

Short Communication

Mineral content of red skinned potatoes of Eastern India

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ABSTRACT

Potato tuber colour is an important factor that influences consumer preferences. Eastern plain region of India contributes about 50% of total potato acreage and production. Consumers in this region generally prefer red skinned varieties. Growing awareness for nutrient rich food can create a niche market for nutritious potatoes. Potato is crop of choice for mineral biofortification owing to better mineral bioavailability due to its high ascorbic acid and minimal phytate content. Iron and zinc are the essentially required minerals for good health. Considering the nutritional importance of these elements and wider prevalence of their deficiency in Indian sub-continent, thirteen Eastern regions red skinned advanced hybrids and varieties were evaluated to find the genetic diversity for iron and zinc content. A significant wide range of contents was observed for both the elements. High heritability of both mineral suggests feasibility of selecting genotypes for breeding nutrient rich varieties. Identified genotypes can be utilised as parental lines for future breeding programme and can be released as nutrient rich potato variety.

Key words: Potato, eastern India, mineral, genetic diversity

INTRODUCTION

Potato is a nutritious crop that has proven capacity of providing food security and mitigating poverty. This crop yields quick and better nutritious produce per unit area and fits well into different cropping pattern. The iron content of potatoes is comparable to most other vegetables and is better than white rice while it is humble source of zinc. The average iron content in whole potato is 0.78 mg /100 g fresh weight (FW) while average zinc content is 0.29 mg / 100 g FW. Presence of promoters and inhibitors components is essential parameters for any biofortification activity. Potato has minimal phytate content that inhibits the nutrient bioavailability while known source of ascorbic acid, an important factor for better nutrient absorption. Iron and zinc deficiency are major risk factors affecting global population especially the poor people. In India 79 % of children (<3 years), 55 % women and 24% men are iron deficient (NFHS-3) while 25% of the Indian population is at risk of zinc deficiency.

Globally India is the second largest producer of potato after China. Per capita consumption of potato in India is 20 kg and this will increase to 50 kg by

2050. With the increasing trend for potato consumption and wider population coverage there is a need to discover the nutritional composition of varied potato genotypes as it will affect the health of common mass.

Breeding of any crop involves selection of new parental lines based on the results of characterisation of germplasm for trait of interest and developing new cross combinations. Identification of high and low iron and zinc containing potato genotypes can be used in breeding program as parental material and for introgression of high Fe and Zn controlling genes or QTLs.

Thirteen advanced hybrids and varieties were raised under uniform field and management conditions at the ICAR-CPRS, Patna, India during 2015-16 in plots of 4.8 m² with inter and intra row spacing of 60 cm by 20 cm. Freshly harvested unblemished 10 tubers were cleaned with tap water followed by rinsing in high purity 0.1 N HCL and finally with double distilled water. Air dried samples in triplicate were peeled with stainless steel peeler, sliced lengthwise and oven dried at 70 °C. The acid digest grinded samples were used in atomic absorption spectrometer

for determination of iron and zinc content. Statistical analyses were performed by means of TNAUSTAT software (Manivannan, 2014). The mean values were compared by One-Way ANOVA.

Thirteen advanced stage hybrids and varieties (**Table 1**) were evaluated for iron and zinc content. Analysis of variance depicted significant variations ($p < 0.01$) for the content of both the elements.

Table 1. Pedigree of coloured skinned advanced hybrids and varieties

Genotypes	Parentage	Genotypes	Parentage
PS/7-7	Kufri Arun × Desiree	PS/9-09	J/96-84 × CP 2132
PS/5-75	CP 2376 × Kufri Kanchan	PS/6-88	Kufri Arun × CP 3192
RH-3	Kufri Pukhraj × CP 3192	MS/08-88	CP1923 × JN 2207
P-7	Kufri Arun × CP 3192	PS/8-31	Kufri Arun × PRT-19
PS/78-1	PRT 17 × CP 3192	PS/6-24	CP 2376 × D-150
P-14	MS/89-1095 × CP 3290	Rajendra-II	Clonal selection of PC 46
Rajendra-III	Clonal selection of PC 676		

The iron contents ranged from 19.28-63.94 ppm dry weight basis and the mean value was 33.03 ppm (**Table 2**). The highest performing genotype was the Rajendra-II containing 3 times more iron than the lowest ranking advanced hybrid PS/9-09. The iron content is reported up to 11.2 mg /kg FW (Rivero *et al*, 2003). With the average dry matter content of 20 % the content varies to 56 ppm and the iron content of US varieties and advanced breeding selections (17 to 62 ppm dry weight basis; Brown *et al*, 2010) were comparable to our study. In earlier analysis of Indian potato genotypes the iron content varies between 21 to 53 ppm in tuber flesh on dry weight basis (Trehan and Sharma, 1996).

