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Influence of soil, environment, crop and verities on protein and minerals (in, Zn, Cu and Mn), in northern Karnataka

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Abstract
Small millets are climate smart cereals and they are rich in fibre, protein and minerals which are essential for human good health. Now days, number of nations including India suffering from malnutrition. The aim of investigation is to know what factors influence on nutrients of small millets are. presently There were eight different genotypes were taken from four small millet crops *viz*., Finger millet, foxtail millet, proso millet and little millet and experiments were carried out in Hanumanamatti and Dhrwad in zone -8 and Mudhol in zone-3 of Karnataka. These genotypes produced protein range from 7.05 per cent (DHFM-78-3 at finger millet) to 11.975 per cent (DHPM-2769 in proso millet), iron content recorded range from1.437 mg/100 g (karisavi grain) to 5.686 mg/ 100 (DHPM-2769in proso millet at Dharwad). Variability of manganese range between 0.0962 mg/ 100 g (DHPM-2769 at Dharwad) to 0.931 mg /100g of (DHFM-78-3 in finger millet at Hanumanamatti), while copper range from 0.207 mg /100 g (DHLM-36-3 in little millet at Hanumanamatti) to 0.934 mg/100 g (DHLM-36-3 in little millet at Mudhol). The zinc content varied from 0.364 mg/100g (Mallesavi in little millet at Hanumanamatti) to 1.262 mg/100g of grain (DHPM-2769, Mudhol).

Keywords: Foxtail millet, little millet, finger millet, proso millet, nutrition, soil, zinc, iron, copper and magnesium, protein

Introduction
The group of small millets is represented by finger millet *(Eleusine coracana)* little millet *(Panicum sumatrense)*, foxtail millet (*Setaria italic*) barnyard millet (*Echinochloa frumentacea) and* Proso millet (*Panicum miliaceum*). Millets are group of small grained cereal food crops which are highly nutritious and grown under marginal/ low fertile soils with very low inputs such as fertilizers and pesticides**.** These crops largely contribute to food and nutritional security of India. Most of millet crops are native of India and are popularly known as nutri cereal as they provide most of the nutrients required for normal functioning of human body. Millets are rain fed crops and are grown in regions with low rainfall and thus resume greater importance for sustained agriculture and food security. Millets require very less water as compared to rice and wheat and considered drought tolerant crops. These crops are majority grown in regions receiving less than 450 mm rain fall (compared to about 700 mm for maize). There are twenty amino acids that help to form the thousands of different proteins in our body and our body needs protein for growth and maintenance of tissues. Proteins do most their work in the cell and various jobs which includes antibodies production against microbes. Similarly, essential elements like iron, zinc, manganese and copper also play big role in metabolic activities which help to lead normal life. These all things insist to know quantity of protein and essential minerals in different genotypes of different small millets in different locations.

Materials and Method
Eight small millets genotypes *viz*., DHFt-109-3 and Halnavani of foxtail millet and DHLM-36-3, Karisavi and Mallesavi of little millet and DHPM-2769 and DHPM-2181 of proso millet and

DHFM-78-3 of finger millet were grown at Hanumanamatti (red soil and zone-8 of Karnataka), Dharwad (black soil and zone 8 of Karnataka) and Mudhol (black soil and zone-3 of Karnataka) collected the grains and estimated protein and minerals *viz*., iron, manganese, copper and zinc according to AOAC 2005. The experiment was performed at the Department of Food and nutrition, College of Community Science, University of Agricultural Sciences, Dharwad, Karnataka state, India. Eight cultivars from four small millets were evaluated in three replications.

Eight small millets genotypes *viz*., DHFt-109-3 and Halnavani in foxtail millet and DHLM-36-3, Karisavi and Mallesavi in little millet and DHPM-2769 and DHPM-2181 in proso millet and DHFM-78-3 in finger millet were grown at Hanumanamatti (red soil and zone-8 of Karnataka), Dharwad (black soil and zone 8 of Karnataka) and Mudhol (black soil and zone-3 of Karnataka) collect the grains and estimated protein and essential minerals and estimation procedure has been given below.

Protein estimation

The experiment was performed at Food Technology Department of the Community Science College, University of Agricultural Sciences, Dharwad, Karnataka state, India. Eight cultures from four small millets were evaluated in three replications. Out of four crops foxtail millet genotypes produced maximum followed by proso millet, little millet and finger millet.

The nitrogen analyses were performed according to the INCT-CA method N-001/1 (Kjeldahl method) using the salt sodium sulfate (Na_2SO_4 P.A., Vetec V000121) and the copper sulfate catalyst ($CuSO_4.5H_2O$ P.A., Isofar 321) as digestion mixture components. However, different ratios between these compounds (salt-to-catalyst ratio) and different amounts of the digestion mixture per aliquot were used. The same concentrated sulfuric acid was used for all analyses (H_2SO_4 technical grade 95% Vetec V0T0145).

The experiment lasted nine days, and each group of samples (low-nitrogen, high-nitrogen, and the standard) was analyzed for three consecutive days.

To perform the digestion procedures, approximately 200 mg of the samples were poured into glass tubes followed by the addition of the digestion mixture according to the aforementioned treatments. Subsequently, 5 mL of sulfuric acid was added. The tubes were then heated up to 400°C, and from this moment began the digestion time count. The digestion end-point was defined when the solution became liquid and translucent, and the brownish smoke stopped being released. The tubes were allowed to cool at room temperature. After that, distilled water was added to the tube in sufficient quantity to double the final volume of the solution and then manually stirred.

Then, the contents of the tubes were steam-distilled in the Kjeldahl distillation apparatus (TE-036/1, *Tecnal Equipamentos para Laboratórios*, Piracicaba, and São Paulo State, Brazil) using 25 mL of a sodium hydroxide solution (500 g L^{-1}, NaOH P.A., ACS Vetec 1137). The steam obtained from distillation was collected in an Erlenmeyer flask containing 20 mL of a boric acid solution (40 g L^{-1}, H_3BO_3 P.A., Proquímios). Methyl red and bromocresol green were used as indicators. The final volume of the distilled was standardized to 100 mL.

The distilled was then titrated with a standard solution of hydrochloric acid (0.02 N for low-nitrogen materials and 0.05 N for the standard and high-nitrogen materials, HCl P.A., Vetec V000154). The hydrochloric acid solutions were previously standardizing using sodium carbonate solutions (Na_2CO_3 anhydrous P.A., Isofar 349) as described in method INCT-CA N-001/1.

Nitrogen contents in the samples were estimated through the equation:

Where,

$$N = \frac{(V - B) X\ Ne\ X\ f\ X\ 14\ X\ 1000}{A} \quad (1)$$

N is the nitrogen content (g $kg^{-1)}$, V is the volume of hydrochloric acid solution in the titration (mL), B is the volume of hydrochloric acid solution obtained in the titration of the blanks (mL), Ne is the expected normality of hydrochloric acid solution (0.02 or 0.05 N), *f* is the correction factor of the hydrochloric acid normality obtained by using sodium carbonate solutions, and A is the aliquot weight (mg).

The evaluations of the analytical standard (Lysine-HCl) were performed based on the nitrogen recovery from the aliquots (g $g^{-1)}$. The actual content of nitrogen in Lysine-HCl was established through the chemical composition of the molecule and the purity of the material. The dry matter content of the standard was performed in triplicate by the Karl Fisher titration method using the equipment 870 KF Titrino plus (Metrohm, Herisau, Switzerland). The nitrogen content of the standard was 137.3 g N kg^{-1} of dry matter.

The statistical analyses of the nitrogen recovery of the standard were performed according to the model.

$$Y_{ijkl} = \mu + R, + RQ_{ij} + D_k + \varepsilon_{ijkl} \quad (2)$$

Where,

Y_{ijkl} is the nitrogen recovery in the aliquot l, at day k, using salt-to-metal catalyst ratio i, and amount of digestion mixture j; μ is the general constant; R_i is the effect of salt-to-metal catalyst ratio in the digestion mixture i (fixed effect); Q_j is the effect of digestion mixture amount j (fixed effect); RQ_{ij} is the interaction between the main effects (fixed effect); D_k is the effect of the day of analysis k (random effect); and ε_{ijkl} is the random error.

Based on the results of analysis of variance, the evaluation of nitrogen recovery from the standard was performed through Student's *t*-test considering the hypotheses:

H_o: $\mu = 1$ (3a)

H_a: $\mu \neq 1$ (3b)

When the null hypothesis was accepted (3a), it was concluded that there is complete recovery of the nitrogen from the standard. The statistical analyses of the nitrogen content and digestion time for high- and low-nitrogen materials were performed separately. It is noteworthy that the nitrogen contents were evaluated on as-is basis in order to avoid the accumulation of error from the estimation of the total dry matter content. The model was:

$$Y_{ijklm} = \mu + M_i + R_j + Q_k + MR_{ij}, + MQ_{ik}, + RQ_{jk} + MRQ_{ijk} + D_l + \varepsilon ijklm \quad (4)$$

Where:

Y_{ijklm} is nitrogen content or digestion time in the aliquot m, at day l, from sample i, using salt-to-metal catalyst ratio j, and digestion mixture amount k; μ is the general constant; M_i is the sample effect i (fixed effect); R_j is the effect of salt-to-metal catalyst ratio in the digestion mixture j (fixed effect); Q_k is the

effect of digestion mixture amount k (fixed effect); MR_{ij}, MQ_{ik}, RQ_{jk} and MRQ_{ijk} are the interactions between the main effects (fixed effects); D_l is the effect of the day of analysis (random effect); and ε_{ijklm} is the random error.
Subsequently, another set of analysis of variance was performed for the nitrogen content of each sample evaluated by each treatment according to the model.

Where,

$$Y_{ij} = \mu + D_i + \varepsilon_{(i)j} \quad (5)$$

Y_{ij} is the nitrogen content in the aliquot j analysed on day i; μ is the general constant; D_i is the effect of the day of analysis i (random effect), and $\varepsilon_{(i)j}$ is the random error.
The estimate of residual variance (variability between aliquots) obtained from model (5) was used to calculate the repeatability of nitrogen contents according to each treatment as follows:

$$r = \frac{\sqrt{\hat{\sigma}^2_e}}{\overline{\overline{Y}}} \text{ x100 (6)}$$

Where:
r is the standardized repeatability (%), $\hat{\sigma}^2_e$ is the residual variance, and $\overline{\overline{Y}}$ is the average content of nitrogen.
All statistical procedures were carried out using the Mixed procedure of SAS 9.4 (2014) and adopting $\alpha = 0.05$. When necessary, average values were compared using the Fisher's Least Significant Difference.

