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Response of organic manure and inorganic iodine fertilization on minerals content in spinach (*Spinacia oleracea* L.)

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Abstract
Effects of organic and inorganic Iodine fertilizer on the Minerals content in (*Spinacia oleracea* L.) was studied in Poly house of the Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Chemistry, Banaras Hindu University. The experiment was laid out in a Randomized Complete Design (RCD) with 14 treatment and 3 replications Treatment included organic (FYM) and inorganic (Potassium iodide and iodate) with a control. Caliuma and Magnesium content in the plant samples was analyzed by extracting HNO_3 and $HClO_4$ by compelximetric titration method with flam photometer. A critical examination on fortification of iodine in spinach with recommended doses of fertilizer (NPK)/NPK + FYM revealed that iodine application either KI or KIO_3 improved the Ca and Mg in spinach. FYM (1% organic carbon) application with chemical fertilizers (N,P,K) reduced the magnesium content at both stages 45 DAS + 60 DAS whereas calcium content at 60 DAS were improved with the application of FYM with N, P, K fertilizers and iodine.

Keywords: Organic, inorganic fertilizer, mineral spinach, *spinach*

Introduction

Vegetables play an important role in human diets, as they support the normal functioning of the different body systems. They provide our cells with vitamins, minerals, fibber, essential oils and phytonutrients. Vegetables contain low amounts of fat and calories (Banerjee *et al*., 2012). Leaf vegetables came from very wide variety of plants and they are plants with edible leaves. Each of us knows lettuce and spinach, as well as mustard, but also early springtime nettles are valuable source of vitamin C. Green leafy vegetables are popularly used for food, being a rich source of carotene, ascorbic acid, minerals and dietary fiber. One of the most popular vegetable is lettuce. Lettuce is cultivated worldwide, and is one the most consumed green leafy vegetables in the raw form for its taste and high nutritive value, being regarded as an important source of phytochemicals, including carotenoids, in the diet (Chang *et al*., 2013). [1] Spinach contains number of different phytochemicals which have a high nutritional value. It is a rich source of antioxidants, especially high in vitamins A, C, E, K, -carotene, selenium and omega-3 fatty acids as well as rich in lutein and zeaxanthin. Spinach contains microelements such as potassium, calcium, magnesium, manganese, zinc and others. Spinach extracts have several beneficial effects, such as anticancer, anti-aging and protecting of central nervous system (Lomnitski *et al*., 2003). [2] Spinach contains many phyto-nutrients that have health promotional and disease prevention properties. Mustards are very low in calories and fats, but are supposed to be one of the highest among leafy vegetables, which provide vitamin K. It is a rich source of flavonoids, carotenes, lutein and zea-xanthin. Moreover fresh mustard leaves are an excellent source of vitamin C, several essential minerals such as calcium, iron, magnesium, potassium, zinc, selenium, and manganese (Banerjee *et al*., 2012) [3]. Spinach (*Spinacia oleracea* L.) is an important vegetable crop of Utter Pradesh and gaining its popularity to all kinds of people due to its high carotene and vitamin C contents. In our country, most of the people, especially the children suffer from malnutrition tremendously, which affect their national life. According to World Health Organization and Food and Organization, an adult person's diet should contain 250 g vegetable per day [1]. Minerals and vitamins are essential protective nutrients for maintenance of nutritional and health status of the body. They cannot be synthesized in the human body and, therefore, they must be obtained through diet. Foods containing minerals and vitamins in adequate amounts should be included in the daily diet to ensure adequate supply of minerals in body. Spinach form a considerable part of an Indian diet, which is basically vegetarian. The composition of nutrient content of the vegetables vary

widely depending on the part of the plant used as food (Hughes and Marion, 1970) [2]. Generally, spinach vegetables are considered to contribute appreciable amounts of minerals and vitamins; but when compared with other groups of vegetables, green leafy vegetables are known to be exceptionally rich in minerals, β-carotene (Duckworth, 1966) [3] and are also a good source of dietary fiber and antioxidants (Svanberg and Nyman, 1977 and Schneeman, 1989) [4, 5]. Green leafy vegetables, in general, are inexpansive foods rich in minerals and vitamins. Specifically, it is also well known that nutrient elements in the leaves of spinach are always important to human health (Welch, 2002) [6]; spinach as a dietetic nutrient has long been the object of many investigators. Spinach is the commonly consumed green leafy vegetables in different parts of India.

