5.1. Introduction and Review of Literature

5.1.1. Introduction

All forms of living matter require inorganic elements, or minerals, for their normal life processes. They are required by the body in small amounts for the maintenance of health and life. These are the essential inorganic minerals present in the soil and obtained by all organisms primarily through plant foods. There are 21 minerals recognized as being essential for humans and several more that occur in the body, but their function and essentiality are yet to be known (Desai, 2000).

The minerals are generally classified into two groups depending on their amounts in the adult body. The macronutrients which exist in the body at levels greater than 0.005% of body weight and micronutrients are required at levels less than 0.005% of the body weight and are essential. They are involved in enzyme reactions as cofactors but also have several other functions (Clydesdale and Francis, 1985). Minerals are a complex group of compounds and are chemically very reactive. They can combine with other compounds in food. Some of these compounds aid in their absorption into the blood and are said to increase the mineral availability or “bioavailability”. Certain other compounds inhibit mineral absorption and thus decrease their bioavailability. Certain foods such as flour and cereals are fortified with some of the minerals to increase their nutritive value. Minerals can become toxic compounds in higher doses (Desai, 2000).

The major minerals are required in concentrations of greater than 100 ppm (parts per million). Sufficient micro nutrients in the daily diet are one of the pre-requisites for human health (Caballero, 2003; Black, 2003). Estimates suggest that some 815 million house holds world wide suffer from micronutrient deficiency (Underwood, 2003).
Cereals are the most important staple crops and thus are a particularly important source of vitamins, minerals and rare amino acids. But, cereals in general contain only low levels of micro nutrients, most of which are lost during processing for food or feed (Cheng & Hardy, 2003). Wise food choices provide the necessary foundation for optimal nutrition. Science has not fully identified the specific chemical components that account for the benefits of healthy eating patterns. Selection of a variety of foods, using tools such as USDA / HHS dietary guidelines for Americans and the USDA food guide pyramid, is the best way to provide a desirable balance, without excessive intakes of macro nutrients, micro nutrients and other beneficial components of foods. Nevertheless, for certain nutrients and some individual, fortification, supplementation or both may also be desirable. The recommendations of the national academy of sciences food and nutrition board provide a sound scientific basis for vitamin and minerals intakes. Intakes exceeding those recommendations have no demonstrated benefit for the normal, healthy population. It is the position of the American Dietetic Association that the best nutritional strategy for promoting optimal health and reducing the risk of chronic diseases is to wisely choose a wide variety of foods. Additional vitamins and minerals from fortified foods and or supplements can help some people to meet their nutritional needs as specified by science based nutrition standards such as the dietary reference intakes (Hunt and Dwyer, 2001).

5.1.2. Significance and Role of Minerals

Food security depends not only on the quantity of food available but also on its nutritional quality. Unfortunately, the poorest individuals in the world are faced with a limited choice and generally rely on a single staple food crop for their energy intake. Most plants are deficient in some essential amino acids, vitamins and minerals but a balanced diet provides adequate qualities of all. Problems arise when the diet is restricted to a single protein source, which is often the case for both human populations
and domestic animals in developing countries (Graham et al., 2001). Milled cereals are also deficient in several vitamins and minerals, the most important of which are vitamin A, iron and zinc. Genetic modification strategies to provide nutrient fortification represent one of most straightforward approaches to alleviate malnutrition. Fe deficiency is the most prevalent form of mineral deficiency around the world, even in developed countries, and causes severe anemia, particularly in women and children (Graham et al., 2001). In developed world, mineral deficiency is prevented by balanced diets, minerals supplements and fortification. In developing countries, such counter measures do not exist and since cereals and legumes are naturally deficient in minerals such as Fe and Zn, there is widespread anemia and other diseases caused by mineral deficiency. Transgenic plants with increased mineral levels provide one solution to this problem, and there have been some encouraging results with plants designed to accumulate Fe (Cakmak, 2002).

More than 2 billion people consume diets that are less diverse than 30 years age, leading to deficiencies in micro nutrients, especially iron, zinc, selenium, iodine and vitamin A. A strategy that exploits genetic variability to breed staple crops with enhanced ability to fortify themselves with micro nutrients (genetic bio fortification) offers a sustainable, cost-effective alternative to conventional supplementation and fortification programs (Genc et al., 2005).

