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INTEGRATIVE EFFECT OF MAGNESIUM SULPHATE ON THE GROWTH OF FLOWERS AND GRAIN YIELD OF PADDY: A CHEMIST'S PERSPECTIVE

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ABSTRACT

Integrative effects of magnesium sulphate ($MgSO_4$) were investigated in field experiment on paddy (*Oryza sativa*), flowers and vegetables during summer (February to May) in 2013. The experiment consisted of three levels of $MgSO_4$ concentration (0, 1.5, 3.0 g/m^2) in different sub plots. Application of $MgSO_4$ as 3.0 g/m^2 resulted in the most effective improved growth and highest grain yield of paddy. This dose of the $MgSO_4$ is also very effective for the qualitative and quantitative production of the flowers like rose, china rose, marigold and sunflower and vegetable (bitter gourd). This has been assessed to show the necessity of this particular bio-essential element (Mg) in highly cultivated agricultural land in our densely populated country.

Keywords: Mg(II), Paddy, Flowers, Grain yield, Atomic absorption spectroscopy

INTRODUCTION

Magnesium (Mg) has long been illustrious for its essential role in chlorophyll formation and photosynthesis. Magnesium has an important role in living system because it is one of 18 nutrients essential for plant growth[1]. Mg has a number of key functions in plants. Particular metabolic processes and reactions that are influenced by Mg include: (i) photophosphorylation (such as ATP formation in chloroplasts), (ii) photosynthetic carbon dioxide (CO_2) fixation, (iii) protein synthesis, (iv) chlorophyll formation, (v) phloem loading, (vi) partitioning and utilization of photoassimilates, (vii) generation of reactive oxygen species, and (viii) photooxidation in leaf tissues. Consequently, many critical physiological and biochemical processes in plants are adversely affected by Mg deficiency, leading to impairments in quality, growth and yield[2]. In most cases, the involvement of Mg in metabolic processes relies on Mg activating numerous enzymes. An important Mg-activated enzyme is the ribulose-1,5-bisphosphate (RuBP) carboxylase, which is a key enzyme in the photosynthesis process and the most abundant enzyme on earth[3].

Plants take up Mg in the ionic form (as Mg^{2+} dissolved in soil solution). The rocks and clay particles in soils contain Mg but it is not plant available. As rock and clay particles weather over time (break down over time), minerals like Mg are released but this process is very slow. Magnesium levels in soil decline over time as a result of crop removal, soil erosion, and leaching. Low soil pH, and/or high levels of potassium (K) and calcium (Ca), low temperatures, and dry soil conditions can all contribute to Mg deficiency. Despite the well-known role of Mg for various critical functions, there is surprisingly little research activity on the role of Mg nutrition in crop production and quality[4]. Hence, Mg is often considered a "forgotten element". However, Mg deficiency is increasingly becoming an important limiting factor in intensive crop production systems, especially in soils fertilized only with N, P, and K. In particular, Mg depletion in soils is a growing concern for high-productivity agriculture. Due to its potential for leaching in highly weathered soils and the interaction with Al, Mg deficiency is a critical concern in acid soils[5]. In our present investigation, the application of magnesium ion with different concentrations in the paddy fields, flowering and vegetable gardens are analyzed which shows significant results especially on the production of paddy, flowers and vegetables.

EXPERIMENTAL

Study area

In the present study, field experiments to study the effect of $MgSO_4$ on paddy yield and production of flowers, vegetables were conducted at Raghunathpur block of Purulia and Joypur block of Bankura in West Bengal during crop season of 2012–2013.

Sample collection

The soil samples were collected (100 g) from Raghunathpur and Joychandi Hill area of Raghunathpur block in Purulia and Joypur block of Bankura district. The soil samples were collected in polyethylene bottle from field surface (0-15 cm depth); three replicas were collected from each of three sampling blocks to make comparative study. The effect of magnesium nutrition on rice grain, flowers and vegetables were studied in the field of different blocks of Purulia and Bankura, West Bengal during irrigated rabi crops (February to May).

Sample treatment and analysis

The soil samples were extracted with 10 ml of concentrated nitric acid (HNO_3) and 5 ml of concentrated hydrochloric acid (HCl) and immediately sun dried followed by hot air oven drying at 60°C until constant weight. The oven dried extracts were made fine homogenized powder by grinding with firm precaution to keep uncontaminated followed by further analysis. For Atomic absorption spectral analysis, 200 mg of given samples were transferred to 50 ml graduated PP plastic vial. Then sample was dissolved in 1% HNO_3 solution by shaking. After complete dissolution, the solution was made up to exactly 50 ml volume with 1% HNO_3 solution. Samples were further diluted (100/333 times) so as to fit in the calibration range. 1% HNO_3 in extra pure deionised water was used as a calibration blank and diluents for standards/samples preparation. For total inorganic magnesium content analysis in all types of samples flow injection hydride generation atomic absorption spectrophotometer (FI-HGAAS; Perkin Elmer A Analyst-400) was used.