Estimation of minerals
A Phoenix 986 AA Win V2.1 atomic absorption spectrometer with self-reversal background correction mode (SR lamp BGC mode). The operating parameters for working elements were set as recommended by the manufacturer. The elements were determined by using air-acetylene flame. Microwave apparatus Ethod D (Milestone, Sorisole, Italy) with maximum pressure 1450 psi and maximum temperature 300 ºC. All reagents used in the present work were an analytical reagent grade (Merck). Double distilled deionized water was used for all dilutions. HNO3 and HClO4 were GR quality (Merck). All the plastic and glassware were cleaned by soaking in dilute HNO3 and were rinsed with distilled water prior to use. The standard solutions used for calibration were produced by diluting a stock solution of 1000 mg/L of the given elements supplied by (Merck). The calibration curves for analyte metals were drawn after setting various parameters of FAAS including wavelength, slit width, lamp current at an optimum level. Tea samples were purchased from supermarkets in Aleppo city-Syria in the year 2010. The microwave digestions were carried out in the experimental heating program for the digestion procedure which is given in Table-1. TABLE-1 HEATING PROGRAM FOR THE DIGESTION TEA LEAVE PROCEDURE Step Time (min) Power (Watt) Step Time (min) Power (Watt) 1 2 250 4 2 400 2 2 0 5 8 600 3 2 250 Ventilation 10 0 After the optimization of the digestion conditions, about 1 g of an oven-dried tea sample was put in microwave tube with 6 mL of concentrated HNO3 and 2 mL of concentrated HClO4 and placed in 70 ºC water path for 10 min, then it closed tightly and put in microwave to be digested by using heated program which is given in Table-1. The digested sample transferred to beaker and evaporated to about 5 mL, then transferred to volumetric flask 10 mL and completed to volume by distilled deionized water. A digested blank was carried out in the same way.

Results and Discussion
The protein name comes from the Greek word proteins meaning ''primary'' or first place. Proteins are made up of amino acids that joins together to form long chains. Generally protein as a string beads in which each bead in which each bead is an amino acid. There are 20 amino acids that help to form the different proteins in body. Proteins do most of their work in the cell and perform various jobs. Important works of proteins are 1) growth and maintenance of tissues. 2) Consumed the proteins breaks down the same amount of protein that will use to build and repair tissues. Other times especially periods of illness during pregnancy and breast feeding, it breaks down more protein than it can create, and thus increasing body's need needs. Similarly, recovering from an injury or surgery older adult and athletics require more proteins as well.
Enzymes are proteins that aid the thousands of biochemical reactions that takes place within and outside of body cells. The structure of enzymes allows them to combine with other molecules inside the cell called substances which catalyse the reaction that are essential to metabolism in body. Enzymes may also function outside the cell such as digestive enzymes like lactase and sucrose which helps to digest sugar. Some enzymes require other molecules, vitamins or minerals for a reaction to take place during digestion, energy production, blood clotting. Lack or improper function of these enzymes can result in disease.
Balances fluids proteins regulate body process to maintain fluid balance. Protein regulates body process to maintain fluid balance. Proteins help from immune globins or antibodies to fight infection. If there are antibodies these viruses and bacteria free to multiply. Once body has produce antibodies against particular bacteria or viruses our cells never forgets how to manage or make them to control. This allows the antibodies to respond quickly the next time a particular disease. Some proteins transport nutrient throughout year entire body while other store them. Protein can serve as a valuable energy source but only in situation of fasting exercise or inadequate calorie intake. Looking of above all we need to eat food which contain sufficient protein. This study reveals that different millets contain different quantity of protein which was estimated in eight different genotypes of four different small millets which were cultivated three different locations and data were presented in Table 1, 2, and 3.
The different small millets cultivated at Hanumanamatti and estimated protein content and data were presented in table 1. There was negligible variation found in foxtail millet genotypes for protein content (11.125% in DHft-109-3 and 11.025% in Halnavani). In little millet, Karisavi (9.425%) and Mallesavi (9.1%) genotypes recorded slightly more protein content when compared to improved variety, DHLM-36-3 (8.3%) while, in proso millet genotype, DHPM-2181 (11.98%) produced more protein than DHPM-2769 (11.0%). The finger millet genotype DHFM-78-3 (8.9%) also produced considerable more amount of protein at Hanumanamatti. At Dharwad, protein content varied from 7.08% (finger millet variety, DHFM 78-3) to 11.9 per cent (DHFt-109-3 foxtail millet). There is negligible difference found among little millet genotypes, DHLM-36-3 (8.21%), Karisavi (8.61%) and Mallisavi (8.21%) for protein per cent. The proso millet genotype, DHPM-2181 (11.6%) exhibited slightly more than DHPM-2769 (10.35%) which was briefed in Table 2. Same small millets genotypes were evaluated at Mudhol and data were elaborated in Table 3. The protein content varied from 7.44 per

cent (DHFM-78-3: finger millet) to 10.74 per cent (DHFt-109-3: foxtail millet). The foxtail millet genotypes *viz*., DHFt-109-3 (10.74%) and Halnavani (10.1%), little millet genotypes, DHLM-36-3 (7.505%), Karisavi (7.05%) and Mallesavi (7.827%) and proso milet genotypes, DHPM-2769 (9.66%) and DHPM-2181 (10. 33%) recorded negligible differences for protein content in respective crops. The foxtail millet genotypes, DHFt-109-3(11.125%) and Halnavani (11.025%) and proso millet genotypes, DHPM-2769 (11%) and DHPM-2181 (11.975%) recorded protein content more than grand mean (10.09%) at Hanumanamatti. The foxtail millet genotypes, DHFt-109-3 (11.9% and 10.74%) and Halnavani (10.265% and 10.10%) and Proso millet genotypes, DHPM-2769 (10.35% and 9.665%) and DHPM-2181 (11.60% and 10.337%) were produced more protein content than Grand mean (9.52%) at Dharwad and Mudhol, respectively.

Different small millets genotypes contain varying quantity of protein at different locations and results have been presented in Table 4. The foxtail millet genotype, DHFt-109-3 produced highest protein at Dharwad (11.9%) followed by Hanumanamatti (11.025%) and Mudhol (10.74%) while, another land race Halnavani produced highest at Hanumanamatti (11.025%) followed by Dharwad (10.265%) and Mudhol (10.1%). Among foxtail millet genotypes, DHFt-109-3 exhibited highest protein content at Dharwad (11.9%) followed by Hanumanamatti (11.025) and Mudhol (10.74%). These results were not agreed with nitrogen content in soil atdifferent locations, Hanumanamatti (245 kg/ha) followed by Dharwad (139 kg/ha) and Mudhol (109 kg/ha). The foxtail millet landrace, Halanavani contain highest protein content at Hanumanamatti (11.025%), Dharwad (10.265%) and Mudhol (10.1%). The little millet genotypes, *viz*., DHLM-36-3, Karisavi and Mallesavi produced maximum protein at Hanumanamatti (DHLM-36-3: 8.3%, Karisavi: 9.425% and Mallesavi: 9.1%) followed by Dharwad (DHLM-36-3: 8.172%, Karisavi: 8.612%, and Mallesavi: 8.212%.) and Mudhol (DHLM-36-3: 7.505%, Karsavina: 7.05% and Malesia: 7.827%). The little millet genotypes produced highest protein at Hanumanamatti (DHLM-36-3: 8.3, Karsavina: 8.61% and Malesia: 9.1%). Followed by Dharwad (DHLM-36-3: 8.17, Karesavi: 9.425% and Mallesavi: 8.21%) and Mudhol (DHLM-36-3: 7.50, Karisavi: 7.05% and Mallesavi: 7.82%). The protein content of little millet genotypes fallow nitrogen content of soil at different locations but was not exactly proportion. The finger millet genotype DHFM-78-3 recorded maximum protein at Hanumanamatti (8.9%) followed by Mudhol (7.44%) and Dharwad (7.082%). The results of DHFM-78-3 holds good at Hanumanamatti but not correlate with Dharwad and Mudhol. The proso millet genotypes DHPM-2769 (11%) and DHPM-2181 (11.975%) produced highest protein at Hanumanamatti (DHPM-2769: 11% and DHPM-2181: 11.98%) followed by Dharwad (DHPM-2769: 10.35 and DHPM-2181: 10.35%) and Mudhol (DHPM-2769: 9.6665 and DHPM-2181: 10.337). The results were follows nitrogen content in soils of different locations but not exact proportion. When look into crop wise highest protein found in foxtail millet (10.84%) followed by proso millet (10.82%) and little millet (8.84%) and finger millet (7.8%)

Different small millets exhibited different level of protein which has presented in Table 5. Out of four small millets, first second and third ranks occupied by Foxtail millet genotypes (10.84%), proso millet genotypes (10.82%) and little millet genotypes (8.24%), respectively. The finger millet genotype, DHFM-78-3 (7.80%) produced lower level of protein content as compare to other small millets. These results reveal that protein content depends upon crop, variety, soil and environment. Similar results were observed by Sujata Bhat *et al* 2018 [2], Sarita Ekta Singh 2016 [3] and Himanshu *et al* 2018 [5] in only one location.

Iron (Fe).

The role of iron in our body was very complex. Iron is an essential element for blood production beyond this, iron supports many other body functions as well. Despite its importance, we know less about why we need to ensure we maintain our iron level or how much iron we need. Look into the following functions that our iron levels help to sustain good health.