Although minerals comprise only 4 – 6 % of human body weight, they are of critical importance in the diet (Groff & Gropper, 2000; Graves & Trotter, 2003). Studies have confirmed that 70 % of men and 80 % of women consumed foods that have less than two thirds of one or more essential minerals and vitamins (Redmon, 1999). In children and older people, low mineral intakes deteriorate immune responses (Lesourd, 1997). Mineral ions play an essential role in regulating enzyme activities, maintaining acid-base balance and osmotic pressure facilitating membrane transfer of essential nutrients and maintaining nerve and muscular irritability (Anderson, 2004).
The concentrations of micronutrients such as zinc and selenium can be increased substantially in staple crops by increasing the availability in soil by fertilizers (Graham et al., 2001; Lyons et al., 2003). However, the sustained use of expensive fertilizers may be difficult in developing countries. An alternative is the selection of plant varieties with superior ability to accumulate certain nutrients in the grain. This approach is particularly attractive for iron (Fe), which is very difficult to enhance by fertilization and for which substantial genotypic variation exists within staple crops (Graham and Welch, 2001).

5.1.3. Calcium

The most important and predominant mineral of the skeleton is calcium, it has a large number of vital functions with in the body, including the muscular, neurological and endocrine systems (Evered and Harnett, 1986). A number of factors control calcium balance. The amount of calcium within the skeleton changes with age, body size and composition, increasing during growth and declining in parallel with the bone loss during aging (Kanis and Pasmore, 1989). During growth, the skeleton increases in size, in calcium content, and in calcium requirements and even after growth stops, the amount of bone and its calcium content together may continue to rise. The form of calcium given, the efficiency of its absorption and the recommended requirements are the most important factors in calcium nutrition (Blanchard, 1989). Calcium is likely to be deficient in typical human diets, it is affected by plant phytates and also high-Ca diets decreased zinc availability.

5.1.4. Phosphorus

Phosphorous in the human body is found both in its organic and inorganic forms, and is distributed throughout the body. It is an integral part of phospholipids, phosphoproteins, and sugar phosphates. Most biochemical reactions require adenosine
triphosphate for which phosphate is necessary. The effects of phosphorus deficiency are widespread, and disorders of phosphorous metabolism are closely related to important bone diseases (Russell et al., 1999).

5.1.5. Iron

Iron is involved in many oxidation reduction reactions. It is an essential element for the formation of haemoglobin of red cells of blood and plays an important role in the transport of oxygen. Deficiency of iron results in anemia, impairment of temperature regulation and a secondary deficiency of thyroid hormone. Deficiency of iron in early childhood results in decreased growth and weight gain (Fairbanks, 1994).

5.1.6. Potassium

Potassium is an important constituent of fluids present outside and within the cell. Proper concentration of these electrolytes inside and outside the cell is essential to maintain osmotic balance and keep cells in proper shape. Potassium is present in all foods particularly in fruits and vegetables. In plant foods, potassium is present in higher concentrations than sodium by a factor of 10 to 50 fold. Plant foods are indeed the rich source of potassium. The exact requirement of K is not known, but potassium present in a vegetarian food is probably adequate to meet the daily requirement (Gopalan et al., 1989).

5.1.7. Magnesium

Magnesium is the most abundant intra cellular divalent cation involved in a large number of metabolic processes. Magnesium plays an important role in a wide range of fundamental cellular reactions such as the synthesis of fatty acids and proteins, activation
of amino acids, phosphorylation of glucose, oxidative decarboxylation of citrate and transketolase reactions. Human skeleton contains up to 70% of total body magnesium, which is distributed widely in the soft tissues and skeleton. Plasma magnesium levels are maintained remarkably constant by rapid adaptation by the kidney; a fall in magnesium intake is rapidly followed by a fall in the urinary output, and only later by hypomagnesemia (Desai, 2000). Most cereal grains are fair sources of magnesium. The Mg content of forage plants is normally higher in legumes than in grasses (NRC, 1982b). Contrary to most minerals, Mg availability improves with increasing maturity of grasses and may be decreased by heavy K and N fertilization (Kemp et al., 1961). Deficiency of Magnesium leads to serious biochemical and symptomatic changes (Shils, 1994). For humans, pure dietary Mg deficiency is rare. Inadequate intake or provision of Mg is associated with alcoholism, protein-calorie malnutrition and incorrectly formulated parental preparations (Shils, 1990).

