6 |
| GC-3 | | 8.7 | 7 | 1.6 | 2.8 |
| GC-4 | | 9.5 | 8 | 1.8 | 2.9 |
| GC- C | 46$^{th}$ day | 11.4 | 10 | 1.6 | 2.8 |
| GC-1 | | 12.8 | 12 | 1.7 | 3.0 |
| GC-2 | | 13.5 | 13 | 1.9 | 3.4 |
| GC-3 | | 14.1 | 14 | 1.9 | 3.4 |
| GC-4 | | 15.9 | 16 | 2.0 | 3.5 |
| GC- C | 61$^{st}$ day | 20.2 | 14 | 1.8 | 3.4 |
| GC-1 | | 22.8 | 15 | 2.0 | 3.6 |

| | | | | | |
|---|---|---|---|---|---|
| GC-2 | | 23.6 | 17 | 2.0 | 3.8 |
| GC-3 | | 24.0 | 18 | 2.2 | 4.0 |
| GC-4 | | 25.1 | 20 | 2.3 | 4.1 |
| GC- C | | 29.5 | 21 | 2.2 | 4.3 |
| GC-1 | | 30.4 | 24 | 2.3 | 4.6 |
| GC-2 | $76^{th}$ day | 31.4 | 28 | 2.4 | 4.8 |
| GC-3 | | 33.1 | 30 | 2.5 | 5.0 |
| GC-4 | | 38.3 | 33 | 2.7 | 5.1 |
| GC- C | | 39.5 | 34 | 2.5 | 5.0 |
| GC-1 | | 42.3 | 38 | 2.6 | 5.1 |
| GC-2 | $91^{st}$ day | 45.8 | 42 | 2.7 | 5.4 |
| GC-3 | | 49.3 | 43 | 2.8 | 5.5 |
| GC-4 | | 53.5 | 47 | 3.0 | 5.7 |

*A. Green Chilli Plants - Monitoring on $16^{th}$ Day*

Table I shows the green Chilli plants growth of five different pots was recorded. On the $16^{th}$ day, in G.C.C a minimum plant height of 5.3 cm was observed and G.C-1, G.C-2 and G.C-3 had the plant heights 5.4, 5.5, 5.6cm respectively. Maximum plant height of 5.8cm was observed in G.C-4.

The stem-width also increased gradually from G.C-4. A minimum stem-width of 1.3 mm was observed for G.C-C and for G.C-1, G.C-2, G.C-3, G.C-4 it was 1.4, 1.5 1.6, and 1.7 mm respectively.

Similarly, the total number of leaves and number of leaves having maximum width also increased gradually. G.C-C had 2 leaves, with one leaf had the maximum width of 1.0 cm and G.C-1 had 3 leaves, of which, one leaf had the maximum width of 1.1 cm. G.C-2 also had three leaves, of which, one leaf had the maximum width of 1.2cm. G.C-3 had four leaves, of which, one leaf had the maximum width of 1.3cm. G.C-4 had a total of four leaves, of which, two leaves had the maximum width of 1.3cm.

*B. Green Chillies - Monitoring on $31^{st}$ Day*

On $31^{st}$ day, minimum plant height of 7.0 cm was observed in G.C-C and G.C-1, G.C-2 and G.C-3 had the plant heights 7.1, 8.0, 8.7cm respectively. Maximum plant height of 9.5cm was observed in G.C-4.

The stem-width also increased gradually from G.C-4. A minimum stem-width of 1.3 cm was observed for G.C-C and for G.C-1, G.C-2, G.C-3, G.C-4 it was 1.4, 1.5 1.6, and 1.8 cm respectively.

Similarly, the total number of leaves and number of leaves having maximum width also increased gradually. G.C-C had four leaves, with two leaves had the maximum width of 2.2 cm and G.C-1 had five leaves, of which, three leaves had the maximum width of 2.4 cm. G.C-2 also had six leaves, of which, four leaves had the maximum width of 2.6 cm. G.C-3 had seven leaves, of which, four leaves had the maximum width of 2.8 cm. G.C-4 had a total of eight leaves, of which, five leaves had the maximum width of 2.9 cm.

*C. Green Chillies - Monitoring on $46^{th}$ Day*

On $46^{th}$ day, minimum plant height of 11.4 cm was observed in G.C-C and G.C-1, G.C-2 and G.C-3 had the plant heights 12.8, 13.5, 14.1 cm respectively. Maximum plant height of 15.9 cm was observed in G.C-4.

The stem-width also increased gradually from G.C-4. A minimum stem-width of 1.6 cm was observed for G.C-C and for G.C-1, G.C-2, G.C-3, G.C-4 it was 1.7, 1.9 1.9, and 2.0 cm respectively.