In the present study the zinc content varied between 7.03-39.20 ppm on dry weight basis. Advanced hybrid P/6-24 had the highest zinc content followed by Rajendra-II. Zinc content in potato germplasm has been reported to be in range of 0.22 (Tuberosum gp; Rivero *et al*, 2003) -0.76 (Andigena gp) mg/100g FW of tuber (Andre *et al*, 2007). Considering an average 20 % dry matter, the zinc content (11-38 ppm dry weight basis) in these studies corroborates to that of results of our study while zinc content of United States genotypes and previous reports of Indian genotypes was on lower side ie 12 to 18 ppm (Brown *et al*, 2011) and 10 to 18 ppm (Trehan and Sharma, 1996), respectively on dry weight basis.

Table 2. Iron and zinc content in coloured skinned advanced hybrids and varieties

Genotype	Iron content (mg/kg DW/ppm)	Zinc content (mg/kg DW/ppm)
Rajendra- II	63.94	30.62
PS/5-75	36.10	16.6
PS/7-7	29.72	12.06
PS/9-09	19.28	7.03
PS/6-88	30.19	18.51
RH-3	32.68	19.88
P-7	29.00	16.96
MS/08-88	30.38	19.90
PS/8-31	32.48	9.71

PS/78-1	21.02	12.39
Rajendra- III	22.67	17.79
P-14	43.04	19.57
P/6-24	38.93	39.20
Mean	33.03	18.48
Range	19.28-63.94	7.03-39.20
Std. Error	2.80	2.88
Std. deviation	4.98	5.00

Phenotypic and genotypic variance estimates depict the extent of variation in the present germplasm. Genotypic variance was high for both traits indicating sufficient variability in the genotypes (**Table 3**).

The better variability magnitude of the present germplasm may be due to varied pedigree of each genotype thus broadening the genetic base. Broad-sense heritability is the ratio of genotypic variance/phenotypic variance that provides an estimate of the proportion of total transmissible variation. It predicts the changes affected to the trait by virtue of selection. High estimates of heritability (broad sense) were obtained for both the characters studied depicting feasibility for improvement of these characters through direct selection (Table 3). Similarly, Brown *et al*, 2010 recorded high iron content in red-skinned clones with high heritability while high zinc variability and heritability was observed in russet potato clones (Brown *et al*, 2011). Heritability estimates along with genetic advance are useful in selection of individuals. Heritable variation can be found out with greater degree of accuracy when studied with genetic

advance. The genetic advance was moderate for iron and zinc content but this may be compensated by the high heritability values and indicates additive gene action governing these traits and their suitability of direct selection for further improvement. Correlation between iron and zinc content was moderate ($r=0.65$) in contrast to weak correlation ($r = 0.35$) observed by (Andre *et al*, 2007) while highly significant ($r=-0.70$ to 0.84 , $p<0.01$) to non significant correlations obtained by Brown *et al*, 2011.

The bioavailability of potato iron is higher than those of cereals and leguminous crops due to higher ascorbic acid content. In the present study the correlation estimate revealed no significant relationship between iron and ascorbic acid content (data not shown). Brown *et al.*, (2010) also did not observe significant relationship between iron and ascorbic acid.

The suitable genotypes identified will be used as parental lines for specialty potato breeding programme and the advanced hybrids can be released as nutrient rich potato variety.

Table 3. Variance, heritability and genetic advance for iron and zinc content

	Iron	Zinc
Genotypic variance	123.60	64.52
Phenotypic variance	131.93	72.85
Heritability	93.68	88.56
Genetic advance	22.16	15.57
Genetic advance (% of mean)	67.10	84.26

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