5.1.8. Zinc

Zinc is a component of many enzymes and bio membranes. It is involved in binding many transcription factors and stabilizes hormone – receptor complexes (King and Keen, 1994). As in soils and plants, zinc deficiency is also a common nutritional problem in humans, predominantly in developing countries where diets are rich in cereal-based foods and poor in animal protein (Prasad, 1984; Welch, 1993). Foods derived from cereals are not only low in Zn, but also rich in compounds depressing bioavailability of Zn to humans, such as phytic acid and fibre. Wide spread occurrence of Zn deficiency in humans in Turkey were shown through extensive field survey and laboratory studies (Cavdar and Arcasoy, 1972; Cavdar et al., 1980, 1983). Deficiency of zinc may cause growth retardation, hypogonadism, immune deficiencies, behavioral disturbances, night blindness, delayed healing of wounds and impaired taste (King and Keen, 1994). Bioavailability of Zn is very low in foods containing high amounts of phytic acids and fibre.
These compounds have high binding and complexing affinity to Zn and thus hamper biological utilization of Zn in human and animal cells (Welch, 1993). Cereal grains and cereal-based foods are rich in phytic acid and fibre. Therefore, consumption of cereal-based foods in large amounts may easily result in Zn deficiency, particularly in children and nursing mothers (Harland et al., 1988). In biological systems, zinc is involved in the activity of more than 300 enzymes (Singh et al., 2005).

5.1.9. Copper

Copper is one of a relatively small group of metallic elements which are essential to human health. These elements, along with amino and fatty acids as well as vitamins, are required for normal metabolic processes. It plays an important role in iron absorption. In fact, it is essential for the normal healthy growth and reproduction of all higher plants and animals (Gopalan et al., 1989). However, as the body cannot synthesise copper, the human diet must supply regular amounts for absorption. The world health organization and the food and agricultural administration are likely to suggest that the population mean intake of copper should not exceed 12mg/day for adult males and 10mg/day for adult females. A deficiency in copper is one factor leading to an increased risk of developing high cholesterol levels and coronary heart diseases in humans. Copper deficiencies are also associated with premature births, chronic diarrhea and stomach diseases. Copper is present in a wide variety of vegetables, fruits, grains, dried beans, nuts, meats, seafood and chocolate, as well as drinking water (White and Broadley, 2009).

5.1.10. Manganese

Manganese is involved in enzyme activation and is a component of several metalloenzymes. Its function in glycosyltransferase is well recognized and its deficiency leads to abnormality in skeletal bone mineralization. It also participates in lipid and
carbohydrate metabolism (Gopalan et al., 1989). Deficiency of manganese causes impaired growth, skeletal abnormalities, disturbed or depressed reproductive function and defects in lipid and carbohydrate metabolism (Nielsen, 1994).

5.1.11. Selenium

Selenium is an essential micronutrient for humans and animals, with antioxidant, anti-cancer and anti-viral effects (Combs, 2001; Rayman, 2002). It is a non-metal that is found in the oxygen series and exists in multiple oxidation states. Within biological systems, the element is a constituent of the amino acids that comprise proteins. The two most common forms of the element that enter the body are selenomethionine and selenocysteine which are found mainly in plants and animals respectively (Burk and Levander, 1999). Selenium content of food varies between regions throughout the world. Wheat is a major dietary source of Se (Lyons et al., 2003). It is an essential element and along with vitamin E, it is required for maintaining liver integrity. Selenium deficiency leads to liver necrosis. An endemic disease of cardiomyopathy in children (Keshan syndrome) is attributed to low Se in the environment (Gopalan et al., 1989).

5.1.12. Review of Literature

Kumari and Srivastava in 2000 reported that calcium, iron and zinc ranged from 516.00 to 596.00, 8.26 to 15.10 and 1.66 to 2.22mg / 100gm respectively in malted flour of finger millet genotypes. Kurien et al. (1959) had investigated the distribution of nitrogen, calcium and phosphorous in ragi. Salih et al. (1991) reported that Maikah is a rich source of calcium and contain nutritionally useful quantities of zinc. Ragee et al. (2006), reported whole grain cereal meals have higher content of total ash or minerals compared to refined wheat flours (barley 2.9%, rye, millet and sorghum 1.8 – 1.9%). Salih et al. (1991) reported that iron was present in Dactyloctenium and oryza at 121
and 168 mg kg\(^{-1}\) respectively. Manganese was also enhanced in *Dactyloctenium* at about 425 mg kg\(^{-1}\). Hira *et al.* (1993) reported that wheat being the major staple food of India contributes almost one third of calcium and more than two thirds of iron required by adult humans in low socio-economic groups of population of northern India. O’Dell *et al.* (1972) reported that wheat bran contains 70 to 80% of the total phosphorus of the whole wheat Kernel, 80 to 90% of which is phytate phosphorous.

