OPEN ACCESS Freely available online

Journal of Horticulture

ISSN: 2376-0354

Short Communication

Agronomic Biofortification of Food Crops with Iron

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ABSTRACT

Agronomic biofortification or ferti fortification is the process of increasing the concentration of essential elements in the edible portion of plant products through soil application, foliar application or fertigation. This strategy has been developed as a food based method to address widespread deficiencies in Fe and Zn that remain prevalent to a great extent in various countries. Micronutrient malnutrition, which is also known as "hidden hunger" is a major health issue in most parts of the world and affects more than 2 billion people. More than 60% of the world's population is Fe deficient Anaemia is the most common Fe deficiency disorder. Nearly 50% of women of reproductive age and 26% of men in the age group of 15-59 years are anaemic. This area has not been widely explored in vegetables yet, hence, this concept on proper research and study might help reduce the problem of malnutrition.

Keywords: Biofortification; Micronutrients; Anaemia; Fe; Malnutrition

INTRODUCTION

World Health Organization has estimated that biofortification of iron could help in curing two billion people suffering from iron deficiency-induced anemia. The mineral elements like Zn, Fe and Cu are as crucial for human health as organic compounds such as carbohydrates, fats, protein and vitamins. The daily dietary intake of a young adult ranges from 10 mg-27 mg for Fe, 2 mg-3 mg for Cu and 15 mg for Zn. Intake less than these values can slow down physiological processes. The relative studies on biofortification in vegetable crops are countable and those which have been published are reported here under [1].

DECSRIPTION

Mundra and Bhati conducted a field experiment at Jobner (Rajasthan), revealed that the application of 10 kg and 20 kg $FeSO_4$ ha^{-1} significantly reduce P and Mn concentration in seed and its uptake but increased the uptake of N and Fe compared to control in cowpea.

Fawzi, et al. used liquid metalosates of Iron (Fe), Manganese (Mn) and Zinc (Zn) (amino-acid-chelated) compounds which were applied foliarly at a concentration of 100 ppm of the element, either individually or in combinations in pea and cowpea.

It was observed that foliar application of Fe increased Fe concentration in pea seeds upto 384 ppm (dry weight) as compared to control (196 ppm). Similar results were obtained with cowpea. Foliar application leadto increase in Fe concentration upto 278 ppm as compared to control (248 ppm). Kumpawat and Manohar reported that the seed protein content of gram was increased by the application of 30 kg P2O5 ha-1 and 20 kg FeSO4 ha-1 along with seed inoculation over control [2].

Shukla and Shukla observed that increase in Fe and P concentration in seeds of chickpea with increasing levels of $FeSO_4$ up to 50 kg ha^{-1} over control. Mahriya and Meena recorded that application of Fe up to 4 kg ha^{-1} significantly increased protein content of cowpea, whereas, Fe content of cowpea seeds significantly increased with the application of iron @ 6.0 kg ha^{-1} over lower levels. Singh observed that application of ferrous sulphate and zinc sulphate irrespective of Rhizobium inoculation significantly increased the Fe and Zn content of the in grain and straw of chickpea crop over control.

Kumar observed that the application of 20 kg P_2O_5 $ha^{-1}$and 4 kg Fe ha^{-1} significantly increased content and uptake of N and Fe in seed and stover but P content decreased significantly with increasing levels of iron in cowpea crop over control.

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Received: 20-Jan-2020, Manuscript No. HORTICULTURE-24-3147; **Editor assigned:** 23-Jan-2020, PreQC No. HORTICULTURE-24-3147 (PQ); **Reviewed:** 06-Feb-2020, QC No. HORTICULTURE-24-3147; **Revised:** 22-May-2024, Manuscript No. HORTICULTURE-24-3147 (R); **Published:** 19-Jun-2024, DOI: 10.35248/2376-0354.24.11.361.

Citation: Budhani A, Bhanderi DR, Saravaiya SN, Patel DP (2024) Agronomic Biofortification of Food Crops with Iron. J Hortic. 11:361.

Kumawat, et al. noted that soil application of 25 kg $FeSO_4$ ha-1 significantly increased Fe concentration in green leaves of mung bean as compared to control. Singh, et al. conducted an experiment on enrichment of rice cultivars with Fe at different plant growth stages through ferti-fortification. It was observed that Fe concentration in rice panicles of variety PR120 increased significantly at 0.5% $FeSO_4$ (72.8 mg kg^{-1}) as well as 1% $FeSO_4$ (171.5 mg kg^{-1}) as compared to control (28.8 mg kg^{-1}) [3].

Ali, et al. reported that the highest concentration of iron in leaves (794.90 µg g^{-1}), in stems (634.27 µg g^{-1}) and in grain (146.43 µg g^{-1}) was obtained with foliar application of 1.5% $FeSO_4$ at branching+1.5% $FeSO_4$ at flowering in mung bean. Marquez-Quiroz, et al. reported that the Fe content had values varying from 73.1 ppm to 97.2 ppm and the highest Fe content was found in cowpea plants treated with 100 µM L^{-1} ferrous sulfate and 50 µM L^{-1} iron chelate, with an increase of 29.4% and 32.0%, respectively, over the control [4].

Pingoliya, et al. noted that soil application of $FeSO_4$ @ 7.5 kg ha^{-1} resulted in higher protein content of 23.45% in chickpea as compared to control (19.69%). Singh, et al. observed that highest concentration of iron was observed when it was sprayed in combination with urea and zinc (46.34 mg kg^{-1}) followed by spray of zinc+iron (44.24 mg kg^{-1}), iron+urea (44.13 mg kg^{-1}), iron alone (44.11 mg kg^{-1}) and no iron spray (36.18 mg kg^{-1}) in chickpea. Togay, et al. reported that application of 20 kg $FeSO_4$ ha^{-1} resulted in higher concentration of Fe in lentil seeds in 2006-2007 (86.7 mg kg^{-1}) and 2008-2009 (64.5 mg kg^{-1}) as compared to control (48.6 mg kg^{-1} and 48.8 mg kg^{-1}, respectively,). Kabir, et al. reported that highest Fe concentration of 85 ± 0.7 mg kg^{-1} in grains of pea was found with foliar spray Fe sulfate (73.7 mg l^{-1} Fe) at the time of flowering [5].

Saleem, et al. reported that soil application of NPK+30 kg Zn and Fe each in maize resulted in higher Fe content in the grain of 122.7 mg kg^{-1} as compared to control (74.1 mg kg^{-1}).

CONCLUSION

Hence, agronomic biofortification is a potential cost-effective and sustainable agronomic way to enrich the micronutrient content of food as well as vegetable crops. It is an upcoming strategy for dealing with the deficiencies of micronutrients in the developing country.

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