REVIEW OF LITERATURE

Many researchers have reported the noxious problem of municipal solid wastes (Goswami *et al.,* 2001; Kaviraj and Sharma, 2003) and house hold wastes (Neuhauser *et al.,* 1988; Frederickson *et al.,* 1997; Appelholf *et al.,* 1998). The problem of post harvest residue of some local crop e.g. wheat (*Triticum aestivum*), perl millet (*Peniseaum typhoides*) and sorghum (*Sorghum vulgare*), golden gram (*Vigna rediata*) and vegetable wastes are also the major waste problem in the field (Ashok, 1994; Kaushik and Garg, 2003; Muthukumaravel *et al.,* 2008; Suthar, 2008). High rate of industrializations has also increased the problems of solid waste management. These problems starts from rural level i.e. agro kitchen vegetable, animal wastes etc to industrial and urban level i.e. solid wastes of textile mill, sugar mill, vine industries, dairy plant sludge and municipal solid wastes etc. These wastes are harmful to human being and their cattle causing several diseases, odour and pollution problems through microbial decomposition (Reinecke *et al.,* 1992).

Various organic wastes such as municipal solid wastes, livestock excreta (Kaviraj and Sharma, 2003), sewage sludge (Liu *et al.,* 2005) have various kind of heavy metals. The physico-chemical properties of soil depend on heavy metals (Wen *et al.,* 2004). Liu *et al.* (2005) have reported that *Eisenia foetida* reduced the heavy metals from sewage sludge and improve the fertility. Earthworms have ability to accumulate heavy metals in yellow tissue (Fishar and Molnar, 1992; Shahmansouri *et al.,* 2005).

Heavy metals are a major category of pollutant disturbed the environment and human health (Hu, 2002). These heavy metals entered in human body through contaminated food stuffs which are produced from contaminated soil (Roels *et al.,* 1997; Ye *et al.,* 2000). The contamination of soil caused by heavy metals emitted from industries, fossil fuels, erosion of rock etc (Martine and Griswold, 2009).These heavy metals can minimize by use of earthworm because the earthworm accumulated the heavy metals in their body (Morgan and Morgan, 1999; Leonard and Dolfing, 2001; Dei and Becquer, 2004). *Eisenia foetida* have exposed a wide range of heavy metals bioaccumulation in their body (Saxena and Chauhan, 1998; Shahmansouri *et al.,* 2005).

Bansal and Kapoor (2000) has reported the management of various agricultural residue and crop waste through the use of earthworms. Fly ash and seawage sludge (Fang *et al.,* 1999), mango leaves and rice stubble (Talashilkar *et al.,* 1999), water hyacinth (Gajalakshmi *et al.,* 2001), plant litter (Shanthi *et al.,* 1993; Fredrickson *et al.,* 1997), vine fruit industries sludge (Atharasopoulous, 1993), municipal solid wastes, paper mill sludge (Elvira *et al.,* 1997; Gajalakshmi *et al.,* 2002a, b) agriculture residue, plant litter, livestock and dairy processing plant sludge (Kavian and Ghatneker, 1991; Gratelly *et al.,* 1996; Elvira *et al.,* 1998) are ingested by earthworms and egested as a peat like materials termed vermicompost. Recycling of wastes through vermicomposting reduced the problem of wastes.

Eisenia foetida (Savigny)

Eisenia foetida is commonly known as the compostworm, wiggler or redworm. They are brown, red or purple in colour and distributed throughout the country due to their migratory behaviour (Talashilkar and Dosani, 2008). *Eisenia foetida* can tolerate temperature up to 30-35°C with high regenerative capacity. It attains sexual maturity within 30-40 days (Gupta, 2005; Garg *et al.,* 2005; Elvira *et al.,* 1998). The cast production efficiency of *Eisenia foetida* ranges from 8-12 mg/worm/day (Srivastava and Singh, 2004). Mature adult worm produces 2-3 cocoons per weeks (Lowe and Butt, 2002). The egg hatched within 3 weeks and each cocoon produces 2-20 baby worms (Ghatnekar *et al.,* 1998). An adult *Eisenia foetida* produces approximately 250 worms within 6 month and life span is 70-80 days (Gupta, 2005).

