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Enhancing Nutritional Value of Jute Leafy Vegetable through Ferti-Fortification

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INTRODUCTION

Micronutrient malnutrition is one of the serious health problems in the developing world. In India, about 230 million people are estimated to be undernourished, that account for more than 27% of the world's undernourished population (Chakraborti *et al.,* 2011). Zinc (Zn) and Iron (Fe)deficiencies are growing public health and socioeconomic issue, particularly in the developing countries (Welch and Graham 2004). Nearly five lakh children under five years of age die annually because of Zn and Fe deficiencies (Black *et al.,* 2008).Green and leafy vegetables can make an important contribution to the diet as they are a rich source of micronutrients including pro-vitamin A. In India, tender leaves of jute (*Corchorusolitorius*)is popularly knownas *'pat sag'* being used as vegetable in daily diet specially in West Bengal from March – July as it is a very good source of proteins, vitamins (A, C, E) and they are also rich in mineral nutrients like calcium and iron (Choudhary *et al.,* 2013) and have laxative properties. Moreover, jute leaves are known to contain high levels of iron and folate, which are useful for the prevention of anemia (Steyn *et al.,* 2001). Notwithstanding its importance as a leafy vegetable, very little efforts have been made for enhancing its foliage yield and nutritional quality especially Zn and Fe. Bio-fortification is a recent approach aimed at increasing the bio-available nutrients, such as Fe and Zn, in these staple crops rather than using fortificants or supplements (Waters and Sankaran 2011, White and Broadley 2005). Agronomic bio-fortification increasing nutrient contained in edible parts through ferti-fortificationin is one of the cheapest options to enhance the concentration of mineral nutrient and micronutrient in jute leaf. Moreover, nutrient management with ferti-fortification to enhance crop yield and quality is one of the sustainable and low-cost strategies to improve micronutrient content in edible portions of crops. Since most of the leafy vegetable foliage biomass is economic; they require a good amount of nitrogenous fertilizer for their quick growth, good vegetative growth as well as nitrogen deficiency exerts its effect on plant growth through reduced leaf area index and hence low light interception and low biomass production. Application of nitrogen to increase yield in leafy vegetables is a well-recognized practice (Sarkar *et al.,* 2014).Keeping the above facts in view about the application of nitrogen to enhance foliage yield and Zn and Fe application for enriching the micronutrient content in jute leaves, the present study was carried out to investigate the effect of N management on bio-fortification of Zn and Fe on foliage yield of jute.

A field experiment was conducted at the experimental field of CRIJAF, Barrackpore, duringpre-*kharif* season of 2014 and 2015. The soil was clay loam in texture, with medium organic carbon (0.65%), available N (295 kg/ha) and K (180 kg/ha), while the available P content in soil was high (35 kg/ha). The soil DTPA- Fe and Zn contents were 6.27 and 1.10 mg/kg as against the critical limit of 4.5 and 0.60 mg/kg, respectively. The experiment was conducted in factorial randomised block design with 3 levels nitrogen doses *i.e* 40 kg/ha 80 kg/ha and 120 kg/ha and micronutrients application (no micronutrient, foliar spray of 0.2% $ZnSO_4$ and 0.2%$FeSO_4$, soil application of $ZnSO_4$@25 kg/ha + $FeSO_4$ @10 kg /ha) with three replication. The jute variety JRO-8432 was sown on 7[th] April 2014 and 2015 at 25 cm spacing. The half dose of N and a full dose of P (30 kg/ha), K(30 kg/ha) and $ZnSO_4$ @ 25 kg/ha + $FeSO_4$ @10 kg /ha were applied at the time of sowing. Remaining and half dose of N as per treatments applied at 25 days after crop sowing (DAS). Foliar spray of micronutrient as per treatment was applied at 25 DAS. The crop was harvested at 45 DAS when the jute plant attained the height of about 40 cm. The leaves were

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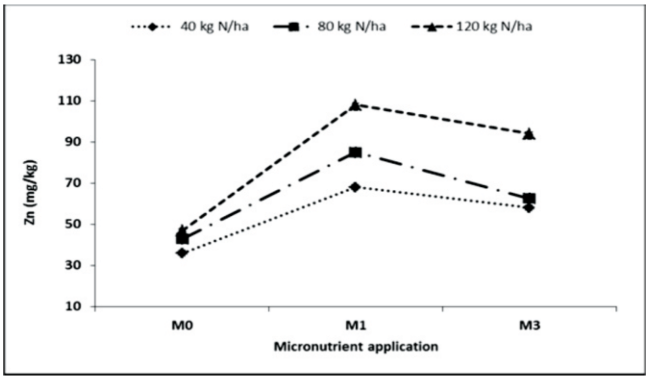
analysed for N, Zn and Fe content and results are reported on dry weight basis. Nitrogencontent in leaf was determined by using the Micro-Kjeldahl nitrogen method. The value of nitrogen was multiplied by 6.25 to obtain crude protein content.Fe and Zn concentrations were analyzed using atomicabsorption spectrometer model: Perkin Elmer 5100.Significant effect of different nitrogen doses on foliage yield of jute has been recorded (Table 1).