1. If we feel that you may be need support one or more of these areas, it may be worth consulting our health care practitioner about our iron levels.
2. One of most important functions of iron is heme synthesis which forms haemoglobin a protein found in red blood cells.
3. Haemoglobins' primary role is to transport oxygen from the lungs to body tissue to maintain basic life functions.
4. Without healthy blood cells, our body can't get enough oxygen result of this increasing tired or exhausted.
5. Iron plays vital role in the process by which cells generate energy.
6. Human cells require iron in order to covert biochemical energy from nutrients into ATP (Adenosine Triphosphate) from multistep process known as cellular respiration. ATP is the primary energy source. Without sufficient iron less ATP can be produced which is another reason why these lacking iron are easily tired and fatigued.
7. Iron is necessary for immune cells proliferation and maturation, particularly lymphocytes which are associated with helping us to keep us to keep healthy. Lower level of iron may contribute to increased risk of our immune system being compromised and our body falling sick.
8. Iron play an important role in maintaining normal cognitive function includes brain function such as memory, attention (concentration), alertness, learning, intelligence, language and problem solving. Maintaining sufficient level of iron in our bodies help us to ensure our brain is performing its best any mental work having to rely on that shot of caffeine in the morning.

As our body don't produce iron we need to make sure we include sufficient iron as part of our healthy diets. Some people lifestyles can mean that they struggle to get iron they need from their di*et al*one.

Iron is not actively excreted from our body in urine or intestines. Iron is only lost with cells from skin and interior surface of body intestine, urinary track and air ways. The total amount is estimated at lost 14 µg per kilogram body weight per day (Green R. 1968) [10]. In children probably more correct to relate these losses to body surface. Anon menstruating 55 kg woman losses about 0.8 mg Fe per day and a 70 kg man loses about 1 mg /day FAO /WHO 1988.

Worldwide the highest prevalence of iron deficiency is found in infants, children, adolescence and woman of child bearing age, especially pregnant woman. The weaning periods in infants is especially critical because of very high iron requirements. Now day people are suffering from iron deficiency due to insufficient availability of iron in food stuffs. So, need to investigate presence of iron content in different small millets in different locations. The present study includes four crops and eight genotypes and three locations and results were elaborated in

Table 1,2,3,4 and 5.

The iron content in different small millet genotypes at Hanumanamatti were presented in Table 1. Among four small millets little millet land race, Mallesavi recorded highest iron content of 5.686 mg per 100 g of rice among eight genotypes. After Mallesavi, second and third rank occupied by improved variety, DHLM-36-3 (3.849 mg/100 g rice) and another land race Karisavi (3.34 mg/100 g of rice). When we look in to other small millets, finger millet improved variety DHFM-78-3 noticed 2.776 mg per 100 g of grain and proso millet genotypes, DHPM-2181 and DHPM-2769 produced iron content of 2.4 mg/100 g of rice and 2.332 mg /100 g of rice, respectively. The foxtail millet genotypes DHFt-109-3 and Halnavani recorded iron content of 1.985 and 2.023 mg/ 100 g of rice, respectively. The little millet genotypes, Mallesavi (5.686 mg/100 g of rice), DHLM-36-3 (3.84 mg/100 g of rice) and Karisavi (3.34 mg/100 g of rice) recorded statistically superior over grand means (3.04 mg/ 100 g of rice).

The trial was conducted at Dharwad which comprised eight genotypes and results have been presented in table 2. The little millet improved genotype, DHLM-36-3 (3.925 mg/ 100 g of rice) recorded highest iron content followed by Karisavi (3.13 mg/100 g of rice). These were statistically superior over grand mean (2.33 mg /100 g of rice). Another little millet land race showed iron content of 2.02 mg /100 g of rice. The proso millet genotype DHPM-2769 and DHPM-2181 produced iron content 2.12 mg/100 g of rice and 1.915 mg/100 g of rice. Finger millet genotype DHFM-78-3 noticed iron content of 1.86 mg /100 g of grains. The foxtail millet genotypes DHFt-109-3 and Halnavani exhibited 1.865 mg/ 100 g of rice and 1.77 mg / 100 g of rice, respectively.

Same cultures were grown at Mudhol and iron content estimated and elaborated in table 3. The little millet improved variety, DHLM-36-3 recorded highest iron content of 2.365 mg /100 g of rice followed by proso millet improved genotype DHPM-2769 (2.31 mg/100 g of rice) and little millet land race, Mallesavi (2.25 mg/ 100 g of rice). These were statistically superior over grand mean (2.032 mg/100 g of rice). The little millet land race Karisavi and proso millet genotype, DHPM-2181, finger millet variety DHFM-78-3 and foxtail millet genotypes, DHFt-109-3 and Halnavani produced 1.437 mg/100 g and 1.953 mg /100 g of rice, 1.9 mg /100 g 2.012 and 2.030 mg/1000 g of rice at Mudhol location, respectively. The finger millet variety DHFM-78-3 noticed 1.9 mg /100 g of grains.

The different small millets genotypes produced iron content varies from location to location which has been presented in table 4. The little millet land race Mallesavi produced highest iron content at Hanumanamatti (5.686 mg / 100 g of rice) followed by Dharwad (2.25 mg/100 g of rice) and Mudhol (2.05 mg /100 g of rice). These results were accorded with soil iron content at Hanumanamatti (21.08 ppm), Dharwad soil (4.25 ppm) and Mudhol soil (3.82 ppm) which was not exact proportion. The land race Karisavi and improved variety DHLM-36-3 exhibited maximum iron content at Hanumanmatti (3.34 and 3.849 mg/100 g of rice) followed by Mudhol (3.13 and 3.925 mg / 100 g of rice) and Dharwad (1.437 and 2.365 mg/100 g of rice), respectively. These results were not agreed with soil content of different locations. The finger millet improved variety, DHFM-78-3 produced highest iron content at Hanumanamatti (2.776 mg/ 100 g of grains) followed by Dharwad (1.9 mg/100 g of grains) and Mudhol (1.86 mg /100 g of grains). These results not correlated with soil iron content. The proso millet genotype, DHPM-2769 and DHPM-2181 recorded highest iron content at Hanumanamatti (2.32 and 2.4 mg/ 100 g of rice) followed by Dharwad (2.312 and 1.953 mg/100 g of rice) and Mudhol (2.12 and 1.915 mg/ 100 g of rice). The proso millet genotypes not produced according to iron content in soil of different locations. The foxtail millet improved variety, DHFt-109-3 and Halanavani produced (approximately 2.0 mg /100 g of rice) more or less similar results across locations. Results were not agreed with soil iron content.

The iron content of different locations which were depicted in Table 5. The highest iron content found in little millet (3.11 mg/ 100g of rice) followed by finger millet (2.18 mg /100 g of rice) and proso millet (2.17 mg/100 g of rice) and least iron content noticed in finger millet (1.947 mg/ 100 g). The foxtail millet genotypes *viz.*, DHFt-109-3 (1.95 mg/ 100 g of rice) and Halnavani (1.94 mg/100 g of rice) did not show much difference for iron content across locations but little millet improved variety, DHLM-36-3 (3.38 mg/100 g of rice) produced highest iron content followed by Mallesavi (3.33 mg/100 g of rice) and Karisavi (2.64 mg/100g of rice) across locations. Proso millet genotype DHPM-2769 (2.25 mg/100 g of rice) recorded slightly more iron content than DHPM-2181 (2.09 mg/100 g of rice). Out of four small millets, little millet (3.11 mg/100 g of rice) recorded highest iron content followed by proso millet (2.17 mg/100 g of rice) and finger millet (2.17 mg/100 g of rice) and foxtail millet (1.947 mg/100 g of rice). Himansu *et al* (2018) [5] reported 3.9-7.5 mg/100 g of finger millet grain, 3.26 - 19 mg/100g of foxtail millet rice, 13-20 mg/100 g of little millet rice, 4.0 -5.2 mg/100 g of proso millet rice. Sujata Bhat *et al* (2018) [2] found 3.9 mg/100 g of iron in finger millet grain. Similar results were observed by Murgan and Nirmalkumari (2006) [1] iron rich in foxtail millet grain (2.8 mg/100 g grain).

Manganese (Mn) is an essential nutrient for intercellular activities; it functions as co factor for a variety of enzymes, including organase, glutamine synthetase (GS), Pyruate carboxylase and Mn superoxide dismutase (Mn-SOD). Through this metallo protein, Mn plays critically important role in development, digestion, reproduction, immune response and regulation of neuronal activities. Generally, Mn deficiency is rare contrast Mn poisoning may be encountered upon over exposure to this mental. Excessive Mn tends to accumulate in liver pancrease, bone, kidneys, and brain with the latter being the major torget of Mn intoxication. Hapatic cirrhosis, polyethemia, hyper manganesemia, dystonia and Parkinsonism like symptoms have been reported in patients with Mn poisoning. In recent years Mn has come to forefront of environmental concerns due to its neurotoxicity. Molecular Mechanism of Mn toxicity includes oxidative stress, mitochondrial dysfunction, protein misfolding, and endoplasmic reticulum stress. Autophagy dysregulation, apoptosis and disruption of other mental homeostasis are not fully understood till today.

The intake of Mn varied from 2.3 mg/day to 8.8 mg/ day in western diet. The lowest Mn level in water with observable adverse effect is 4.2 mg/day for 60 kg person. So, need to study manganese content in small millets because millets contain higher level minerals if grains were rich in manganese which was negative impact on human health. There by conducted experiments was conducted in different locations *viz*., Dharwad, Hanumanamatti and Mudhol. The results were elaborated in Table 1, 2, 3, 4, and 5.

There were eight genotypes, evaluated for Mn at Hanumanamatti and results were depicted in Table 1. The least Mn found in DHPM-2769 (0.107 mg /100 g rice) and slightly more in DHPM-2181 (0.187 mg/100 g of rice) in proso millet while, Karisavi (0.475 mg/100 g of rice), DHLM-36-3 (0.320

mg /100 g) and Mallesavi (0.320 mg/100 g of rice) in little showed lower level of Manganese. In foxtail millet, Halnavani (0.445 mg /100 g of rice) recorded lower level of Manganese than DHFt-109-3 (0.924 mg/100 g) and finger millet genotype, DHFM-78-3 (0.931 mg/100g). The proso millet genotypes, DHPM-2769 (0.107 mg/100 g of rice) and DHPM-2181 (0.187 mg/100 g of rice), Mallesavi (0.32 mg/100 g of rice) and Karisavi (0.147 mg/100 g of rice) were statistically lower than grand mean (0.46 mg/100 g of rice).