According to the report of WHO (2002), the global burden of Fe deficiency has risen from about 35% of world’s population in 1960 to over 50% in 2000. Rosado (2003) reported successful efforts to fortify flour with zinc oxide (20 – 50 mg/kg) and copper gluconate (1.2 – 3.00 mg/kg). Groenendyk and Seawright (1974) reported that certain tropical grasses (Setaria) contain high levels of oxalic acid and field cases of Ca deficiency have been reported in horses. The oxalates precipitates Ca and render it less available for absorption. The basis of iron requirements for growth have been reviewed by an expert group for FAO/WHO (1988). In 1985, De Maeyer and Adiels states that around 600 to 700 million of the world’s population suffer from iron deficiency anemia. McCance and Widdowson (1942) reported on zinc metabolism, including its balance and absorption. Sanstead *et al.* (1967), and Halstead *et al.* (1972) reported zinc – responsive growth failures in adolescent boys in Egypt and Iran. Davis *et al.* (1984) reported that zinc content of vegetable foods varies greatly with variety, species and growing location. Meta-analysis of many studies show that supplemental zinc can improve growth, particularly of stunted infants (Brown *et al.*, 1998), and reduce the prevalence of diarrhea, both known consequences of zinc deficiency (Bhutta *et al.*, 1999).

Trace elements like iron, zinc, magnesium, selenium, copper and manganese are some of the elements involved in antioxidant defense mechanisms. Inadequate intake of these nutrients has been associated with ischemic heart disease, arthritis, stroke and cancer, where pathogenic role of free radicals is suggested (Lal *et al.*, 1999). Several trace elements such as copper, manganese have immunomodulatory functions.
and thus influence the susceptibility to the course and outcome of a variety of viral infections (Chaturvedi et al., 2004). The versatile role of selenium in nutrition has been reviewed by Bansal and Kaur (2005). They summarized the effective role of selenium in carcinogenesis, immune function, AIDS, male reproduction and cardiovascular diseases. Burk and Lame (1983) had reported on modification of the chemical toxicity by selenium deficiency. White and Broadly (2009) have reported on biofortification of crops with seven mineral elements often lacking in human diets. Genc et al. (2005) reported on exploiting genotypic variation in plant nutrient accumulation to alleviate micronutrient deficiency in populations. Broadly et al. (2006) have reported on biofortification of food crops with selenium. Hell and Hillebrand (2001) have reported on plant concepts for mineral acquisition and allocation. Maeyer et al. (2008) compiled the role of biofortified crops to alleviate micronutrient malnutrition. Bouis (2003) reviewed the micronutrient fortification of plants through plant breeding. Jablonski and Sobezak in 2007 studied the role of mineral elements in diet of pregnant and breast-feeding women.

Gilani and Nasim (2007) have reported on impact of foods nutritionally enhanced through biotechnology in alleviating malnutrition. Welch (2002) studied the global breeding strategies for biofortified staple plant foods to reduce micronutrient malnutrition. Zhu et al. (2007) reviewed the transgenic strategies for the nutritional enhancement of plants. Progress in breeding for trace minerals in staple crops was reported by Gregorio in 2002. Effects of dietary fiber and phytic acid on mineral availability were reported by Torre et al. (1991). Freeland in 1988 reported on mineral adequacy of vegetarian diets. Spears (2003) reviewed the trace mineral bioavailability in ruminants.
5.2. MATERIALS AND METHODS

The quality parameters were analysed using grain samples. The grains were oven dried, ground to fine powder and used for the determination on dry matter basis. The following elements were analysed using the methods indicated below. The average of two readings were taken and tabulated.

5.2.1. Phosphorus content

Total phosphorous, was determined by vanadomolybdate phosphoric acid yellow colour method (Jackson, 1973) and expressed as percentage.

5.2.2. Potassium content

Potassium content was estimated by using a Eel flame photometer (Collins and polkinphorne, 1952).