Kaviraj and Sharma (2003) reported the *Eisenia foetida* as a superior species than *Lampitto mauritii* for conversion of waste into vermicomposts. Garg *et al.* (2006b) and Suthar (2007 b) observed that the *Eisenia foetida* have a great potential to change the different livestock excreta into vermicomposting. Biomass gain and cocoon production by *Eisenia foetida* was more in cow, buffalo dung than goat dung (Loh *et al.,* 2005). Gunadi and Edwards (2003) observed the fecundity of *Eisenia foetida* in different animal dung and found that the worm growth is faster in pig wastes than cattle solid wastes. Addition of cow dung with solid textile mill sludge is suitable for the survival of *Eisenia foetida* (Atiyeh *et al.,* 2000; Kaushik *et al.,* 2003, 2004). Earthworm is a potential source for biodegradation of organic waste such as pig, horse manure, rabbit droppings, crop residue and city garbage (Ghatnekar *et al.,* 1998).

Accumulation of the pesticides and heavy metals was reported in the tissues of earthworm *Eisenia foetida* by Garg *et al.* (2005) and Gupta *et al.* (2005). It degrades wastes in the vermicompost which is useful for fish bait (Gupta, 2005). Different species of earthworms have different potential with respect to the composting ability and the preparation of high protein feed for aquaculture whereas dead earthworm (*Eisenia foetida*) powder contains 62-64% protein, 4.3% lysine, 2.3% cystine and 2.2% methionin, 14% fat 14% carbohydrate and amino acids (Balaji, 1994; Edwards and Bohlen, 1996; Ismail, 1997). Vermiculture is a mixed culture containing soil bacteria and effective strain of earthworm (Ghosh, 2004; Board, 2008). Earthworms increase the nitrate production by stimulating bacterial activity, mucus production, and dead tissues decomposition (Aira *et al.,* 2002). Feeding on aerobic sewage sludge and domestic animal manure, earthworm increase the rate of decomposition (Chaudhary and Bhattacharjee, 2002; Kaushik *et al.,* 2003). Mitchell (1997) observed that during vermicomposting, earthworms decrease the anaerobic process and increase the aerobic condition, therefore decline in methane and volatile sulphur compounds.

Garg *et al.* (2005) reported that cow, horse, goat and sheep dung supported the growth and reproduction of *Eisenia foetida*, hence it can be used as feed materials in large scale vermicomposting. Purohit (2003) and Garg *et al.* (2006a) studied the growth and fecundity of earthworm *Eisenia foetida* in the combination of water hyacinth and cow dung. In the large scale vermicomposting, the use of solid textile mill sludge as raw material with inoculation of *Eisenia foetida* can help to convert wastes in the valuable vermicompost (Kaushik *et al.,* 2003; Garg *et al.,* 2005). Recently the specific name of *Eisenia* was revised from *foetida* to *fetida*, however, in the present compilation, the previous name was retained.

Vermiculture and vermicomposting

The scientific method of breeding and earthworm population in controlled condition is known as vermiculture and the biological wastes managements through earthworms is known as vermicomposting (Gupta, 2005; Singh *et al.,* 2011). The earthworms feed on organic substances and produce rich organic manure which is known as vermicompost (Rangnathan, 2006). Vermicompost is finally divided in to peat like materials with high porosity, aeration, drainage, water holding capacity that contain plant nutrients (Kaviraj and Sharma, 2003; Maboeta and Van-Rensburg, 2003; Chauhan *et al.,* 2010). Gupta (2005) reported that the earthworms provide a tremendous surface area for the microbial attack on faecal matter by mastication of organic wastes and also maintain stable pH of soil through their guts which contain various enzymes such as proteases lipase, amylases, cellulases, lichenases and chitinases. The microbial and vermic-activity are responsible for biochemical degradation of organic matter (Aira *et al.,* 2002). Nath and Singh (2011) reported that the potential of earthworm *Eisenia foetida* for production of vermicompost. The cattle dung, horse wastes, pig wastes, turkey waste, poultry droppings, paper wastes and water hyacinth are converted into useful product by the earthworm *Eisenia foetida* through vermicomposting (Edward *et al.,* 1998; Ghose *et al.,* 1999; Gajalakshmi *et al.,* 2002a, b; Gunadi *et al.,* 2002; Kaushik and Garg, 2003).