At present time growing concern regarding the nutritive value of foods and to nourish the ever increasing population and the inadequacy of essential nutrients can be improved through fortifications. The findings from various studies conducted by several groups of investigators revealed that content of minerals in plant foods can be altered by the application of fertilizers to the soil by balancing the macronutrients and with micronutrients (Kongale, 1986; Summai *et al*., 1980 and Patel *et al*., 1997) [7, 8, 9]. However, most of this research was carried out with foods other than vegetable crops. Hence, the present study was undertaken to find the effect of addition of chemical fertilizers and in combination, chemical fertilizer and FYM to soil on mineral contents of most popular green leafy vegetable, spinach (*Spinacea oleracea* L.). In addition, the spinach was tried to fortify iodine by the application potassium iodide/potassium iodate in soil. Thus, iodine was applied in soil in addition chemical fertilizer/chemical fertilizer + FYM Fertilizers are essential part of modern farming system, about 50% of the world production being attributed to fertilizer use and it may be a source of the environmental and soil degradation (Pradhan, 1992) [10]. Indiscriminate use of chemical fertilizers affects the texture and structure of soil, decreases the soil organic matter content and hinders the microbial activities in soil. In our country, the organic matter status of soil is in so critical position that if the present rate of its degradation is continued, in near future our soil would become barren. The use of organic manures in field helps in improving soil texture, structure, aeration, and keeps the soil environment pollution free. Cowdung as organic manure has been using since long time but due to modernization of agricultural practices its availability is becoming reduced On the other hand, with the development of the poultry industry in Bangladesh in recent the availability of poultry litter is increasing. As organic manure, it is superior to cowdung regarding the quality. The above discussion will suffice to understand the importance of giving adequate attention in the production of spinach using organic fertilizers integrated with chemical fertilizers for maintaining soil fertility and sound environment as well as human health. The present study was therefore, carried out to study the effect of integrated use of organic and inorganic fertilizers on the yield, quality and nutrient uptake by spinach.

Material S and Methods

Geographically, the district Varanasi is situated at 25°18' of northern latitude, 83°36' of Eastern longitude and at an altitude of 80.71 m above the mean sea level in the Indo-Gangatic plain of eastern Uttar Pradesh. The district Varanasi having alluvial soil lies in a semi-arid region to sub-humid belt of northern India. The district is surrounded by district St. Ravidas Nagar in the east, Chandauli in the west, Jaunpur in north and Mirzapur district in the south.

The present investigation involved a pot experiment during the rabi season followed by laboratory analysis of the plant and soil at the Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, is situated at an altitude of 123.93 m above mean sea level and at 25°18' North latitude and -1 80°36' East longitudes. The experimental soil was sandy loam with 2.25 mg kg-1 available iodine, 1.43 Mg m^{-3} bulk density, 2.56 Mg m-3 particle density, 45.4 % water holding capacity, 7.8 pH, 0.254 dS m-1 electrical conductivity, 6.21g kg-1 organic matter, 11.04 C mol (p+) kg-1 cation exchange capacity and 197.27, 19.09, 203.54, 19.77 kg ha-1 of available N, P, K, S, respectively and the soil was characterized by standard method (Jackson, 1967) [11].

The pot experiment was planned in a greenhouse with temperature of 28 ± 3°C during the day and 18 ± 3°C at night. 1.0kg well pulverized soil was filled in each pot. The recommended doses of N, P, K (80:50:50) fertilizers were applied in each pot through urea, single super phosphate and muriate of potash, respectively with different levels and sources of iodine in combination with and without FYM (1% organic carbon). Potassium iodide and potassium iodate were used as an iodine fertilizer for iodine treatments. 100 mg Iodine L^{-1} of potassium iodide and iodate were prepared as stock solution then 0.0, 1.0, 2.5 and 5.0 mg $kg^{-.1}$ iodine solution was applied at 20 DAS in respective pots. Full dose of phosphorus, potassium and 1/3 dose of nitrogen were applied at the time of pot filling through mixing and rest N was applied into two split doses at 20 and 30 days after seed sowing, respectively.