The same small millet genotypes were evaluated at Dharwad and data were presented in Table 2. Out of eight genotypes, DHPM-2769 (0.096 mg/100 g of rice) and DHPM-2181 (0.17 mg/100 g), Karisavi (0.147 mg/100g of rice), Mallesavi (0.26 mg/100 g of rice) and DHFt-109-3 (0.396 mg/100 g of rice) recorded significantly lower manganese than grand mean (0.366 mg/100g of rice). Rest of genotypes *viz*., finger millet variety, DHFM-78-3 (0.917 mg/100 g of rice) and foxtail millet land race, Halnavani (0.805 mg/100 g of rice) exhibited more than grand mean (0.366 mg /100 g of rice) but not cross thresh hold level 4.2 mg /day/70 kg person.

Eight small millet genotypes were evaluated at Mudhol and results were summarized in table 3. Proso millet genotypes, DHPM-2769 (0.102 mg/ 100 g of rice), DHPM-2181 (0.185 mg/100 g of rice) and finger millet genotype, DHFM-78-3 (0.108 mg/100 g of rice) recorded manganese content statistically less than grand mean (0.29 mg/100 g of rice). Rest of little millet genotypes, DHLM-36-3 (0.434 mg/100 g of rice), Karisavi (0.407 mg/ 100 g of rice) and Mallesavi (0.385 mg/ 100 g of rice) and foxtail millet genotypes, DHFt-109-3 (0.38 mg/100 g of rice) and land race Halnavani (0.346 mg/100 g rice) produced manganese content more than grand mean (0.29 mg/ 100 g of rice).

The quantity of Manganese present in different genotypes from different small millets estimated and data were presented in Table 4. The foxtail millet variety, DHFt-109-3 (0.924 mg/100 g of rice) produced highest manganese at Hanumanamatti but it produced lower manganese at Mudhol (0.38 mg /100 g of rice) and Dharwad (0.396 mg/100 g of rice). The manganese present in grains not agreed with soil manganese in different locations. The foxtail millet land race, Halnavani recorded maximum manganese at Dharwad (0.805 mg/100 g of rice) but it noticed lower level at Hanumanamatti (0.445 mg/100 g of rice) and Mudhol (0.434 mg/100 g of rice). These results were not holds good with soil manganese in different locations. Little millet land race, Karisavi recorded maximum manganese content at Hanumanamatti (0.475 mg/100 g of rice) and Mudhol (0.407 mg/100 g) but it produced lower level of manganese at Dharwad (0.107 mg/100 g of rice) and these manganese content not accordance with soil manganese. Another little millet land race Mallesavi exhibited highest manganese at Mudhol (0.385 mg/100 g of rice) followed by Hanumanamatti (0.32 mg/100 g of rice),) and Dharwad (0.26 mg/100 g of rice). These observations complete agreed with soil manganese content in different locations. DHLM-36-3produced highest manganese at Mudhol (0.434mg/100 g rice) followed by Hanumanamatti (0.327 mg/100 g of rice) and Dharwad (0.137 mg /100 g of rice). These results were complete contrast to soil manganese content in different locations. Finger millet variety, DHFM78-3 recorded higher manganese content at Hanumanamatti (0.931 mg/100 g of rice) and Dharwad (0.917 mg/100 g of rice) but it recorded lower level of manganese at Mudhol (0.108 mg/100 g of rice). These results were holds good with soil Mn in different locations The proso millet genotypes, DHPM-2769 and DHPM-2181 produced lower level of manganese (0.107 and 0.187 mg/100 g of rice, respectively) at Hanumanamatti, 0.102 and 0.185 mg/100 g of rice at Mudhol and 0.17 and 0.366 mg/100 g of rice at Dharwad. The results clearly stated that genotype, and soil, environment play big role in production of manganese content in foxtail millet, little millet and finger millet but soil and environment was very less influence on proso millet genotypes.

The manganese content of different small millets in different locations was estimated and data were depicted in table 5. Look into different small millet crops, Finger millet genotype, DHFM-78-3 (0.652 mg/100 g of rice) produced highest manganese followed by foxtail millet (0.55 mg/100 g of rice) and little millet (0.321 mg/100 g of rice) and least manganese found in proso millet (0.141 mg/100 g of rice). Small millets produced manganese content optimum level according to human requirement (1.8-2.3 mg/day /person). Himanusu *et al* (2018) [5] observed 5-5.5 mg/ 100 g of grain in finger millet, 2.19-26 mg/100 g in foxtail millet, 1-20.0 mg/100 g of in little millet rice and 0.6 -1.81 mg/100 g of rice in proso millet.

The human body has an elaborate system for managing and regulating the amount of key trace metals circulating in blood and stored in cells. Nutrient metal from our diet are incorporate into cells if blood levels are depleted transported into cells if cellular levels are inadequate or exerted if blood and cell levels are sufficient or over loaded when this system fails to function properly. Abnormal levels and ratios of trace metals can develop. One of the most common trace metal imbalances is elevated copper and depressed zinc. The ratio of copper to zinc climatically more important than the concentration of either of these traces metal. There is 2.4 gram of zinc distributed throughout the human body. Most zinc is in human brain, muscle, bones, kidney and liver with the highest concentration in the prostrate and parts of the eye. It is second most abundant transition metal in organism after iron and it's the only metal which appears in all enzyme classes. Copper is also a vital dietary nutrient, although copper is third abundant trace metal in the body (behind iron and zinc). The total amount copper in the body is only 75-100 milligrams. Copper is present in every tissue of the body but it stored primarily in the liver with fever amount found in the brain, heart, kidney and muscles. Zinc is involved in numerous aspects cellular metabolism. It was estimated that about 10 per cent of human protein potentially bind zinc in addition to hundreds which transport and traffic zinc. It is required for the catalytic activity of more than 200 enzymes and it play a role in immune function would heal protein synthesis, DNA synthesis and cell division. Zinc is required for proper sense of taste and smell and support normal growth and development during pregnancy, childhood and adolescence. It is believed to possess antioxidant properties which may protect against accelerated aging and helps speed up the healing process after an injury and antimicrobial even at lower concentrations. It also play critical role in normal function of brain and central nerve system. Two examples of zinc containing enzymes are carbonic anhydrase and corboxy peptidase which are vital to process of corbon dioxide (CO_2) regulation and digestion of proteins respectively. In vertebrate blood, carbonic anhydrase convert CO2 into bicarbonate and same enzyme transforms the bicarbonate back into CO2 for exhalation through the lungs. Without this enzymes this conversion would occur about one million times slower at the normal pH or 7 or would require a pH of 10 or more. Corboxy peptidase cleaves peptide linkage during digestion of proteins. Zinc serves a purely structural role in zinc fingers. Zinc fingers form parts of same transcription factors which are proteins that

recognise DNA base sequences during the replication and transportation of DNA. Each of the nine or ten Zn^{2+} ions in a zinc fingers helps to maintain the fingers structure by co-ordinately binding to factors amino acids in the transcriptor factor. The transcription factor wraps around the DNA helix and uses its fingers to accurately bind to the DNA sequence. Zinc ions are coordinated to the amino acid side chains of aspartic glutamic acid, cysteine and histidinne. The metal also has a flexible coordination geometry, which allows proteins using it to rapidly shift conformation to perform biological reactions.

Zinc transport system: Zinc fractions in biology was numerous, but can be separated into three main categories catalytic, regulatory and structural roles. Greater than ten per cent of the human genome codes for zinc containing proteins. Zinc homeostasis is controlled by the coordinated actions of Zn transporters which are responsible for zinc influx and efflux and regulate the intracellular and extra cellular Zn concentration and distribution Zn transporters contribute to cellular events at the molecular, biochemical and genetic level with recent progress un covering the roles of Zn transporters in physiological an pathogenesis.

The presence of zinc is varying in different genotypes in different crops at different locations has been presented in table 1, 2 and 3. Finger millet genotype, DHFM-78-3 produced highest zinc content of 1.88 mg/100 g followed by proso millet genotypes, DHPM-2769 (1.377 mg/100 of rice) and DHPM-2181(1.293 mg/100g of rice) at Hanumanamatti in Table 1. Remaining genotypes, DHFt-109-3 (0.68 mg/100 g of rice), Halanavane (0.605 mg/100g), DHLM-36-3 (0.68 mg/100g of rice), karisavi (0.535 mg/100g of rice) and mallesavi (0.36mg/100g of rice) exhibited average zinc content at Hanumanamatti. At Dharwad, DHPM-2769 (proso millet) produced highest zinc content (1.212 mg /100g of rice) followed by DHPM-2181(1.2 mg/100 g of rice) and foxtail millet genotype DHFt-109-3 (0.692 mg /100g of rice). Rest of genotypes Halanavane (0.642 mg/ 100 g of rice) and little millet genotypes DHLM-36-3 (0.358 mg/100 g of rice), karisavi ((0.43 mg/100 g of rice) and malllesavi (0.405 mg/ 100g of rice) and finger millet genotype (0.397 mg/100 g of grains) showed lower values of zinc content which were elaborated in Table 2.

The zinc content of different small millet genotypes was presented in Table 3. The proso millet genotypes, DHPM-2769 (1.26 mg/100 g of rice) and DHPM-2181 (1.21 mg/100g of rice) recorded higher level of zinc as compared other gentypes, DHFt-109-3 (0.62 mg /100g of rice) and Halanavani (0.61 mg /100g of rice) in foxtail millet and DHLM-36-3 (0.505mg /100g of rice), Karisavi (0.48mg /100g of rice) and Mallesavi (0.42 mg /100g of rice) in little millet and finger millet, DHFM-78-3 (0.41 mg /100g of rice).