Vermicompost decreased toxic metals and is rich source of beneficial microorganisms, higher level of plant available nutrients and therefore may enhance the soil fertility (Garg *et al.,* 2006a). The chemical changes have been observed during breakdown of organic wastes by the activity of earthworm through vermicomposting (Albanell *et al.,* 1988; Ghose *et al.,* 1999). Vermicomposting process is a good technique to increase the level of phosphorus (P) content due to the mineralisation and mobilisation of P due to bacterial and faucal phosphate activity of earthworms (Krisnamoorthy, 1990). Ghosh *et al.* (1999) reported that during vermicomposting the higher level of transformation of phosphorus from organic to inorganic state, and thereby is available as plant nutrient and compared to ordinary composting. The municipal sludge has been decreased reported to the heavy metals (Zn, Fe, Cu, Pb, Mn, Cr, Ni and Co) by the use of earthworm *Eudrilus euginiae* and *Eisenia fetida* through vermicomposting by Selladurai *et al. (*2009).

Since *Eisenia foetida* survive in high range of ecological variation temperature, humidity worms may migrate to deeper soil layer where the temperature and moisture conditions are better and in diapause the worms stop the feeding and with empty gut coil tightly (Bouche and Gardner, 1984). The covering of mucus lined cell provided protection against extreme temperature and also from desiccation. The dipause behavior differs from species to species (Gaddei and Douglas, 1977). Balaji (1994) has reported that generally species are highly resistant to many pesticides and heavy metals, worms could overcome the effect by increasing mucus secretion restricting the movements and increasing the reproducing potential up to certain concentration level sodium is concentrated by *Eisenia foetida* but lead is not.

Vermicomposting is special form of composting in which earthworms feed on the organic matter and stabilised the soil organic matter (Bianchina, 2009), and also is a tool for management of waste and heavy metal contaminations (Jain and Singh, 2004). The application of vermicompost increase in the soil plant nutrient and uptake by the plants which results good productivity of crops (Singh and Sharma, 2003; Roberts *et al.,* 2007). Vermicompost produced from different biological wastes by earthworm is a very good organic fertiliser (Gajalakshmi and Abbasi, 2002).

The most species of the earthworms reduce have been found to plant pathogen and believed to release enzymes and hormones in their excreta which are beneficial for plant growth (Gajalakshmi and Abbasi, 2004). The earthworms *Eisenia fetida*, *Lumricus rubellus, Perionyx excavatus, Lampito mauritii, Eudrilus euginea,* and *Pheretima elongata* have been used to digest and break down different biological matter in to the vermicompost during vermicomposting (Tripathi and Bhardwaj, 2004; Suthar, 2006).

Vermicomposting could be an adequate technology for management of organic wastes in to valuable product through earthworm species (Elvira *et al.,* 1997). During the vermicomposting process the important plant nutrients such as nitrogen, potassium, phosphorus, calcium are converted in to more soluble and absorbable form for the plants (Ndegwa and Thompson, 2001). Vermicompost is a peat like material egested by earthworms after ingestion of various solid organic wastes (Edwards and Bohlen, 1996; Wani, 2002). Sharma *et al.* (2008) have reported that vermicomposting is a better option for management of solid organic wastes. Vermicompost contain biologically active substances such as plant growth regulators through vermistablisation of industrial sludge by earthworms species (Tomati *et al.,* 1987).

In general earthworms are highly resistant to many pesticides and heavy metals. Worms could overcome the effect by increasing mucus secretion, restricting the movement and increasing the reproductive potential up to certain concentration levels (Senapati and Dash, 1984). Earthworms are also known to concentrate the pesticides and heavy metals in their tissues. Sodium was concentrated by *Eisenia foetida* but no lead (Bhole, 1992; Kaushik and Garg, 2003; Gupta *et al.,* 2005). The bioaccumulation of toxicants in the tissues of earthworms varies depending on the soil properties, pH, and calcium concentration (Govindan, 1998).

Vermicomposts can be produce using animal manure as substrate (Contreras-Ramos *et al.,* 2004). Vermicomposts promote soil properties such as granulation, fine filth, efficient aeration, easy root penetration and improved water holding capacity (Edwards and Bohlen, 1996; Peyvast *et al.,* 2008). Vermicomposts constantly promote the biological activity which can cause plants to germinate, flower, growth and yield of bedding plant container media in dependent of nutrient availability (Atiyeh *et al,* 2000; Arancon *et al.,* 2004). Organic manure can increased soil organic matter, soil water retention and transmission and other physical properties of soil, decreased bulk density, and increased aggregation (Turner *et al.,* 1994; Zebrath *et al.,* 1999).

Vermicomposting is an easy and effective way to recycle agricultural wastes, city garbage and kitchen wastes along with bioconversion of organic waste materials in to nutritious compost by earthworm activity (Mall *et al.,* 2005). The earthworms increases the porosity aeration, drainage water holding capacity, which reduced the irrigation water requirement for crops and improves plant nutrients availability (Purohit, 2003).