The plants were grown in green house, keeping moisture level 50% of the field capacity with de-ionized water at regular interval. 5-6 healthy seeds of spinach were shown at proper depth in the month of December and after germination 3 plants in each pot was maintained at 15 days after sowing (DAS). Experimental samples were collected into two stages, 45 and 60 DAS. The fresh weight of edible portion of spinach was taken after harvesting at 45 and 60 DAS.

Processing and Digestion of Plant Sample

The surface moisture of plant leaf samples were blotted in ordinary filter paper. After air drying, plant samples were stored in packets with pencil labelling. After hot air oven drying (65°C) the samples has been grinded and then was stored in desiecator (fused $CaCl_2$ was in the bottom) for further chemical analysis. Weighed 0.5 g of oven dried and processed leaf sample of spinach was taken in a 35 cm digestion tube. 10 mL of concentrated HNO_3 was added for each sample and kept overnight at a covered place/chamber for pre-digestion. After pre-digestion when sample dissolved in HNO_3, 10 mL of concentrated HNO_3 and 2-3 mL of $HClO_4$ were added in the same tube. The tubes was placed on a hot plate in acid proof digestion chamber having fume exhaust system and heated at about 100°C (KEL PLUS KES 20 model plant digestion system) for first one hour and then raised the temperature of about 200°C. Digestion continued until the contents became colourless and only white dense fumes appeared. The acid contents were reduced in digestion tubes to about 2-3 mL by continuous heating at the same temperature. After removing the tubes from hot plate, cooled it and 10 mL of 2N HCl was added to each tube. Digestion continued for by warmed the content slightly for some time. The samples were then filtered through Whatman No. 42 filter

paper into a 50 mL volumetric flask then made up the volume to 50 mL through 3-4 times washing of filter paper through distilled water.

Determination of **Calcium and Magnesium in Plant**

Calcium and magnesium content in plant were determined by compelximetric titration (Na-EDTA). Total Ca and Mg were determined by using erichrome black T indicator and then Ca by using muroxide indicator, Buffer used in this compleximetric titration was $NH_4Cl + NH_4OH$.

Results and Discussion

The present research work entitled "Influence of Organic and Inorganic Iodine Fertilization on the Minerals Content in Vegetable Crop spinach (*Spinacia oleracea* L.). has been carried out in during *rabi* season to evaluate the effect of N, P and K fertilizers and in combination with N, P and K fertilizer + 1% organic carbon containing FYM application as well as iodine application through KI/KIO_3 in different doses on Ca and Mg contents in leafy vegetables, spinach. The response obtained due to various treatments during the course of investigation are being presented in this section. An attempt has been made to explain possible variations exhibited by various treatments on the basis of statistical calculations.

Effect of fertilization and iodine application on calcium content (g kg^{-1}) in spinach

Data on Ca content (g kg^{-1}) in spinach leaf at 45 days and 60 days after sowing corresponding to fertilization and iodine application are presented in Table 1. The chemical fertilizer with FYM increased Ca content in spinach only 5.06 per cent at 60 DAS, but had no significant effect at 45 DAS. The calcium content increased by the application of KI and KIO_3 (Fig. 4) at both the stages, but enhancement of Ca content was more at 45 DAS (11.66 to 41.66) than 60 DAS (5.71 to 22.85). A close observation of data on interactive effect of nutrient sources with iodine sources reveals that the calcium content was maximum at 60 DAS, when iodine applied through KIO_3 @ 5.0 mg kg^{-1} with chemical fertilizer + FYM. The iodine application with chemical fertilizer + FYM irrespective of doses of iodine enhanced Ca content in leaf of spinach.

Effect of fertilization and iodine application on magnesium **content (g kg^{-1}) in spinach**

Data on magnesium content (g kg^{-1}) in spinach leaves corresponding to different treatments are presented in Table 1. A through observation of data reveals that chemical fertilizer increased the magnesium content in spinach at both stages 45 DAS (2.89%) and 60 DAS (4.05%). Effect of iodine application on magnesium content in spinach was observed (Table 4.5) similar trend as in the calcium content. The KI and KIO_3 application similarly increased (Fig. 4.6) the magnesium content in spinach. But the initial doses @ 1.0 mg kg^{-1}) of both the iodine sources, KI as well as KIO_3 increased maximum per cent of magnesium content (30.50 to 38.98%) in spinach at both stages (45 DAS and 60 DAS). The magnesium content was gradually decreased due to enhancement of iodine doses (@ 2.5 and @ 5.0 mg kg^{-1}) of KI as well as KIO_3.