Different genotypes of different small millets produced different quantity of zinc in different locations (Hanumanamatti, Mudhol and Dharwad) which were presented in table 4. The foxtail millet genotypes, DHFt -109-3 and Halnavani produced zinc content across locations similar results (approx. 0.60 mg/100 g of rice). These results not agreed with zinc content in different locations, Hanumanamatti (1.30 ppm), Dharwad (0.93 ppm) and Mudhol (0.29 ppm). The little millet genotypes, DHLM-36-3(.417 mg/100 g of rice), Mallesavi (0.364 mg/100 g of rice) and Karisavi (0.535 mg/100 g of rice) produced approximately similar results which were not agreed with soil zinc content. The proso millet genotypes, DHPM-2769 and DHPM-2181 (1.262 mg/100 g of rice) exhibited higher level of zinc content across locations. There for zinc content in proso millet, foxtail millet and little millet genotypes were not dependent on soil zinc content. Finger millet genotype, DHFM-78-3 produced highest zinc content at Hanumanamatti (1.88 mg/100 g of grains) followed by Mudhol (0.416 mg/ 100g of grains) and Dhrwad (0.397 mg/100 g of grains). Hanumamanamatti soil exhibited more zinc content similarly more zinc content in finger millet grains but it was not holds good at Mudhol and Dharwad.

The different crops recorded different levels of zinc content in different locations and results has been presented in table 5. The foxtail millet showed maximum zinc content at Dharwad (0.667 mg/ 100 g of rice) followed by Hanumanamatti (0.643 mg/ 100 g of rice) and Mudhol (0.667 mg/ 100 g of rice). Little millet produced highest content at Mudhol (0.471 mg/ 100 g of rice) followed by Hanumanamatti (0.438 mg/ 100 g of rice) and Dharwad (0.397 mg/100 g of rice). The finger millet recorded highest zinc at Hanumanamatti (1.882 mg/100 g of grain) which produced lower values reported in Mudhol (0.416 mg/100g of grain) and Dharwad (0.397 mg/100 g of grain). The proso millet genotypes exhibited highest zinc at Hanumanamatti (1.335 mg/100 g of rice) followed by Mudhol (1.2395 mg/ 100 g of rice). Out of four small millets, proso millet genotypes (1.26 mg/100 g of rice) produced highest zinc content followed by finger millet (0.89 mg / 100 g of grain) and foxtail millet (0.642 mg/100 g of rice) and lowest zinc content found in little millet (0.436 mg/100 g of rice). The finger millet genotype, DHFM-78-3 produced higher zinc content at Hanumanamatti (1.882 mg/100 g of grain) while, lower levels of zinc content at Mudhol (0.416 mg/ 100 g of grain) and Dharwad (0.397 mg/100 g of grain) found lower values of zinc content. The proso (1.26 mg/100g of rice) millet produced higher values of zinc content across the locations and finger (0.90 mg/100g of grains) and Foxtail (0.64mg/100g of rice) and list found in little millet (0.44 mg/100g of rice) across the locations. Himanshu *et. al* (2018) [5] reported 2-2.3 mg/100 g, 2.14-9 mg/100 g,3.5-11 mg/100 g and 1.4-2.4 mg/100 g of zinc content in finger millet grain, foxtail millet, little millet and proso millet rice, respectively.

Copper

Copper is also vital dietary nutrient, although only small amounts of the metal are needed for wellbeing (5). Although copper is the body (behind iron and zinc), the total amount of copper in the body is only 75-100 mili gram (6)Copper is present in every tissue of the body but it stored primarily in liver with fewer amounts found in the brain, heart, kidney and muscles. Copper plays an important role in our metabolism, largely because it allows many critical enzymes to function properly. Copper is an essential for maintaining strength of the skin, blood vessels, epithelial and connective tissues through body. Copper plays role in the production of haemoglobin, mylin, melanin and it also keep the thyroid gland functioning normally. Copper can be act as antioxidant and pro antioxidant.

Copper metabolism: copper is absorbed in the gut and transported to the liver bound to albumin. It enters the blood streams via plam protein called ceruloplasmin where its metabolism is controlled and is excreted in bile.

Copper enzymes: Copper protein have diverse roles in biological electron transport and oxygen transportation process that exploit the easy inter conversion of Cu (I) and Cu (II) (55). In cytochrome copper oxidase which is required for aerobic respiration, copper and iron cooperate in the reduction of oxygen. Copper is also found Cu/Zn super oxide dismutase is an enzyme that detoxify super oxides by converting it to oxygen and hydrogen peroxide $2H2O \dashrightarrow H2O2+O2$ (7, 55). Copper is

also component of lysyl oxidase an enzyme that participates in the synthesis of collegen and elastin, two important structural proteins found in bone and connective tissue. As part of the enzyme cytochrome C oxidase. Copper play a role in energy production as part dopamine β hydroxyylase a role in conversion of dopamine to norepine phrine and with factor IV helps in blood clotting. Copper is also important for production of the thyroid hormone thyroxine. The copper containing enzyme tyrosinase converts tyrosine to melinine. Cu is also necessary for the synthesis of phospholipids found in myelin sneaths in pheripheral nerves. Several Cu protein don't interact directly with substances, hence they are not enzymes. These proteins relay electrons by the process called electron transfer. These all studies clearly indicated and need to investigate copper quantity in different small millet in different locations. The study conducted at Hanumanamatti, Dharwad and Mudhol and results were elaborated in Table1, 2, 3, 4 and 5.

The copper content of different small millet at Hanumanamatti was estimated and elaborated in table 1. The foxtail millet land race Halnavani (0.802 mg/100 g of rice), little millet land race, Mallesavi (0.663 mg/100 g of rice), finger millet variety DHFM-78-3 (0.836 mg/100 g of grain) and proso millet variety, DHPM-2769 (0.69 mg/ 100 g of rice) were recorded statistically superior over grand mean (0.58 mg /100 g of rice) for copper content. At Dharwad Foxtail millet genotype DHFt-109-3 (0.867 mg/100 g of rice), finger millet genotype, DHFM-78-3 (0.706 mg/100 g of grain) and proso millet genotype DHPM-2769 (0.611 mg/ 100 g of rice) produced copper content more than grand mean (0.53 mg/100 g of rice) and results has been briefed in table 2. The copper content of different small millets at Mudhol has been presented in table 3. The little millet variety, DHLM-36-3 (0.934 mg/ 100 g of rice) recorded highest copper content followed by land races Karisavi (0.881 mg/ 100 g of rice), Mallesavi ((0.841 mg/100 g of rice) and finger millet genotype, DHFM-78-3 (0.834 mg/100 g of grain) were exhibited statistically superior over grand mean (0.68 mg/100 g of rice).

The copper content varies from genotype to genotype and location to location and results have been presented in Table 4. The foxtail millet variety DHFt-109-3 recorded maximum copper content at Dharwad (0.867 mg/100 g of rice), followed by Hanumanamatti (0.477 mg/100 g of rice) and Mudhol (0.415 mg/100 g of rice) but land race Halnavani produced highest copper at Hanumanamatti (0.802 mg/100 g of rice) followed by Mudhol (0.406 mg/100 g of rice) and Dharwad (0.383 mg/100 g of rice). These results were not proportion to soil copper content at different locations **(**Hanumanamatti: 0.48 ppm, Dharwad: 1.75 and 3.57 ppm). The little millet variety, DHLM-36-3 produced maximum copper content at Mudhol (0.934 mg/100 g of rice) followed by Dharwad (0.357 mg/100 g of rice) and Hanumanamatti (0.207 mg/100 g of rice). The copper content of soil also similar pattern as found in grains / rice at Mudhol (3.57 ppm), Dharwad (1.75 ppm) and Hanumanamatt (0.48 ppm). The little millet land races Karisavi and Mallesavi (0.881 and 0.841 mg/100 g of rice) recorded highest copper content at Mudhol followed by Hanumanamatti (0.428 and 0.663 mg/100 g of rice) and Dharwad (0.302 and 0.472 mg/100 g of rice), respectively. These were not holds good with soil copper content. The finger millet genotype DHFM-78-3 (approximately 0.8 mg/100 g of rice) and proso millet genotypes, DHPM-2769 (approximately (0.69 mg/100 g of rice) and DHPM -2181 (0.56 mg/100 g of rice) exhibited copper content more or less similar across the locations (Hanumanamatti, Dharwad and Mudhol). These results were not similar with soil copper content at different locations.

The copper content in different crops in different locations has estimated and briefed in table 5. The DHFM-78-3 produced highest copper content of 0.79 mg/100 g of grain followed by proso millet rice of 0.67 mg/100 g of rice, little millet of 0.57 mg/ 100 g of rice and foxtail millet of 0.56 mg/ 100 g of rice. Himanshu, *et al* (2018) [5] observed 0.4-4 mg/100 g, 1-3.0 mg/100 g, 1.0-4.0 mg/100 g and 0.83-5.8 mg/100g of copper content in finger millet grain, foxtail millet, little millet and proso millet rice, respectively.

Summary

There was negligible variation for protein content found in foxtail millet genotypes DHft-109-3 (11.125%,11.9% and 10.74%) and Halanavani (11.025%, 10.265% and 10.1) and in little millet genotypes, Karisavi (9.425%, 8.61% and 7.05%) and Mallesavi (9.1%,8.21% and 7.82%,) while, slightly less protein content in improved variety, DHLM-36-3 (8.3%, 8.17% and 7.50%). In proso millet genotype, DHPM-2181 (11.6%) exhibited slightly more than DHPM-2769 (10.35%) at Hanumanamatti, Dharwad and Mudhol, respectively.

