Aluminium phosphide is a toxic fumigant which is available worldwide and is cheap too. The phosphine gas released when the tablet is exposed to moisture inhibits the utilization of oxygen at cellular level and causes other oxidative stress to the organism, which is exposed to it. Thus, it is widely used throughout the world for controlling stored grain pests. The main reason for toxicity is the release of the phosphine gas which can affect various organ systems and can result in death (Shakeri and Mehrpour, 2014). The residue left after release of the gas when the pellet or tablet completes the reaction is not properly disposed and is even considered harmless. Aluminium phosphide residue decomposed is off white in appearance, main ingredients are aluminium hydroxide, ammonium carbonate and eupholite or talcum powder (Wang et al., 2014). The only method of disposal of the residue is either chemical treatment or burying in pits underground, away from a potable water source. These methods are also hardly employed. Thus, exposing wide variety of organisms including humans to this residue.

TOXICOLOGICAL EFFECTS: When rats were fed with the phosphide powder residue, they showed significant hepatic damage. The hepatic enzymes such as alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase and glutamyl transferase levels were significantly high in the serum (Iyanda, 2013). This clearly points to severe hepatic damage.

The rats fed with phosphide powder residue also showed histopathological changes such as congestion of meninges in brain, severe congestion in the interalveolar septum of the lungs (Iyanda et al., 2013). Incomplete reaction residue of aluminium phosphide still has unspent phosphine. When an animal is exposed to this residue, phosphine may induce oxidative stress. Phosphine can increase the cellular oxygen demand and cause heavy utilization of glucose by the brain, there can be high activity of glycogen phosphorylase to support the increased glucose demand, glycolytic enzymes such as hexokinase and phosphofructokinase also increase in amount (Dua et al., 2001). Further, there can be considerable inhibition of the acetylcholinesterase activity, this can lead to respiratory failure due to excessive secretions in the nasal and airway passages (Mittram et al., 2001).

Rats exposed to aluminium phosphide can show detrimental effects on brain tissue as well, high lipid peroxidation can be observed in the brain, in regions of cerebrum, cerebellum and brain stem (Dua et al., 2001). Lipids play an essential role in maintaining the cellular integrity. Oxidative stress at cellular level causes build up of oxygen free radicals which causes formation of lipid peroxides that disturbs cellular integrity and can eventually lead to cell death. these authors also observed increase in the activity of enzymes such as superoxide dismutase and catalase and decreased activity of enzyme glutathione reductase. Both superoxide dismutase and catalase are enzymes which play important role in eliminating the oxygen free radicals. Increase in levels of these enzymes point towards the oxidative stress the organism is under. Glutathione reductase is an enzyme which is needed to maintain a reducing atmosphere in the cell and preventing from oxidative stress to be induced. The reduction in the levels of these enzymes clearly suggests the presence of oxidative stress in the organism.
of the enzyme indicate towards conditions which can lead to build up oxidative stress inside the cell. Stress generated by phosphine in hepa 1c1c7 cells were studied and the results showed increased lipid peroxidation, increased amount of reactive oxygen species and oxidative DNA damage (Hsu et al., 1998).

RESISTANCE IN STORED GRAIN PESTS: On one hand severe damaging effects of incomplete reaction residue are apparent, on the other hand the pests for which the compound is used as a fumigant have started acquiring resistance towards it. Many species of stored grain pests have shown resistance towards the chemical which includes the rice weevil, which is a menace and apparently a very destructive stored grain pest (Champ and Dyte, 1976). One of the reasons for development of the resistance maybe due to an earlier improper fumigation procedure which results in a selective pressure on the stored grain pests and the ones which are better adapted survive and subsequent fumigation procedures result in further establishment of this resistance. Rph1 and Rph2 genes are responsible for conferring resistance in the insects (Mau et al., 2012).

CONCLUSIONS

Many evidences clearly point towards the fact that incomplete reaction residue of aluminum phosphide cannot be considered harmless and subjected to mismanaged and improper disposal. It may have damaging impact on humans. There is a need for more studies related to soil ecotoxicological impacts of the residue, especially in soil dwelling organisms such as earthworms. Also, the purpose of the usage of the chemical is defeated when the pests develop resistance towards it. This entails avital need for the assessment of the fumigation practices followed in the country and for the proper disposal of the residue.

REFERENCES