Similarly, the total number of leaves and number of leaves having maximum width also increased gradually. G.C-C had ten leaves, with three leaves had the maximum width of 2.8 cm and G.C-1 had twelve leaves, of which, four leaves had the maximum width of 3.0 cm. G.C-2 also had thirteen leaves, of which, five leaves had the maximum width of 3.4 cm. G.C-3 had fourteen leaves, of which, five leaves had the maximum width of 3.4 cm. G.C-4 had a total of sixteen leaves, of which, six leaves had the maximum width of 3.5 cm.

*D. Green Chillies - Monitoring on $61^{st}$ Day*

On $61^{st}$day minimum plant height of 20.2cm observed in G.C.C and G.C-1, G.C-2 and G.C-3 had the plant heights 22.8, 23.6, 24.0 cm respectively. Maximum plant height of 25.1cm was observed in G.C-4.

The stem-width also increased gradually from G.C-4. A minimum stem-width of 1.8 cm was observed for G.C-C and for G.C-1, G.C-2, G.C-3, G.C-4 it was 2.0, 2.0, 2.2 and 2.3cm respectively.

Similarly, the total number of leaves and number of leaves having maximum width also increased gradually. G.C-C had fourteen leaves, with four leaves had the maximum width of 3.4 cm and G.C-1 had fifteen leaves, of which, five leaves had the maximum width of 3.6 cm. G.C-2 also had seventeen leaves, of which, seven leaves had the maximum width of 3.8cm. G.C-3 had eighteen leaves, of which, eight leaves had the maximum width of 4.0cm. G.C-4 had a total of twenty leaves, of which, nine leaves had the maximum width of 4.1cm.

*E. Green Chillies - Monitoring on 76$^{th}$ Day*

On 76$^{th}$day minimum plant height of 29.5cm was observed in G.C.C and G.C-1, G.C-2 and G.C-3 had the plant heights 30.4, 31.4, 33.1cm respectively. Maximum plant height of 38.3cm was observed in G.C-4.

The stem-width also increased gradually from G.C-4. A minimum stem-width of 2.2 cm was observed for G.C-C and for G.C-1, G.C-2, G.C-3, G.C-4 it was 2.3, 2.4, 2.5 and 2.7cm respectively.

Similarly, the total number of leaves and number of leaves having maximum width also increased gradually. G.C-C had twenty one leaves, with seven leaves had the maximum width of 4.3 cm and G.C-1 had twenty four leaves, of which, eight leaves had the maximum width of 4.6 cm. G.C-2 also had twenty eight leaves, of which, nine leaves had the maximum width of 4.8 cm. G.C-3 had thirty leaves, of which, nine leaves had the maximum width of 5.0cm. G.C-4 had a total of thirty three leaves, of which, ten leaves had the maximum width of 5.1cm.

*F. Green Chillies - Monitoring on 91$^{st}$ Day*

On 91$^{st}$ day, minimum plant height of 39.5cm was observed in G.C-C and G.C-1, G.C-2 and G.C-3 had the plant heights 42.3, 45.8, 49.3 cm respectively. Maximum plant height of 53.5cm was observed in G.C-4.

The stem-width also increased gradually from G.C-4. A minimum stem-width of 2.5 cm was observed for G.C-C and for G.C-1, G.C-2, G.C-3, G.C-4 it was 2.6, 2.7, 2.8 and 3.0 cm respectively.

Similarly, the total number of leaves and number of leaves having maximum width also increased gradually. G.C-C had thirty four leaves, with nine leaves had the maximum width of 5.0 cm and G.C-1 had thirty eight leaves, of which, eleven leaves had the maximum width of 5.1 cm. G.C-2 also had forty two leaves, of which, twelve leaves had the maximum width of 5.4 cm. G.C-3 had forty three leaves, of which, fifteen leaves had the maximum width of 5.5 cm. G.C-4 had a total of forty seven leaves, of which, seventeen leaves had the maximum width of 5.7cm.

*G. Green Chilli Plants - Yield Report*

TABLE II GREEN CHILLIES - YIELD REPORT

| Classification | Total Number of Fruits | Total Weight of Fruits (gm) |
|---|---|---|
| G.C-C | 15 | 75 |
| G.C-1 | 19 | 89 |
| G.C-2 | 24 | 115 |
| G.C-3 | 27 | 123 |
| G.C-C | 33 | 150 |

Table II shows the yield of fruits and weight of fruits was recorded. Since the yield fruits were not uniform, measurements were made as and when and a consolidated table comprising the total weight of fruits is presented.

G.C-C had minimum number of 15 fruits i.e., the total weight of fruits was 75 gm G.C-1 yield 19 fruits. The total weight was 89 gm G.C-2, G.C-3 and G.C-4 had 24, 27 and 33 number of fruits and had a weight of 115, 123 and 150 gm.