The foxtail millet genotype, DHFt-109-3 produced highest protein at Dharwad (11.9%) followed by Hanumanamatti (11.025%) and Mudhol (10.74%) while, another land race Halnavani produced highest at Hanumanamatti (11.025%) followed by Dharwad (10.265%) and Mudhol (10.1%). Among foxtail millet genotypes, DHFt-109-3 exhibited highest protein content at Dharwad (11.9%) followed by Hanumanamatti (11.025) and Mudhol (10.74%). These results were not agreed with nitrogen content in soil atdifferent locations, Hanumanamatti (245 kg/ha) followed by Dharwad (139 kg/ha) and Mudhol (109 kg/ha). The foxtail millet landrace, Halanavani contain highest protein content at Hanumanamatti (11.025%), Dharwad (10.265%) and Mudhol (10.1%). The little millet genotypes, *viz*., DHLM-36-3, Karisavi and Mallesavi produced maximum protein at Hanumanamatti (DHLM-36-3: 8.3%, Karisavi: 9.425% and Mallesavi: 9.1%) followed by Dharwad (DHLM-36-3: 8.172%, Karisavi: 8.612%, and Mallesavi: 8.212%.) and Mudhol (DHLM-36-3: 7.505%, Karsavina: 7.05% and Mallesavi: 7.827%). The little millet genotypes produced highest protein at Hanumanamatti (DHLM-36-3: 8.3, Karisavi: 8.61% and Mallesavi: 9.1%). Followed by Dharwad (DHLM-36-3: 8.17, Karisavi: 9.425% and Mallesavi: 8.21%) and Mudhol (DHLM-36-3: 7.50, Karisavi: 7.05% and Mallesavi: 7.82%). The protein content of little millet genotypes fallow nitrogen content of soil at different locations but was not exactly proportion. The finger millet genotype DHFM-78-3 recorded maximum protein at Hanumanamatti (8.9%) followed by Mudhol (7.44%) and Dharwad (7.082%). The results of DHFM-78-3 holds good at Hanumanamatti but not correlate with Dharwad and Mudhol. The proso millet genotypes DHPM-2769 (11%) and DHPM-2181 (11.975%) produced highest protein at Hanumanamatti (DHPM-2769: 11% and DHPM-2181: 11.98%) followed by Dharwad (DHPM-2769: 10.35 and DHPM-2181: 10.35%) and Mudhol (DHPM-2769: 9.6665 and DHPM-2181: 10.337). The results were follows nitrogen content in soils of different locations but not exact proportion. The iron content of different small millets *viz*,. foxtail millet genotypes, DHFt-109-3 (1.98, 2.86 and 2.01 mg/100 g of rice) Halanavani (2.02, 1.77 and 2.03 mg/100 g of rice), little millet genotypes, DHLM-36-3 (3.84, 3.94 and 2.36 mg/100 g of rice), Karisavi (3.34, 3.13 and 1.43 mg/ 10g of rice), Mallesavi (5.68, 2.05 and 2.25 mg/100g of rice) and finger millet genotype, DHFM-78-3(2.77, 1.86 and 1.9 mg/ 100g of grains) and proso millets genotypes, DHPM-2769 (2.38, 2.12 and 2.31 mg/100g of rice) and DHPM-2181 (2.4, 1.91 and 1.95mg/100g of rice) showed negligible

difference for iron content among genotypes in different small millets at Hanumanamatti, Dharwad and Mudhol, respectively.

The little millet land race Mallesavi produced highest iron content at Hanumanamatti (5.686 mg / 100 g of rice) followed by Dharwad (2.25 mg/100 g of rice) and Mudhol (2.05 mg /100 g of rice). These results were accorded with soil iron content at Hanumanamatti (21.08 ppm), Dharwad soil (4.25 ppm) and Mudhol soil (3.82 ppm) but these were not exact proportion. The land race Karisavi and improved variety DHLM-36-3 exhibited maximum iron content at Hanumanmatti (3.34 and 3.849 mg/100 g of rice) followed by Mudhol (3.13 and 3.925 mg / 100 g of rice) and Dharwad (1.437 and 2.365 mg/100 g of rice), respectively. These results were not agreed with soil content of different locations. The finger millet improved variety DHFM-78-3 produced highest iron content at Hanumanamatti (2.776 mg/ 100 g of grains) followed by Dharwad (1.9 mg/100 g of grains) and Mudhol (1.86 mg /100 g of grains). The proso millet genotype, DHPM-2769 and DHPM-2181 recorded highest iron content at Hanumanamatti (2.32 and 2.4 mg/ 100 g of rice) followed by Dharwad (2.312 and 1.953 mg/100 g of rice) and Mudhol (2.12 and 1.915 mg/ 100 g of rice). The proso millet genotypes not produced according to iron content in soil of different locations. The foxtail millet improved variety DHFt-109-3 and Halanavani produced (approximately 2.0 mg /100 g of rice) more or less similar results across locations. Results were not agreed with soil iron content.

The highest iron content found in little millet (3.11 mg/ 100g of rice) followed by finger millet (2.17 mg /100 g of rice) and proso millet (2.17 mg/100 g of rice) and least in finger millet (1.947 mg/ 100 g).

Out of four small millet genotypes, foxtail millet genotypes, DHFt-109-3 (0.924, 0.396 and 0.38 mg / 100 g of rice), Halanavani (0.445, 0.805 and 0.346 mg / 100 g of rice) showed variation for manganese at Hanamanamatti, Dharwad and Mudhol, respectively. Little millet genotypes, DHLM-36-3 (0.327, 0.137 and 0.434 mg / 100 g of rice), Karisavi (0.745, 0.147 and 0.407 mg / 100 g of rice), Mallesavi (0.32, 0.026 and 0.325 mg / 100 g of rice) showed highest variation for manganese at Hanumanamatti, while least manganese found in Mallesavi at Dharwad. The finger millet genotype, DHFM-78-3 (0.930, 0.91 and 0.108 mg / 100 g of rice) noticed higher level manganese and least variation found at Hanumanamatti and Dharawd and least manganese at Mudhol (0.108 mg/100 g of grains). The proso millet genotypes, DHPM-2769 (0.107, 0.096 and 0.102 mg / 100 g of rice) and DHPM-2181 (0.187, 0.17 and 0.185) were not noticed much variation for manganese at Hanumanamatti, Dharwad and Mudhol which was least.

The foxtail millet variety DHFt-109-3 (0.924 mg/100 g of rice) produced highest manganese at Hanumanamatti but it produced lower manganese at Mudhol (0.38 mg /100 g of rice) and Dharwad (0.396 mg/100 g of rice). The manganese present in grains not agreed with soil manganese content in different locations. The foxtail millet land race, Halnavani recorded maximum manganese at Dharwad (0.805 mg/100 g of rice) but it noticed lower level at Hanumanamatti (0.445 mg/100 g of rice) and Mudhol (0.434 mg/100 g of rice). These results were not holds good with soil manganese content in different locations. Little millet land race, Karisavi recorded maximum manganese content at Hanumanamatti (0.475 mg/100 g of rice) and Mudhol (0.407 mg/100 g) but it produced lower level of manganese at Dharwad (0.107 mg/100 g of rice) and these results were not accordance with soil manganese content. Another little millet land race Mallesavi exhibited highest manganese at Mudhol (0.385 mg/100 g of rice) followed by Hanumanamatti (0.32 mg/100 g of rice),) and Dharwad (0.26 mg/100 g of rice). These observations complete agreed with soil manganese content in different locations. DHLM-36-3 produced highest manganese at Mudhol (0.434mg/100 g rice) followed by Hanumanamatti (0.327 mg/100 g of rice) and Dharwad (0.137 mg /100 g of rice). These results were complete contrast to soil manganese content in different locations. Finger millet variety, DHFM78-3 recorded higher manganese content at Hanumanamatti (0.931 mg/100 g of rice) and Dharwad (0.917 mg/100 g of rice) but it recorded lower level of manganese at Mudhol (0.108 mg/100 g of rice). These results were holds good with soil Mn in different locations. The proso millet genotypes, DHPM-2769 and DHPM-2181 produced lower level of manganese (0.107 and 0.187 mg/100 g of rice, respectively) at Hanumanamatti, 0.102 and 0.185 mg/100 g of rice at Mudhol and 0.17 and 0.366 mg/100 g of rice at Dharwad.

Look into different small millet crops, Finger millet genotype, DHFM-78-3 (0.652 mg/100 g of rice) produced highest manganese followed by foxtail millet (0.549 mg/100 g of rice) and little millet (0.321 mg/100 g of rice) and least manganese found in proso millet (0.141 mg/100 g of rice).

The foxtail millet genotypes, DHFt-109-3 ((0.68, 0.692 and 0.62 mg/ 100 g of rice) and Halanavani (0.605, 0.642 and 0.61 mg/ 100 g of rice) recorded least variation for zinc between genotypes and among different locations. The little millet genotypes, DHLM-36-3 (0.605, 0.358 and 0.505 mg/100 g of rice), Karisavi (0.535, 0.43 and 0.487 mg /100g of rice) and Mallesavi (0.364, 0.358 and 0.420 mg/ 100g) noticed little variation among genotypes and locations. Finger millet genotype, DHFM-78-3 (1.882, 0.397 and 0.416 mg/ 100 g) exhibited highest zinc at Hanumanamatti while, it produced lower level at Dharwad and Mudhol. There was considerable amount zinc present in proso millet genotypes, stable across locations and gentypes, DHPM-2769 (1.377, 1.212 and 0.416 mg/100 g of rice) and DHPM-2181 (1.293, 1.2 and 1.21 mg/100 g of rice)

The foxtail millet genotypes, DHFt-109-3 and Halnavani produced zinc content across locations similar quantity (approx. 0.60 mg/100 g of rice). These results not agreed with zinc content in different locations, Hanumanamatti (1.30 ppm), Dharwad (0.93 ppm) and Mudhol (0.29 ppm). Little millet genotypes, DHLM-36-3(.417 mg/100 g of rice), Mallesavi (0.364 mg/100 g of rice) and Karisavi (0.535 mg/100 g of rice) produced approximately similar results which were not agreed with soil zinc content. The proso millet genotypes, DHPM-2769 and DHPM-2181 (1.262 mg/100 g of rice) exhibited higher level of zinc content across locations. Thereby, zinc content in proso millet, foxtail millet and little millet genotypes were not dependent on soil zinc content. Finger millet genotype, DHFM-78-3 produced highest zinc content at Hanumanamatti (1.88 mg/100 g of grains) followed by Mudhol (0.416 mg/ 100g of grains) and Dharwad (0.397 mg/100 g of grains). Hanumamanamatti soil exhibited more zinc content similarly more zinc content finger millet grains at Hanumanamatti but it was not holds good at Mudhol and Dharwad.