Browsing of data on interactive effect (Table 2) it was found that chemical fertilizer application with iodine treatments were comparatively superior over chemical fertilizer + FYM with iodine application. Organic matter (1% oc) addition adsorbed the native soil magnesium, thus Mg content decreased in spinach leaves. The magnesium content increased maximum with (48.00 per cent) the application of chemical fertilizer with 1.0 mg kg^{-1} iodine through KI at 60 DAS.

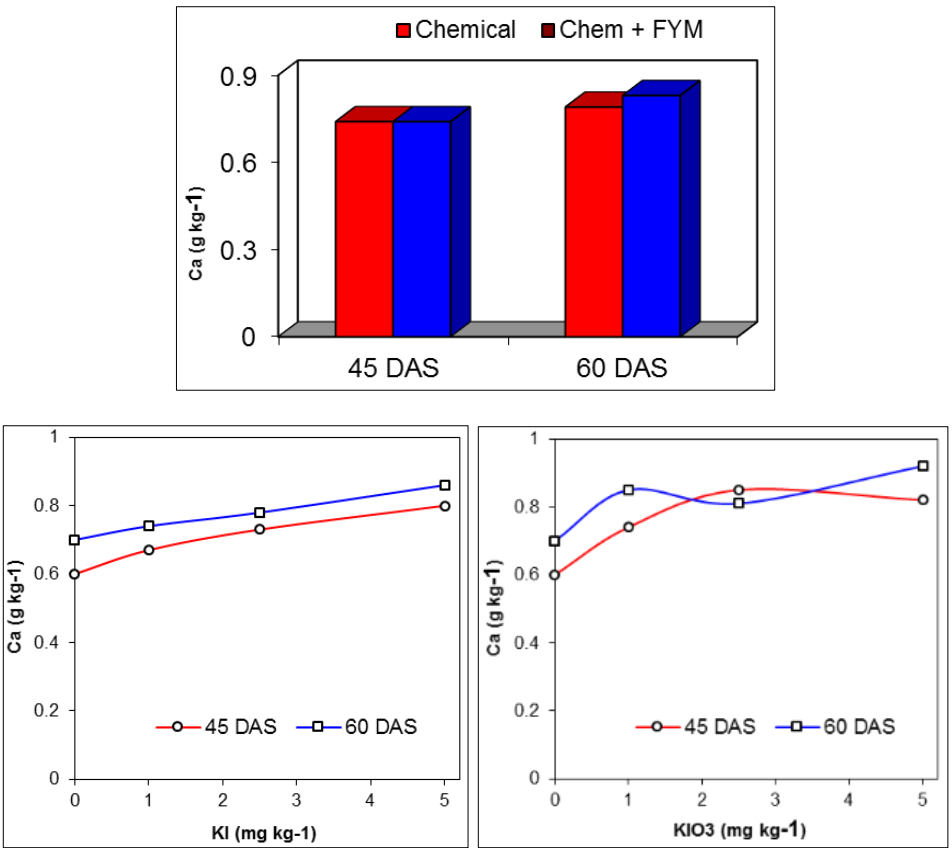

Fig 1: Effect of fertilization and iodine application on calcium content (g kg^{-1}) in spinach.