TABLE III GREEN CHILLIES: ASH ANALYSIS

| Classification | K (%) | Ca (%) | Mg (%) | $SO_4$ (%) | Fe (ppm) | Mn (ppm) | Zinc (ppm) | Cu (ppm) |
|---|---|---|---|---|---|---|---|---|
| G.C-C | 3.7 | 1.8 | 0.34 | 0.54 | 50 | 65 | 8 | 25 |
| G.C-1 | 3.9 | 2.1 | 0.39 | 0.57 | 65 | 80 | 11 | 29 |
| G.C-2 | 4.1 | 2.4 | 0.46 | 0.60 | 75 | 98 | 14 | 35 |
| G.C-3 | 4.3 | 2.7 | 0.51 | 0.64 | 90 | 112 | 17 | 39 |
| G.C-4 | 4.7 | 3.1 | 0.55 | 0.69 | 115 | 127 | 19 | 46 |

*H. Green Chillies: Ash Analysis*

Table III shows the ash analysis of green chillies of different plants was recorded. Ash samples from the five different pots were analysed for various parameters viz., the percentage of calcium, magnesium, sulphate and potassium. The trace metals like iron, manganese, zinc and copper were also analysed and presented in ppm. A gradual increase in the values of all the secondary nutrients and micronutrients from G.C-C to G.C-4 was observed.

The percentage of potassium was found to increase marginally from G.C-C to G.C-4, because the necessary potassium was totally supplied by the soil, sand and organic

mixture. Despite the soil mixture provides the required potassium, the increasing addition of bittern, activated a marginal increase in the intake of potassium.

The percentage of potassium in all the five different ash samples was found to increase gradually from G.C-C to G.C-4. Minimum percentage was observed for G.C-C i.e., 3.7% and for G.C-1, G.C-2 and G.C-3, it was 3.9% 4.1% and 4.3% respectively. But, a maximum percentage of ash was observed for G.C-4 i.e., 4.7 %. These values were found to correlate with the earlier observations that 3.5- 5.0 % of potassium is sufficient for green chillies (E. R. Beaufils, 1973).

The percentage of calcium in all the five different ash samples was fond to increase gradually from G.C-C to G.C-4. Though soil provides required calcium, the increasing addition of bittern, activated a marginal increase in the intake of calcium. G.C-C had the minimum value of calcium i.e., 1.8 % and for G.C-1, G.C-2 and G.C-3, it was 2.1%, 2.4 % and 2.7 %. A maximum value of 3.1% was observed for G.C- 4.

The percentage of magnesium was found to increase significantly from G.C-C to G.C-4, since magnesium needed for the plant was exclusively supplied by bittern. G.C-C had the minimum percentage of magnesium i.e., 0.34 %. But for G.C-1, G.C-2 and G.C-3, it was 0.39 %, 0.46 % and0.51 % respectively. Maximum value of 0.55% was observed for G.C-4.

The percentage of sulphate also increased markedly from G.C-C to G.C-4, because, bittern supplied the necessary requirement of sulphate. G.C-C had minimum percentage of sulphate i.e., 0.54% and for G.C-1, G.C-2 and G.C-3 it was 0.57%, 0.60 % and 0.64% respectively. But, G.C-4 recorded maximum percentage of sulphate i.e., 0.69%.

The trace metals present in the five different samples were also analysed and a marginal increase was observed from G.C-C to G.C-4. Though, the soil mixture provides the required micronutrients, the trace metals present in bittern activated the intake of various micronutrients, resulted in gradual increase in the values of iron, manganese, zinc and copper from G.C-C to G.C-4.

G.C-C had minimum value of iron i.e., 50 ppm and for G.C-1, G.C-2 and G.C-3, it was 65 ppm, 75 ppm and 90 ppm respectively. Maximum value of 115 ppm was observed for G.C-4.

The value of manganese for G.C-C, was found to be minimum i.e., 65 ppm, but for G.C-1, G.C-2, G.C-3, it was 80 ppm, 98 ppm and 112 ppm respectively. But a maximum of 127 ppm was observed for G.C-4. The value of zinc for G.C-C, was found to be minimum i.e., 8 ppm, but for G.C-1, G.C-2, G.C-3, it was 11 ppm, 14 ppm and 17 ppm respectively. But a maximum of 19 ppm was observed for G.C-4.

The value of copper for G.C-C, was found to be minimum i.e., 25 ppm. But for G.C-1, G.C-2, G.C-3, it was 29 ppm, 35 ppm and 39 ppm respectively. But a maximum of 46 ppm was observed for G.C-4. All the tested parameters are in agreement with earlier results (Vaithiyanathan, 2004).

## IV. CONCLUSION

The quantity of bittern added was 0, 5,10,15,20 ml for the five different pots of green chilli plants. The gradual increase in the total number of fruits and the weight of fruits clearly indicated that the increased addition of bittern (lower concentration) which is enriched with secondary nutrients and micro nutrients served as a fertilizer by enhancing the fertility of soil and inturn the yield. Despite the gradual increase in the percentage of all nutrients viz., potassium, calcium, magnesium, sulphate and micronutrients viz., iron, manganese, copper and zinc, the percentage of magnesium and sulphate increased significantly in the ash samples of green chillies as the addition of bittern increase. This is because bittern is enriched with magnesium and sulphate than other elements. This study revealed that bittern can be used as a fertilizer for green chilli plants growth.

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