5.2.3. Calcium, Magnesium, Iron, Zinc, Manganese, Copper and Selenium content.

One gram powdered sample was digested with tri-acid mixture (HNO₃ + H₂SO₄ + HCl O₄) (Jackson and Ul rich, 1959). The digest was filtered made up to 100 ml and was estimated using atomic absorption spectrophotometer,Perkin-elmer and presented as percentage.
5.3. Results and Discussion

The result is shown in the table-9, fig-18, in which Dactyloctenium aegyptium contains calcium (0.43g%), phosphorus (0.43g%), magnesium (135mg%), iron (24.5mg%), zinc (4.9mg%), manganese (8.4mg%), potassium (225.3mg%), copper (17.32mg%), and selenium (0.047mg%). Eleusine indica contains calcium (0.3g%), phosphorus (0.34g%), magnesium (118.9mg%), iron (37.2mg%), zinc (3.95mg%), manganese (10.76mg%) potassium (453.7mg%), copper (11.66mg%), and selenium (0.091mg%). Setaria intermedia contains calcium (0.23g%), phosphorus (0.37g%), magnesium (122.5mg%), iron (38.6mg%), zinc (4.8mg%), manganese (36.5mg%), potassium (303.6mg%), copper (11.38mg%) and selenium (0.09mg%). Setaria pumila contains calcium (0.2g%), phosphorus (0.4g%), magnesium (116.4mg%), iron (45.6mg%), zinc (4.4mg%), manganese (36.9mg%), potassium (241.4mg%), copper (7.88mg%), and selenium (0.087mg%). Sporobolus indicus contains calcium (0.15g%), phosphorus (0.37g%), magnesium (77.2mg%), iron (26.6mg%), zinc (4.6mg%), manganese (6.3mg%), potassium (397.4mg%), copper (7.98mg%), and selenium (0.071mg%). Echinochloa crus-galli contains calcium (0.25g%), phosphorus (0.4g%), magnesium (94.2mg%), iron (22.7mg%), zinc (12.1mg%), manganese (12.1mg%), potassium (348.7mg%), copper (13.66mg%), and selenium (0.076mg%). Control(Eleusine coracana) contains calcium (0.33g%), phosphorus (0.27g%), magnesium(137mg%), iron (5.4mg%), zinc(2.3mg%), manganese (5.49mg%) potassium (408.7mg%), copper (0.47mg%) and selenium (not available).

Dactyloctenium aegyptium shows (0.43g%) Ca which is greater than the calcium content of control- Eleusine coracana(0.33g%). Eleusine indica shows (0.3g%) Ca, which is almost similar to control. Setaria pumila shows(0.2g%), Setaria intermedia (0.23g%), Echinochloa crus-galli (0.25g%) which are less than control. Sporobolus indicus (0.15g%) shows the lowest Ca content.
The phosphorus content in all the members are- 0.43, 0.34, 0.40, 0.37, 0.4g% respectively are greater than that in control (0.27g%). Among the members, *Dactyloctenium aegyptium* shows the highest percentage of phosphorus (0.43g%). In the case of Mg content, *Dactyloctenium aegyptium* shows 135mg%, which is slightly lesser than value of control and *Sporobolus indicus* shows the lowest Mg content (77.2mg%). The other members have a value between *Dactyloctenium aegyptium* and *Sporobolus indicus*.

The iron content in *Setaria pumila* is greater than all other members (45.6mg%) which is greater than the value of control and *Echinochloa crus-galli* shows least iron content (22.7mg%), but greater than value of control (5.4mg%).

*Echinochloa crus-galli* shows greater zinc content (12.1mg%) than control (2.3mg%) and all other members - *Dactyloctenium aegyptium* (4.9mg%), *Setaria intermedia* (4.8mg%), *Sporobolus indicus* (4.6mg%), *Setaria pumila* (4.4mg%), *Eleusine indica* (3.95mg%).

The Mn content is highest in *Setaria pumila* (36.9mg%) followed by *Setaria intermedia* (36.5mg%), *Echinochloa crusgalli* (12.1mg%), *Eleusine indica* (10.76mg%), *Dactyloctenium aegyptium* (8.4mg%), *Sporobolus indicus* (6.3mg%) and control (5.49mg%).