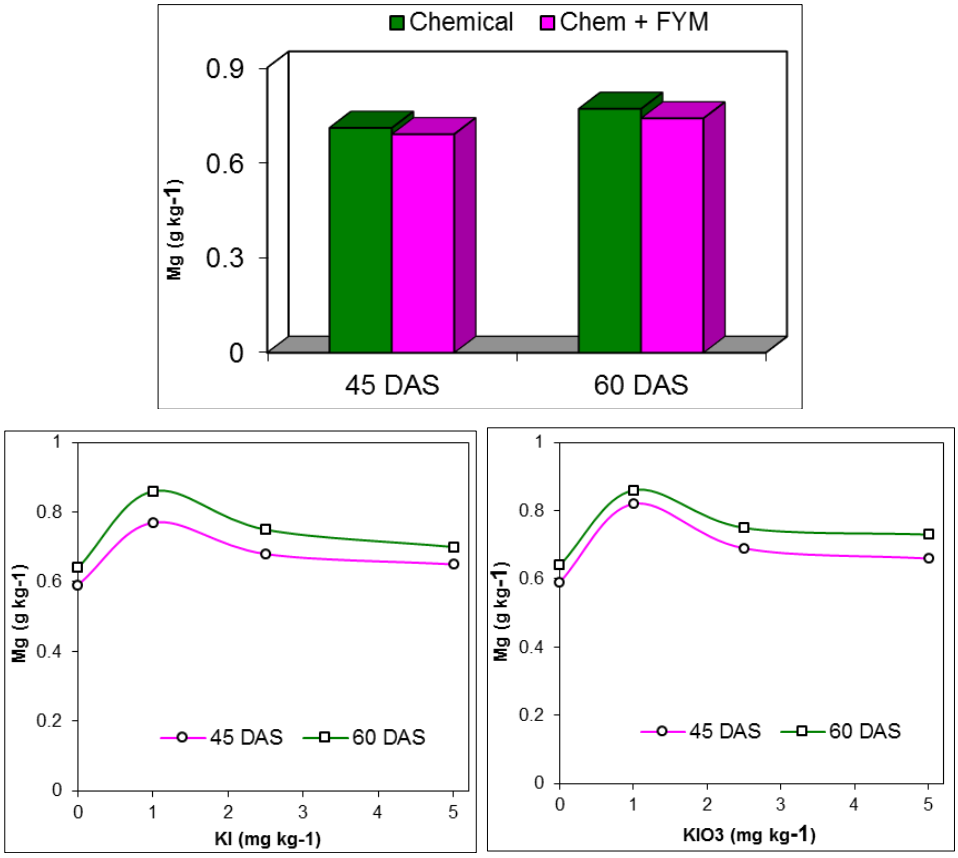

Fig 2: Effect of fertilization and iodine application on magnesium content (g kg^{-1}) in spinach

Table 1: Effect of fertilization and iodine application on calcium and magnesium content (g kg^{-1}) in spinach.

Particulars	Ca		Mg	
	45 Das	60 Das	45 Das	60 Das
Nutrient source				
Chemical (NPK)	0.74	0.79	0.71	0.77
Chemical (NPK) + Organic (FYM)	0.74	0.83	0.69	0.74
SEm ±	0.006	0.006	0.005	0.005
CD (P= 0.05)	NS	0.06	0.01	0.01
Iodine sources/doses				
Control	0.60	0.70	0.59	0.64
KI – 1.0 mg kg^{-1}	0.67	0.74	0.77	0.86
KI – 2.5 mg kg^{-1}	0.73	0.78	0.68	0.75
KI – 5.0 mg kg^{-1}	0.80	0.86	0.65	0.70
KIO_3 – 1.0 mg kg^{-1}	0.74	0.85	0.82	0.86
KIO_3 – 2.5 mg kg^{-1}	0.85	0.81	0.69	0.75
KIO_3 – 5.0 mg kg^{-1}	0.82	0.92	0.66	0.73
SEm ±	0.012	0.012	0.010	0.011
CD (P= 0.05)	0.03	0.03	0.03	0.03

DAS: Days After Sowing, CD: Critical difference

Table 2: Interaction (nutrient source × iodine source) effect on calcium and magnesium content (g kg^{-1}) in spinach