Effect on plant growth and productivity

Nath and Singh (2012) reported that the vermicomposts obtained from the combinations of buffalo and horse dung with gram bran and straw have significant growth in millet crops. All the concentrations of different combinations of animal, agro and kitchen wastes have significant early start in flowering and enhance the productivity of crops. The vermicompost stimulate plant growth providing sufficient amount of nutrition (Atiyeh *et al.,* 2002; Arancon *et al.,* 2004). It contains plant growth regulator and plant growth hormones that increase the growth and yield of different crops (Canellas *et al.,* 2002). The microbial activity in vermicompost could result in the production of significant quantities of plant growth regulators by microorganism (Krisnamoorthy, 1990; Edwards *et al.,* 1998; Shukla and Singh, 2012).

Uses of vermicompost promote the soil segregation and stabilize the soil structures and improve the air water relationship with soil, thus increase the water holding capacity enhancing the root development of plants (Marinari *et al.,* 2000; Gupta, 2005). Karmegam and Danial (2000) have reported better productivity of pea (*Pisum sativum*) due to the application of vermicompost in the agricultural field. The application of vermicompost at 10 tonnes /hec along with the recommended dose of P and N resulted into 50% increase in dry pod yield than the recommended dose of nitrogen and phosphorus alone (Nethra *et al.,* 1999). Shukla and Singh (2010) investigate the potential effect of vermicompost that have a significant effect on the germination, growth and productivity of crops. The combination of buffalo dung with gram bran has a significant positive effect on the germination, growth, flowering and productivity of crops among all the vermicomposts.

Vermicompost have also been shown to influence the growth and productivity of a variety of plants, cereals and legumes, vegetables, ornamental and flowering plants and field crops (Chan and Griffith, 1988; Fulekar and Jadia, 2008). It improved seed germination, enhanced seedling growth and productivity (Atiyeh *et al.,* 2001). Large amounts of humic acid were produced during vermicomposting and reported to have positive effects on plant growth (Garg *et al.,* 2006a). Canellas *et al.* (2002) observed that exchangeable auxin and humic acids extracted from vermicompost enhanced the plant growth.

Bullock and Ristaino (2002) reported that the southern blight (*Sclerotium rolfsii)* incidence was only 3% in the field tomatoes after amended of cotton gin trash composts. Szezech *et al*. (2001) reported that the pure cow manure vermicompost inoculated in the field of *Phytopthora nicotianae, Fuasarium oxysporum* and *Plasmodiophora brassicae* significantly affects the tomato seedling and clubroot disease in cabbage (*Brassica olaraca capitata*) by *Phytopthora, Pplasmodiophora).* Edwards and Arancon (2004) reported that vermicomposts useful for the reduction of arthropods (aphid, milybugs, spidermites) population and also subsequent reduction of plant damage (tomato, pepper and cabbage). Vermicompost could be used for destroying the plant pathogens successfully (Appelholf, 2003).

Phyto-accumulation of heavy metals

Heavy metal accumulation in plant and soil from natural and artificial sources and their effects represent important environmental pollution problems. Most of the heavy metals accumulate in the biological environment in different ways, via the nutrient chain. Increasing heavy metal accumulation at critical levels in living organisms from contaminated environment may have morbidity and mortality effects. Some of the most toxic trace elements for living organisms belonging to the heavy metal group are As, Be, Cd, Cr, Pb, Mn, Hg, Ni, Se and V (Karatas *et al.,* 2006). Determination of the rate of mobilization of heavy metal from sewage sludge or wastewater after its application to soil is very important for agricultural practice, since is allows us to assess the rate at which they pass into the soil solution, which conditions their uptake by plants (Gondek, 2010). Kiziloglu et al. (2008) investigated the effects of untreated and treated wastewater irrigation on some chemical properties of cauliflower (*Brassica olerecea* L. var. *botrytis*) and red cabbage (*Brassica olerecea* L. var. *rubra*) grown on calcareous soil in Turkey. Najafi and Nasr (2009) investigated comparatively the effects of wastewater on soil chemical properties in three irrigation methods. Karimi *et al.* (2008) investigated the effects of municipal sewage sludge on the concentration of lead (Pb) and cadmium (Cd) in soil and on yield of wheat. Their results showed that the application of sewage sludge cause increase of extractable cadmium and lead in soil. These results also showed the application of sewage sludge caused an increase of concentration of cadmium and lead concentration in root and shoot of wheat. Heavy metals are easily accumulated in the edible parts of plants from metal contaminated areas (Arora *et al.,* 2008).