The foxtail millet showed maximum zinc content at Dharwad (0.667 mg/ 100 g of rice) followed by Hanumanamatti (0.643 mg/ 100 g of rice) and Mudhol (0.667 mg/ 100 g of rice). Little millet produced highest content at Mudhol (0.471 mg/ 100 g of rice) followed by Hanumanamatti (0.438 mg/ 100 g of rice) and Dharwad (0.397 mg/100 g of rice). The finger millet recorded highest zinc at Hanumanamatti (1.882 mg/100 g of grain) which produced lower values reported in Mudhol (0.416 mg/100g of grain) and Dharwad (0.397 mg/100 g of grain). The proso millet

genotypes exhibited highest zinc at Hanumanamatti (1.335 mg/100 g of rice) followed by Mudhol (1.2395 mg/ 100 g of rice).

Out of four small millets, proso millet genotypes (1.26 mg/100 g of rice) produced highest zinc content followed by finger millet (0.89 mg / 100 g of grain) and foxtail millet (0.642 mg/100 g of rice) and lowest zinc content found in little millet (0.436 mg/100 g of rice). The finger millet genotype, DHFM-78-3 produced higher zinc content at Hanumanamatti (1.882 mg/100 g of grain) while, lower levels of zinc values at Mudhol (0.416 mg/ 100 g of grain) and Dharwad (0.397 mg/100 g of grain). The proso millet produced higher values of zinc content across the locations and foxtail and little and proso millet produced more or less similar zinc values across the locations. Himanshu *et al.* (2018) [5] reported 2-2.3 mg/100 g, 2.14-9 mg/100 g,3.5-11 mg/100 g and 1.4-2.4 mg/100 g of zinc content in finger millet grain, foxtail millet, little millet and proso millet rice, respectively.

DHft-109-3 (0.477, 0.867 and 0.415 mg/ 100 g of rice) and Halanavani (0.80, 0.383 and 0.406 mg/100 g of rice) showed copper content variation at Hanumanamatti and Dharwad but little variation found at Mudhol in foxtail millet. The little millet genotypes, DHLM-36-3 (0.207, 0.357 and 0.934 mg /100 g of rice) and Karisavi (0.428, 0.302 and 0.881 mg/ 100 g of rice) and Mallesavi (0.663, 0.472 and 0.841 mg/100 g of rice) exhibited difference for copper content in different genotypes. Finger millet genotype, DHFM-78-3 (0.836, 0.706 and 0.834) produced more or less similar quantity of copper across locations (Hanumanamatti, Dharwad and Mudhol). In proso millet, DHPM-2769 (0.69, 0.611 and 0.617) and DHPM-2181 (0.585, 0.567 and 0.68 mg / 100 g of rice) noticed little variation for copper content between genotypes and across locations.

The foxtail millet variety DHFt-109-3 recorded maximum copper content at Dharwad (0.867 mg/100 g of rice), followed by Hanumanamatti (0.477 mg/100 g of rice) and Mudhol (0.415 mg/100 g of rice) but land race Halnavani produced highest copper at Hanumanamatti (0.802 mg/100 g of rice) followed by Mudhol (0.406 mg/100 g of rice) and Dharwad (0.383 mg/100 g of rice). These results were not proportion to soil copper content at different locations (Hanumanamatti: 0.48 ppm, Dharwad: 1.75 and 3.57 ppm). The little millet variety, DHLM-36-3 produced maximum copper content at Mudhol (0.934 mg/100 g of rice) followed by Dharwad (0.357 mg/100 g of rice) and Hanumanamatti (0.207 mg/100 g of rice). The copper content of soil also similar pattern as found in Mudhol (3.57 ppm), Dharwad (1.75 ppm) and Hanumanamatt (0.48 ppm). The little millet land races Karisavi and Mallesavi (0.881 and 0.841 mg/100 g of rice) recorded highest copper content at Mudhol followed by Hanumanamatti (0.428 and 0.663 mg/100 g of rice) and Dharwad (0.302 and 0.472 mg/100 g of rice), respectively. These were not holds good with soil copper content. The finger millet genotype DHFM-78-3 (approximately 0.8 mg/100 g of rice) and proso millet genotypes, DHPM-2769 (approximately (0.69 mg/100 g of rice) and DHPM -2181 (0.56 mg/100 g of rice) exhibited copper content more or less similar across the locations (Hanumanamatti, Dharwad and Mudhol). These results were not positively correlate with soil copper content at different locations. The DHFM-78-3 produced highest copper content of 0.792 mg/100 g of grain followed by proso millet rice of 0.607 mg/100 g of rice, little millet of 0.565 mg/ 100 g of rice and foxtail millet of 0.558 mg/ 100 g of rice.

Table 1: Nutritional profile of foxtail, little, finger and proso millet evaluated at Hanumanamatti

SL. No.	Name of crop	Name of variety	Protein (%)	Iron (mg/100g)	Manganese (mg/100)	Copper (mg/100 g)	Zinc (mg/100 g)
1	Foxtail millet	DHFT-1093	11.025±0.133	1.985±0.068	0.924±0.007	0.477±0.009	0.68±0.019
2	Foxtail millet	Halnavani	11.025±0.133	2.023±0.068	0.44575±0.007	0.802±0.009	0.605±0.019
3	Little millet	DHLM-36-3	8.3±0.133	3.849±0.068	0.327±0.007	0.207±0.009	0.417±0.019
4	Little millet	Karisavi	9.425±0.133	3.340±0.068	0.745±0.007	0.428±0.009	0.535±
5	Little millet	Mallisavi	9.1±0.133	5.686±0.068	0.320±0.007	0.663±0.009	0.364±0.019
6	Finger millet	DHFM-78-3	8.9±0.133	2.776±0.068	0.931±0.007	0.836±0.009	1.882±-0.019
7	Proso millet	DHPM-2769	11±0.133	2.32±0.068	0.107±0.007	0.690±0.009	1.377±0.019
8	Proso millet	DHPM-2181	11.975±0.133	2.4±0.068	0.187±0.007	0.585±0.009	1.293±0.019
		Grand mean	10.09±133	3.0±068	0.46±0.007	0.580±0.009	0.89±0.019
		Sem +/-	0.133	0.068	0.007	0.009	0.019
		CD@1%	0.552	0.268	0.032	0.039	0.079
		CV%	2.640	4.500	3.330	3.240	4.234

Table 2: Nutritional profile of foxtail, little, finger and proso millet evaluated at Dharwad.

SL. No.	Name of crop	Name of variety	Protein (%)	Iron (mg/100g)	Manganese (mg/100)	Copper (mg/100 g)	Zinc (mg/100 g)
1	Foxtail millet	DHFT-109-3	11.9±0.108	1.865±0.05	0.396±0.008	0.867±0.013	0.692±0.033
2	Foxtail millet	Halnavani	10.265±0.108	1.77±0.05	0.805±0.008	0.383±0.013	0.642±0.033
3	Little millet	DHLM-36-3	8.172±0.108	3.925±0.05	0.1370±0.008	0.357±0.013	0.358±0.033
4	Little millet	Karisavi	8.612±0.108	3.132±-0.05	0.147±0.008	0.302±0.013	0.43±0.033
5	Little millet	Mallisavi	8.212±0.108	2.05±0.05	0.026±0.008	0.472±0.013	0.405±0.033
6	Finger millet	DHFM-78-3	7.082±0.108	1.862±0.05	0.917±0.008	0.706±0.013	0.397±0.033
7	Proso millet	DHPM-2769	10.350±0.108	2.12±0.05	0.0962±0.008	0.611±0.013	1.212±0.033
8	Proso millet	DHPM-2181	11.600±0.108	1.915±0.05	0.17±0.008	0.567±0.013	1.2±0.033
		Grand mean	9.52±0.068	2.33±0.05	0.366±0.008	0.53±s0.013	0.66±0.033
		Sem+/-	0.109	0.050	0.009	0.013	0.033
		CD@1%	0.454	0.210	0.037	0.054	0.139
		CV%	2.289	4.323	4.882	4.813	10.016

Table 3: Nutritional profile of foxtail, little, finger and proso millet evaluated at Mudhol.

SL. No.	Name of crop	Name of variety	Protein (%)	Iron(mg/100g)	Manganese (mg/100)	Copper (mg/100 g)	Zinc (mg/100 g)
1	Foxtail millet	DHFT-109-3	10.74±0.131	2.012±0.035	0.38±0.006	0.415±0.01	0.62±0.01
2	Foxtail millet	Halnavani	10.1±0.033	2.030±0.035	0.346±0.006	0.406±0.01	0.61±0.01
3	Little millet	DHLM-36-3	7.505±0.033	2.365±0.035	0.434±0.006	0.934±0.01	0.505±0.01
4	Little millet	Karisavi	7.05±0.033	1.437±0.035	0.407±006	0.881±0.01	0.487±0.01
5	Little millet	Mallisavi	7.827±0.033	2.25±0.035	0.385±0.006	0.841±0.01	0.420±0.01
6	Finger millet	DHFM-78-3	7.44±0.033	1.9±0.035	0.108±0.006	0.834±0.01	0.416±0.01
7	Proso millet	DHPM2769	9.665±0.033	2.312±0.035	0.102±0.006	0.617±0.01	1.262±0.01
8	Proso millet	DHPM-2181	10.337±0.033	1.953±0.035	0.185±0.006	0.517±0.01	1.217±0.01
		Grand Mean	8.44±0.033	2.032	0.29±0.006	0.68±0.01	0.69±s0.01
		Sem+/-	0.131	0.035	0.0069	0.01	0.01
		CD@1%	0.546	0.149	0.026	0.044	0.041
		CV%	3.102990966	3.5	4.75	3.13	2.89

Table 4: The nutritional profile of different small millets genotypes in different locations.