RESULTS AND DISCUSSION

Paddy is the main agricultural product in West Bengal which are cultivated in mainly two seasons; amon paddy (during July to October), specially rain fed and boro paddy (during January to April) solely dependent on ground water irrigation. In this study, experiment was done only for the boro rice along with some vegetables and flowering plants grown in this season. We have collected three soil samples and analyzed the Mg content for each sample using AAS. In Joupur block of Bankura, the agricultural area is frequently cultivated and it is expected that Mg content in this soil will be low. For Raghunathpur and Joychandi hill area, Mg content will be relatively high since Mg is present in this soil as carbonate and oxide (Table-1).

Table-1: Magnesium and pH determination for soil in different blocks

Soil sample	pH of soil	Magnesium content		
		Reading in diluted solution, ppm	Concentration in solid sample % (wt/wt)	Magnesium present in soil, ppm
Joypur	7.0	0.124	0.31	255
Raghunathpur	7.1	0.155	1.29	1351
Joychandi hill	6.7	0.162	1.34	2580

We apply two different concentration of magnesium sulphate ($MgSO_4$) (1.5 g/m^2 in 1 lt and 3 g/m^2 in 1 lt water) and investigate the effect of Mg in the production of crops, vegetables and flowers in comparison to land without added $MgSO_4$. The best result is obtained in the land where 3 g/m^2 is applied. After application of $MgSO_4$ the flower plants, paddy and vegetables became greener and more effective for carbohydrate production. The yield of paddy has increased by 6.4 % using 1.5 g/m^2 of $MgSO_4$ and 17% using 3 g/m^2 of $MgSO_4$ (Figure-1, Table-2). However the life of paddy plant and the harvesting time has increased by 7 days on application of 3 g/m^2. This part of the work was done in the paddy field of Joypur block in Bankura district in West Bengal. The flower plants treated by $MgSO_4$ were Rose plant, China rose plant, Marigold and Sunflower. The number and size of flowers have considerably increased. The vegetable treated by $MgSO_4$ was bitter gourd plant. The production of bitter gourd has increased as compared to untreated plant. These experiments are performed at Raghunathpur block of Purulia district, West Bengal.

Table-2: Effect of $MgSO_4$ on the grain yield of highly cultivated paddy field in Joypur Block

Area of paddy field	$MgSO_4$ applied	Yield	Product increase by
(4 × 4) m^2	25 g	5.0 kg	6.4 %
(4 × 4) m^2	50 g	5.5 kg	17%
(4 × 4) m^2	0 g	4.7 kg	-

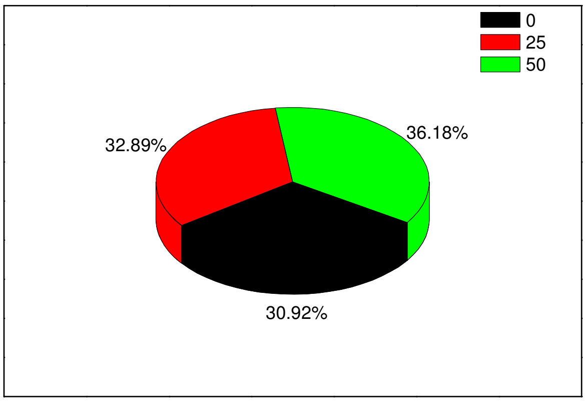

Fig.-1: Effect of $MgSO_4$ on the production of paddy in Joypur block [inset: 0, 25, 50 indicates the applied concentration of $MgSO_4$ in g/m^2]

CONCLUSION

Hence it is desirable to use $MgSO_4$ as fertiliser along with other fertilizers containing N, P, K. The recommended dose of $MgSO_4$ is in between 1.5 g/m^2 to 3 g/m^2. Mg has been a forgotten element for crop production, but its vital role is increasingly being recognized in plant nutrition. Our experimental results will help to take measure especially in the paddy cultivation along with the flowers and vegetable production.

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REFERENCES

1. N.P.A. Huner, W. Hopkins, *Introduction to Plant Physiology,* John Wiley & Sons, Inc (1998).
2. N. Tang, Y. Li, L.-S. Chen, *J. Plant Nut. Soil Sci.,* **175,** 784, (2012).
3. I. Cakmak, C. Hengeler and H. Marschner, *J. Exp. Bot*., **45**, 1251, (1994).
4. I. Cakmak, and E.A. Kirkby, *Physiol. Plant*., **133**, 692, (2008).
5. I. N. Kobayashi, T. Saito, N. Iwata, Y. Ohmae, R. Iwata, K. Tanoi, T. M. Nakanishi, *Physiolog. Planat.,* DOI: 10.1111/ppl.12003 (2012).

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