Therapeutic uses of earthworms

Earthworms are used as antipyretic (Barley, 1961). Stephenson (1930) has reported that earthworm ashes had been used as tooth powder, as stimulant for hairs growth in the head. It is used in the treatment of piles, fever, small pox, jaundice and removal of stones in bladder (Ranganathan, 2006). Earthworm and their extract have antioxidant activity, cure impotency, and rheumatism (Weisbach, 1962), promote lactation, and dilate the bronchi (Reynolds and Reynolds, 1972).

Balamurugan (2006) observed that the earthworm paste beneficial for the treatment of wounds and tropical ulcer. The earthworms contain potent molecules in their intestinal such as *Eisenia fetida* and *Lumbricus rubellus* fluid and subsequently in tissue fluid such as lumbricin I and II are peptides. The fibrinolysin and fibrinokinase are other important enzymes extracted from earthworms which has high 'cellulolytic activity' as well as 'proteolytic activity' and can reduce the viscosity of blood and apparently has beneficial effects on 'paralysis of limbs' or 'aphasia' caused by cerebro-vascular disease (Wang *et al.,* 2003). Kangmin (1998) reported that the collagenase was another valuable enzyme extracted from earthworms which can cure 'thrombus' type diseases.

Cooper (2009) suggested that the earthworms 'leukocytes' can recognize human cancer cells as 'foreign' and can kill them. A peptide 'lumbricin' isolated from *Lumbricus terrestris* by a Japanese scientist has been shown to 'inhibit mammary tumors' in mice. The group of enzymes lumbrokinase (LK) also promises to wage a 'war on cancer' (Kangmin, 1998). Lopez and Alis (2005) reported that the several fatty acids have been isolated from earthworms that have anti-microbial properties. It is a precursor to 'monolaurin' which is a more powerful 'anti-microbial' agent that has potential to fight lipid-coated RNA and DNA viruses, several pathogenic gram-positive bacteria, yeasts and various pathogenic protozoa.

Heavy metals accumulation by earthworms

Heikens *et al.* (2001) reported that the soil decomposers like earthworms accumulate heavy metals at a higher level. The earthworms accumulate lead (Pb) to lesser extent than cadmium (Straalen and Wensem, 1986). Lanno *et al.* (2004) reported that the effects of heavy metals on soil organisms depend on exposure to concentrations that are available for uptake whereas earthworms can be exposed by direct dermal contact with heavy metals in the soil solution or by ingestion of pore water, polluted food and soil particles. Maximum bioaccumulation of in earthworm *Lumbricus terrestris* was reported followed the trend, Zn >Pb> Cr>Fe>Ni from soil.

The earthworms can bioaccumulate high concentrations of heavy metals like cadmium (Cd), mercury (Hg), lead (Pb), copper (Cu), manganese (Mn), calcium (Ca), iron (Fe) and zinc (Zn) in their various tissues. They can particularly ingest and accumulate extremely high amounts of zinc, lead and cadmium (Hartenstein *et al.,* 1979). Earthworms are also known to concentrate the pesticides and heavy metals accumulate in their body tissues (Bhole, 1992; Kaushik and Garg, 2003; Gupta *et al.,* 2005). The bioaccumulation of toxicants in the tissues of earthworms varies depending on the soil properties, pH, and calcium concentration (Govindan, 1998). The influence of levels of heavy metals in soils which are significantally bioaccumulated by earthworms (Morgan and Morgan, 1999).

Bengtsson *et al.* (1992) observed that the earthworms are more susceptible to metal pollution than many other groups of soil invertebrates. The earthworms are capable of accumulating heavy metals from contaminated substrate (Spurgeon and Hopkin, 1996a; Rosciszewska *et al.,* 2003). The level of bioaccumulation of Cd, Cu, Pb and Zn correlates with the amount of heavy metals in the soil (Larsen *et al.* 1994). Earthworms can accumulate heavy metals in their tissues from the environment (Bamgbose *et al.,* 2000). The use of earthworm as a bio-indicator for soil pollution was shown by Morgan and Morgan (1988).

Sizmur and Hodson (2009) have also reported that the earthworm activities increase the mobility and bio-availbility of heavy metals in soil. After prepared vermicompost the earthworm accumulate metals internally in their body tissue, resulted the reduction of metal levels from polluted soil (Macki and Samadyar, 2009; Ruiz *et al.,* 2009). The earthworms can accumulate heavy metals in their tissue during the process of vermicomposting by Gupta *et al. (*2005) and Suthar *et al. (*2008).