Sl. No.	Name of crop	Name of variety	Protein (%)				Iron (mg/100g of rice /grains)		
			Hanumanamatti	Mudhol	Dharwad		Hanumanamatti	Mudhol	Dharwad
1	Foxtail millet	DHFT-109-3	11.025±0.133	10.74±0.131	11.9±0.108	11.22%	1.985±0.068	1.865±0.05	2.012±0.035
2	Foxtail millet	Halnavani	11.025±0.133	10.1±0.033	10.265±108	10.46%	2.023±0.068	1.77±0.05	2.030±0.035
3	Little millet	DHML-36-3	8.3±0.133	7.505±0.033	8.172±0.108	7.99%	3.84±0.068	3.925±0.05	2.365±0.035
4	Little millet	Karisavi	9.425±0.133	7.05±0.033	8.612±0.108	8.36%	3.340±0.068	3.123±0.05	1.437±0.035
5	Little millet	Mallisavi	9.1±0.133	7.827±0.033	8.212±0.108	8.37	5.686±0.068	2.05±0.05	2.25±0.035
6	Finger millet	DHFM-78-3	8.9±0.133	7.44±0.033	7.082±0.108	7.81	2.776±0.068	1.862±0.05	1.9±0.035
7	Proso millet	DHPM-2769	11±0.133	9.665±0.033	10.350±0.108	10.34	2.32±0.068	2.12±0.05	2.312±0.035
8	Proso millet	DHPM-2181	11.975±0.133	10.337±0.033	11.600±0.108	11.30	2.4±0.068	1.915±0.05	1.953±0.035
		Grand mean	10.09±0.133	8.44±0.033	9.52±0.068		3.04±0.068	2.02±0.05	2.032±s0.035
		Sem+/-	0.133	0.131	0.109		0.068	0.050	0.035
		CD@+/-	0.552	0.546	0.454		0.286	0.210	0.149
		CV%	2.640	3.103	2.289		4.5	4.323	3.5

Table 5: Nutritional profile of small millets across locations for different genotypes of different small millets. Cont.

Sl. No.	Name of crop	Name of variety	Mn (mg/100)			Copper (mg/100)		
			Hanumanamatti	Mudhol	Dharwad	Hanumanamatti	Mudhol	Dharwad
1	Foxtail millet	DHFT-109-3	0.924±0.007	0.38±0.006	0.396±0.008	0.477±0.009	0.415±0.01	0.867±0.013
2	Foxtail millet	Halnavani	0.44575±0.007	0.346±0.006	0.805±0.008	0.802±0.009	0.406±0.01	0.383±0.13
3	Little millet	DHLM-36-3	0.327±0.007	0.434±0.006	0.137±0.008	0.207±0.009	0.934±0.01	0.357±0.013
4	Little millet	Karisavi	0.475±0.007	0.407±0.006	0.147±0.008	0.428±0.009	0.881±0.01	0.302±0.013
5	Little millet	Mallesavi	0.320±0.007	0.385±0.006	0.26±0.008	0.663±0.009	0.841±0.01	0.472±0.013
6	Finger millet	DHFM-78-3	0.931±0.007	0.108±0.006	0.917±0.008	0.863±0.009	0.834±0.01	0.706±0.013
7	Proso millet	DHPM-2769	0.107±0.007	0.102±0.006	0.0962±0.008	0.690±0.009	0.617±0.01	0.611±0.013
8	Proso millet	DHPM-2181	0.187±0.007	0.185±0.006	0.17±0.008	0.585±0.009	0.571±0.01	0.567±0.013
		Grand mean	0.46±0.007	0.29±0.006	0.366±0.008	0.580±0.009	0.68±0.01	0.53±0.013
		Sem+/-	0.007	0.007	0.009	0.009	0.010	0.013
		CD@1%	0.032	0.029	0.037	0.009	0.044	0.054
		CV%	3.330	4.750	4.882	3.240	3.130	4.813

Table 6: Nutritional profile of small millets across locations for different genotypes of different small millets. Cont.

Sl. No.	Name of crop	Name of variety	Zn(mg/100)		
			Hanumanamatti	Mudhol	Dharwad
1	Foxtail millet	DHFT-109-3	0.68±0.019	0.62±0.01	0.692±0.033
2	Foxtail millet	Halnavani	0.605±0.019	0.61±0.01	0.642±0.033
3	Little millet	DHLM-36-3	0.417±0.019	0.505±0.01	0.358±0.033
4	Little millet	Karisavi	0.535±0.019	0.487±0.01	0.43±0.033
5	Little millet	Mallisavi	0.364±0.019	0.420±0.01	0.405±0.033
6	Finger millet	DHFM-78-3	1.882±0.019	0.416±0.01	0.397±0.033
7	Proso millet	DHPM-2769	1.337±0.019	1.262±0.01	1.212±0.033
8	Proso millet	DHPM-2181	1.293±0.019	1.217±0.01	1.2±0.033
		Grand mean	0.89±0.019	0.69±0.01	0.66±s0.033
		Sem+/-	0.019	0.010	0.033
		CD@1%	0.079	0.041	0.139
		CV%	4.234	2.890	10.016

Table 7: Nutritional profile of different small millets across locations.

Name of variety	Protein%					Iron Mg/100				
	Hanumanamatti	Mudhol	Dharwad	Average across location	Average crop wise	Hanumanamatti	Mudhol	Dharwad	Average across location	Average crop wise
DHFT-109-3	11.03	10.74	11.90	11.22	10.84	1.99	1.87	2.01	1.95	1.95
Halnavani	11.02	10.10	10.27	10.46		2.02	1.77	2.03	1.94	
DHLM-36-3	8.30	7.51	8.17	7.99	8.24	3.85	3.93	2.37	3.38	3.11
Karisavi	9.43	7.05	8.61	8.36		3.34	3.13	1.44	2.64	
Mallisavi	9.10	7.83	8.21	8.38		5.69	2.05	2.25	3.33	
DHFM-78-3	8.90	7.44	7.08	7.81	7.80	2.78	1.86	1.90	2.18	2.18
DHPM-2769	11.00	9.67	10.35	10.34	10.82	2.32	2.12	2.31	2.25	2.17
DHPM-2181	11.97	10.34	11.60	11.30		2.40	1.92	1.95	2.09	
Sem+/-	0.133	0.131	0.109			0.068	0.040	0.035		
CD @ 1%	0.552	0.546	0.454			0.286	0.15	0.149		
CV%	2.640	3.103	2.289			4.5	3.54	3.5		

Table 8: Nutritional profile of different small millets across locations. Conti.

Name of variety	Mn (mg/100g)					Copper Mg/100				
	Hanumanamatti	Mudhol	Dharwad	Average across location	Average crop wise	Hanumanmatti	Mudhol	Dharwad	Average across location	Average crop wise
DHFM-109-3	0.92	0.38	0.40	0.57	0.55	0.48	0.42	0.87	0.59	0.56
Halnavani	0.45	0.35	0.81	0.53		0.80	0.41	0.38	0.53	
DHLM-36-3	0.33	0.43	0.14	0.30	0.32	0.21	0.93	0.36	0.50	0.57
Karisavi	0.48	0.41	0.15	0.34		0.43	0.88	0.30	0.54	
Mallisavi	0.32	0.39	0.26	0.32		0.66	0.84	0.47	0.66	
DJFM-78-3	0.93	0.11	0.92	0.65	0.65	0.84	0.83	0.71	0.79	0.79
DHPM-2769	0.11	0.10	0.10	0.10	0.14	0.69	0.62	0.61	0.64	0.61
DHPM-2181	0.19	0.19	0.17	0.18		0.59	0.57	0.57	0.57	
Sem+/-	0.007	0.007	0.009			0.009	0.010	0.013		
CD@1%	0.032	0.029	0.037			0.039	0.044	0.054		
CV%	3.330	4.750	4.882			3.240	3.130	4.813		

Table 9: Nutritional profile of different small millets across locations. Conti.

Name of variety	Zn(mg/100)				
	H anumanamatti	Mudhol	Dharwad	Average across location	Average crop wise
DHFT-109-3	0.68	0.62	0.69	0.66	0.64
Halnavani	0.61	0.61	0.64	0.62	
DHLM-36-3	0.42	0.51	0.36	0.43	0.44
Karisavi	0.54	0.49	0.43	0.48	
Mallisavi	0.36	0.42	0.41	0.40	
DHFM-78-3	1.88	0.42	0.40	0.90	0.90
DHPM-2769	1.38	1.26	1.21	1.28	1.26
DHPM-2181	1.29	1.22	1.20	1.24	
Sem+/-	0.019	0.010	0.033		
CD@1%	0.079	0.041	0.139		
CV%	4.243	2.890	10.016		

Table 10: Initial soil properties of the experimental sites

Village Name	N	Iron (ppm)	Zn (ppm)	Mn (ppm)	Copper(ppm)
Mudhol	109	3.82	0.29	2.04	3.57
Dharwad	139	4.25	0.93	4.51	1.75
Hanamanamatti	245	21.08	1.30	3.21	0.48

Conclusions

The highest protein content observed in proso millet (~11.5%) followed by foxtail millet (~11.0) and little millet (~10%) and least found finger millet (~8.0%). The nitrogen content of small millet follows soil nitrogen content but not exact proportion.

The highest iron content found in little millet (3.11 mg/ 100g of rice) followed by finger millet (2.17 mg /100 g of rice) and proso millet (2.17 mg/100 g of rice) and least in finger millet (1.947 mg/ 100 g). The results clearly stated that genotype, and soil, environment play big role in production of manganese content in foxtail millet, little millet and finger millet but soil and environment was very less influence on proso millet genotypes. Finger millet genotype, DHFM-78-3 (0.652 mg/100 g of rice) produced highest manganese followed by foxtail millet (0.549 mg/100 g of rice) and little millet (0.321 mg/100 g of rice) and least manganese found in proso millet (0.141 mg/100 g of rice).

Out of four small millets, proso millet genotypes (1.26 mg/100 g of rice) produced highest zinc content followed by finger millet (0.89 mg / 100 g of grain) and foxtail millet (0.642 mg/100 g of

rice) and lowest zinc content found in little millet (0.436 mg/100 g of rice).

The finger millet genotype, DHFM-78-3 produced higher zinc content at Hanumanamatti (1.882 mg/100 g of grain) while, lower levels of zinc values at Mudhol (0.416 mg/ 100 g of grain) and Dharwad (0.397 mg/100 g of grain). The proso millet produced higher values of zinc content across the locations and foxtail and little and proso millet produced more or less similar zinc values across the locations.

The DHFM-78-3 produced highest copper content of 0.792 mg/100 g of grain followed by proso millet rice of 0.607 mg/100 g of rice, little millet of 0.565 mg/ 100 g of rice and foxtail millet of 0.558 mg/ 100 g of rice

The copper content of small millets genotypes not correlate with soil copper content of different locations.

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