Table 1: Effect of nitrogen and micronutrient application on yield and nutrients content

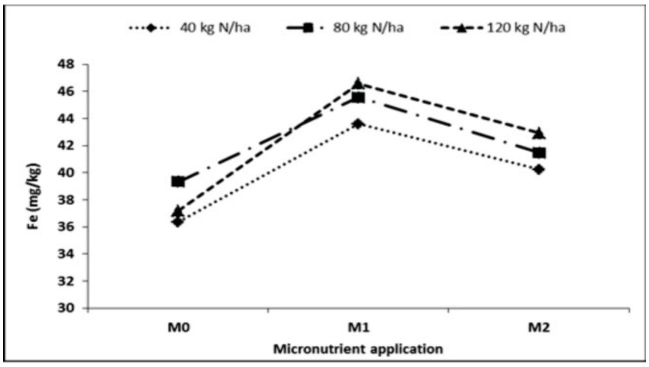
Treatments	Foliage yield (kg/ha)	N (%)	Protein (g/100g)	Zinc (mg/kg)	Iron (mg/kg)
Nitrogen doses					
40 kg/ha	2769	1.97	13.8	54.0	40.24
80 kg/ha	2953	2.62	16.0	63.5	42.95
120 kg/ha	3230	2.72	17.8	81.0	41.47
SEm (±)	92.0	0.19	2.09	3.8	1.46
LSD (P=0.05)	278	0.60	NS	NS	NS
Micronutrient application					
Control (without Fe and Zn)	2844	2.32	15.3	42.3	37.87
Foliar spray of micronutrient (0.2 % ZnSO4 + 0.2 % FeSo4)	3069	2.70	16.0	87.0	45.25
Soil application of micronutrient (25 kg/ha $ZnSO_4$ and 10 kg/ha $FeSO_4$)	3038	2.29	16.2	69.3	41.79
SEm (±)	92.0	0.19	2.09	3.6	1.46
LSD (P=0.05)	NS	NS	NS	19.8	4.43

The highest foliage yield (3230 kg/ha) was recorded with 120 kg N/ha, which was significantly higher over 40 kg N/ha and at par with 80 kg/ha. As nitrogen playsa very important role in enhancing the growth of shoots as well as leaf area, thereby the foliage yield of leafy vegetable Nitrogen content followed the same trend as foliage yield. Protein levels in leaves did not vary significantly with nitrogen doses, though the maximum protein level (17.8%) was recorded with 120 kg N/ha and minimum (13.8%) with 40 kg N/ha. Nitrogen uptake was higher with the application of higher doses of nitrogen and protein is directly related to nitrogen recorded higher level in higher doses. Micronutrient application did not significantly increase the foliage yield, but the higher yield was recorded with 0.2% foliage spray of $ZnSO_4$ and $FeSO_4$. As the DTPA-extractable Fe and Zn levels in the soil were adequate (6.27 mg/kg Fe and 1.10mg/kg Zn).Additional application of these micronutrients through fertilizers did not increase the yields. Increasingdoses of N did not significantly increase the Zn and Fe content in jute leaf, but a higher concentration of Zn and Fe were recorded in a higher dose of nitrogen. Similarly, micronutrient application did not increase significantly either N or protein concentration in jute leaves. While micronutrientapplication significantly increased Zn (87 mg/kg) and Fe (45.25 mg/kg)content in leaf compared to control.Foliar application and soil application of micronutrient did not influence significantly the Zn and Fe content in jute leaves but the higher value of those waswith foliar application of nutrient(Fig. 1 and 2).



M_0-Control, M_1-Foliar spray of 0.2% $ZnSO_4$ and 0.2% $FeSO_4$, M_3-Soil application of $ZnSO_4$ @ 25 kg/ha + $FeSO_4$ @10 kg /ha.

Fig.1: Interaction effect of nitrogen doses and micronutrient application of zn content in jute leaves



M_0-Control, M1-Foliar spray of 0.2% ZnSO4 and 0.2% FeSO4, M3-Soil application of ZnSO4 @ 25 kg/ha + FeSO4 @10 kg /ha

Fig.2: Interaction effect of nitrogen doses and micronutrient application of Fe content in jute leaves.

Wei *et al.* (2012) reported increased grain Fe concentration and bioavailability in rice with foliarapplication of $FeSO_4$ and addition of $ZnSO_4$ to foliar Fe application increased both Fe and Zn content without altering Fe content and bioavailability. Improved grain Zn concentration in rice with the application of Zn-coated urea fertilizer was also reported by Shivay *et al*. (2008). Similarly, Mishra *et al.* (2015) reported that external application of $FeSO_4$ and $ZnSO_4$ enhanced the Fe and Zn concentration in sorghum grain.

CONCLUSION

One field experiment was conducted to study the effect of applied nitrogen with different nitrogen doses *i.e.* 40 kg/ha 80 kg/ha and 120 kg/ha and micronutrients application viz. control, foliar spray of 0.2% ZnSO4 and 0.2% FeSO4, soil application of ZnSO4 @ 25 kg/ha + FeSO4 @10 kg /ha,with three replication to enhance the yield and nutritional value of leafy vegetable jute. Significantly higher foliage yield and nitrogen content in leaves were recorded with 80 kg/ha. Protein content, micronutrient contents were at par with all nitrogen doses.Micronutrient application did not increase significantly, either N or protein concentration in jute leaves, but higher values recorded with this application. Foliar application of Zn and Fe recorded the higher value of Zn and Fe content in leaves compared to soil application. Therefore it may be concluded that application of 0.2% foliage spray of $ZnSO_4$ and $FeSO_4$along with recommended 80kg of N/ ha not only enhanced the yield but also enriched the leafy jute vegetable with protein and Fe and Zn enrich will help to control malnutrition in human being.

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