Particulars	Ca				Mg			
	45 Das		60 Das		45 Das		60 Das	
	Chemical (NPK)	Chemical (NPK) +Organic (FYM)	Chemical (NPK)	Chemical (NPK) + Organic (FYM)	Chemical (NPK)	Chemical (NPK) + Organic (FYM)	Chemical (NPK)	Chemical (NPK) + Organic (FYM)
Control	0.59	0.61	0.69	0.71	0.55	0.64	0.60	0.67
KI – 1.0 mg kg^{-1}	0.63	0.71	0.76	0.73	0.83	0.72	0.89	0.82
KI – 2.5 mg kg^{-1}	0.73	0.74	0.77	0.80	0.72	0.65	0.76	0.74
KI – 5.0 mg kg^{-1}	0.79	0.81	0.83	0.90	0.69	0.62	0.73	0.68
KIO_3– 1.0 mg kg^{-1}	0.76	0.72	0.75	0.95	0.82	0.83	0.86	0.86
KIO_3– 2.5 mg kg^{-1}	0.90	0.81	0.90	0.73	0.67	0.72	0.74	0.76
KIO_3– 5.0 mg kg^{-1}	0.82	0.82	0.86	0.97	0.69	0.64	0.80	0.66
SEm ±	0.017		0.017		0.015		0.016	
CD (P= 0.05)	0.04		0.04		0.03		0.04	

DAS: Days After Sowing, CD: Critical difference

A critical examination on fortification of iodine in spinach with recommended doses of fertilizer (NPK)/NPK + FYM revealed that iodine application either KI or KIO_3 improved the macronutrient content i.e. Ca and Mg) in spinach. FYM (1% organic carbon) application with chemical fertilizers (N, P, K) reduced the magnesium (45 DAS + 60 DAS) in spinach; whereas calcium content (60 DAS) were improved with the application of FYM with N, P, K fertilizers and iodine.

Conclusion

The aim of our research was to determine the effect of different forms and levels of Iodine and in addition to the recommended doses of fertilizers (NPK) or chemical fertilizer + FYM on Mineral nutrient contents of spinach Application of potassium Iodide/Iodine in spinach with recommended doses of fertilizers (NPK)/NPK + FYM significantly improved the Calcium and Magnesium content in spinach leaves FYM (1% organic carbon) application with chemical fertilizers (N, P & K) reduced magnesium content at both the stage (45 DAS and 60 DAS) whereas calcium content were enhanced at (60 DAS) stages.

References

1. World Health Organization and Food and Agriculture Organization.
2. Hughes O, Marion B. Introductory foods, 5th Edn. The Mac Millan Co., London. 1970, 59-85.
3. Duckworth RB. Fruits and Vegetables; Pergamon Press: Oxford, 1966, 142-159.
4. Svanberg SJM, Nyman EMGL. Effect of boiling and storage on dietary fiber and digestible carbohydrates in various cultivars of carrots. J. Sci. Food Agri. 1997; 73:245-254.
5. Schneeman BO. Dietary Fiber. Food Tech. 1989; 43:133-139.
6. Welch RM. the impact of mineral nutrients in food crops on global health. Plant Soil. 2002; 247:83-90.
7. Kongale NV. Efficiency of boronated superphosphate in comparison with other phosphate sources for groundnut, sunflower and cauliflower. Dissertation submitted to Marathwada Agricultural University for M.Sc., 1986.
8. Summai RC, Bhattacharya P, Das Gupta SK. Effect of zinc and iron on yield attributes of mustard (CVT 59). Indian Agriculturist. 1980; 24:201-205.
9. Patel PC, Patel MS, Kalyan Sundaram NK. Effect of foliar spray of iron and sulphur on fruit yield of chlorotic acid lime. J. Ind. Soc. of Soil Sci. 1997; 45:529-533.
10. Pradhan SB. Status of fertilizer use in developing countries of Asia and Pacific region. Proc, 1992.
11. Lomnitski L, Bergman M, Nyska A, Ben-Shaul V, Grossman S. Composition, efficiency and safety of spinach extracts. Nutrition and cancer. 2003; 46(2):222-231.
12. Banerjee A, Datta JK, Mondal NK. Biochemical changes in leaves of mustard under the influence of different fertilizers and cycocel. Journal of Agricultural Technology. 2012; 8(4):1397-1411.
13. Hageman RH, Hodge ES, McHargue JS. Effect of potassium iodide on the ascorbic acid content and growth of tomato plants. Plant Physiol. 1942; 17(3):465-472.
14. Krishnaswamy K, Raghuramulu N. Bioactive phytochemicals with emphasis on dietary practices. Indian Journal of Medical Research. 1998; 108:167-181.