The Potassium content in *Eleusine indica* is (453.7mg%) which is greater than control (408.7mg%) and all other members. *Dactyloctenium aegyptium* (225.3mg%), *Setaria pumila* (241.4mg%), *Setaria intermedia* (303.6mg%), *Sporobolus indicus* (397.4mg%), *Echinochloa crus-galli* (348.7mg%), show less value than control. The value of K in *Setaria pumila*, *Setaria intermedia* and *Dactyloctenium aegyptium* is lower than other members and control.
Dactyloctenium aegyptium shows highest Cu content (17.32mg%). In Echinochloa crus-galli it was (13.66mg%), followed by Eleusine indica (11.66mg%), Setaria intermedia (11.38mg%), Sporobolus indicus (7.98mg%) and Setaria pumila (7.88mg%) respectively.

The selenium content was highest in Eleusine indica (0.091mg%) and lowest in Dactyloctenium aegyptium (0.047mg%). The other members were showing the following values - Setaria pumila (0.087mg%), Setaria intermedia (0.079mg%), Echinochloa crus-galli (0.076mg%) and Sporobolus indicus (0.071mg%).

In the present study nine elements were analysed, of which all the members exhibited a higher value over control with respect to the content of Cu, Mn, Zn and Fe. Dactyloctenium aegyptium is the only plant in the present study having higher Ca (0.43g%) and P (0.43g%) content over control (0.33g% and 0.27g%). Eleusine indica exhibits a higher potassium content (453.7g%) over control (408.7g%). All the members also contain selenium between 0.047 to 0.091mg %. A number of references are available indicating the importance of minerals and the problems in connection with their deficiencies (Graham et al., 2001; Cakmak, 2002; Genc et al., 2005; Redmon, 1999; Anderson, 2004). Different authors proposed strategy for genetic improvement or biofortification using the wild varieties of the cultivars (Genc et al., 2005; Anderson, 2004). The present study revealed that the grains of all the plants employed in the study have higher values of copper, manganese, zinc and iron and are superior to all staple cereals and millets. Hence they could be used as a good gene pool for improving the present cultivars using the conventional breeding or genetic engineering strategies. The possibility of their inclusion in daily diet may enhance and ensure the regular availability of the minerals for a better health.
### Table-9

<table>
<thead>
<tr>
<th>Name of plants</th>
<th>Ca</th>
<th>P</th>
<th>Mg</th>
<th>Fe</th>
<th>Zn</th>
<th>Mn</th>
<th>K</th>
<th>Cu</th>
<th>Se</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Dactyloctenium aegyptium</em></td>
<td>0.43</td>
<td>0.43</td>
<td>135</td>
<td>24.5</td>
<td>4.9</td>
<td>8.4</td>
<td>225.3</td>
<td>17.32</td>
<td>0.047</td>
</tr>
<tr>
<td><em>Eleusine indica</em></td>
<td>0.3</td>
<td>0.34</td>
<td>118.9</td>
<td>37.2</td>
<td>3.95</td>
<td>10.76</td>
<td>453.7</td>
<td>11.66</td>
<td>0.091</td>
</tr>
<tr>
<td><em>Setaria intermedia</em></td>
<td>0.23</td>
<td>0.37</td>
<td>122.5</td>
<td>38.6</td>
<td>4.8</td>
<td>36.5</td>
<td>303.6</td>
<td>11.38</td>
<td>0.079</td>
</tr>
<tr>
<td><em>Setaria pumila</em></td>
<td>0.2</td>
<td>0.4</td>
<td>116.4</td>
<td>45.6</td>
<td>4.4</td>
<td>36.9</td>
<td>241.4</td>
<td>7.88</td>
<td>0.087</td>
</tr>
<tr>
<td><em>Sporobolus indicus</em></td>
<td>0.15</td>
<td>0.37</td>
<td>77.2</td>
<td>26.6</td>
<td>4.6</td>
<td>6.3</td>
<td>397.4</td>
<td>7.98</td>
<td>0.071</td>
</tr>
<tr>
<td><em>Echinochloa crus–galli</em></td>
<td>0.25</td>
<td>0.4</td>
<td>94.2</td>
<td>22.7</td>
<td>12.1</td>
<td>12.1</td>
<td>348.7</td>
<td>13.66</td>
<td>0.076</td>
</tr>
<tr>
<td><em>Eleusine coracana</em> (Control)</td>
<td>0.33</td>
<td>0.27</td>
<td>137</td>
<td>5.4</td>
<td>2.3</td>
<td>5.49</td>
<td>408.7</td>
<td>0.47</td>
<td>NA</td>
</tr>
</tbody>
</table>

### Mineral composition of grains

![Graph showing mineral composition of grains](image)

**Fig-18 Mineral composition of grains**