Heavy metals accumulation by earthworm *Eisenia foetida*

Lanno *et al. (*2004) and Shahmansouri *et al. (*2005) observed significant observed a decrease in heavy metal concentration in the vermicompost of *Eisenia foetida* that indicate its capability of accumulation of heavy metals in its body. The earthworm *Eisenia foetida* accumulates heavy metals in their body tissues during vermicomposting of kitchen wastes with different animal dung (Fisher and Molnar, 1992; Shahmansouri *et al.,* 2005). Suthar and Singh (2008) observed that the earthworms accumulate more soluble fraction of metals in its gut or cutaneous tissues due to digested organic material in their body. The bioaccumulation of heavy metals (Cr, Cd, Pb, Cu and Zn) by Iranian and Australian earthworm *Eisenia fetida* during vermicomposting of organic waste such as sewage sludge was shown by Shahmansouri *et al. (*2005). In addition to above heavy metals the bioaccumulation of Cd, Zn, Ni, Pb and Cr by earthworm *Eisenia fetida* body during the vermicomposting was rereported by Macki *et al.* (2009) and Aleagha and Ebadi (2011). Jain and Singh (2004) reported that earthworms are able to accumulate heavy metals in their body tissue from the polluted soil. Cadmium (Cd) is highly toxic element which accumulated by earthworm *Eisenia foetida* in its body tissues during vermicomposting (Shahmansouri *et al.,* 2005).

During the process of vermicomposting, earthworms accumulate metals internally, resulting in a reduction in metal levels in the soil (Ruiz *et al.,* 2009). Shaymaa *et al. (*2010) observed that *Eisenia foetida* successfully removed about 97 % Pb from the sewage sludge. Sellenduari *et al. (*2009) observed that *Eisenia fetida* was more effective species for accumulation of heavy metals than *Eudrilus eugeniae*. Pattnaik and Reddy (2011) observed that the heavy metals accumulation from urbaon wastes by the use of earthworm *Eisenia fetida*. The earthworm *Eisenia fetida* is a better species for the removal of aluminium, lead and nickel from industrial sludge during vermicomposting than other earthworms (Shaymaa *et al.,* 2010).

Maboeta and Van Resburg (2003) and Shahmansouri *et al. (*2005) also observed bioaccumulation of heavy metals Cr, Cd, Pb, Cu, and Zn by the two strains of *Eisenia foetida* during vermicomposting of sewage sludge. The nickel (Ni) was accumulated by *Eisenia foetida* in their body tissue from the polluted soil (Macki *et al.,* 2009). The earthworm *Eisenia fetida* is a suitable species for the bioaccumulation of heavy metals (Cd, Pb, Zn and Cu) from municipal solid wastes, market waste and flower waste through the vermicomposting process by Pattnaik and Reddy (2011).

It is clear from the above observations that the earthworms are most important soil fauna which helps in recycling of organic wastes as well as accumulates the heavy metals in the body and protect our food stuffs from the contamination of heavy metals. The earthworm *Eisenia foetida* is a promising species for vermicomposting and heavy metals accumulation. The in-situ application of *Eisenia foetida* have a more significant result about the management of different biological wastes and production of good quality vermicompost along with more amount accumulation of heavy metals in the body. The vermicompost is a potent source of nutrients, enzymes, vitamins and plant growth hormones which are essential for growth and productivity of various crops. In the present study attention has been focused on the preparation of vermicomposts of different biological wastes (MSW) singly as well as in binary combination.

Knowledge on the contamination of crops with heavy metals from different areas is not well established in India. Therefore, a study was initiated on this aspect in order to avoid possible adverse effects on human health. The study was designed to determine the amount of metals present in crop plants from northeast Uttar Pradesh.

Purpose of the present study

1. To study the level of heavy metals (Co, Cr, Pb, Ni, Cd and As) in the initial feed mixture and vermicompost prepared from combinations of different animal (buffalo, cow, goat, horse and sheep) dungs with kitchen and municipal solid wastes as well as in earthworm body before inoculation and processed vermicompost.

2. To study the level of heavy metals present in the soil before and after mixing of different vermicompost.

3. To measure the heavy metal concentrations in the crop seeds (maize, pea, rice, and wheat), in the soil, the vermicompost mixed soil and vermicompost mixed soil inoculated with earthworms.

4. To measure the heavy metal concentrations in the earthworm body after harvesting crops.