Review of Literature
Present study pertains to the Study of Physiological and Biochemical Effects of Fluoride on *Hordeum vulgare* variety **RD 2052**, *Cicer arietinum* variety **C888** and *Triticum aestivum* variety **Raj 3077**. The study was carried out with an aim to investigate the entry and accumulation of fluoride in different component of the environment (water, soil and vegetation) and their adverse effects through food chain. Literature abounds on impacts of presence of Fluoride on environment and human beings. Published literature related to the present study is reviewed here.

Woltz (1964) observed the effect of atmospheric fluorides upon certain metabolic processes in Valencia orange leaves. In his studies he found that the removal of fluoride from the atmosphere around Valencia orange trees resulted in greater rates of photosynthesis enhanced chlorophyll contents and lower rates of respiration.

Leonard and Graves, Jr. (1966) carried out worked on a field experiment with bearing ‘Valencia’ orange trees on rough leman root stock to study the effects of different levels of air-borne fluorides on yield, fruit quality and leaf growth. The experimental trees were in a grove exposed to relatively high levels of air-borne fluoride. Six trees were enclosed in individual plastic dry calcium carbonate filters. While unfiltered ambient air was moved through the other 3 green houses. Three additional trees were not enclosed and were used as outdoor checks. The leaves of trees in the unfiltered greenhouse absorbed much less fluoride than those of the outdoor check even thought there was little difference I the fluorine content of the air.

Brewer *et al.* (1967) analysed the effects of accumulated fluoride on yields and fruit quality of ‘Washington’ Navel Oranges. Bearing ‘Washington’ Navel Oranges trees were sprayed periodically over a 6 year period with dilute NaF and NaCl solutions. Fluoride toxicity symptoms produced by citrus trees to HF gas and consisted of 1) a characteristic interventional chlorosis pattern, 2) premature leaf drop, and 3) reduced leaf size. In addition, there were significant reductions in fruit production beginning with the third year of treatment.
Yu and Miller (1967) assessed the effect of fluoride on the respiration of leaves from *Chenopodium murale* and soybean (*Glycine max*, Merr. Hawkeye variety) was studied. Fluoride treatment included both excised leaves cultured in nutrient solutions and leaves from plants fumigation with HF atmosphere. Tissues treated with low fluoride concentration which initially showed increased oxygen uptake eventually showed decreased oxygen consumption.

Lovelace and Miller (1967) studied in vitro effects of fluoride on tricarboxylic acid cycle dehydrogenases and oxidative phosphorylation. Their studies were on the in vitro effect of fluoride on the succinic oxidase system utilizing mitochondria obtained from cauliflower. Preincubation of mitochondria with fluoride did not increase inhibition of succinic oxidase. Various other tricarboxylic acid cycle substrates were used to determine their sensitivity to fluoride; only succinic oxidation was affected.

Garber (1968) reported fluoride uptake in plants. Plants take up F compounds from the soil through the roots and from the air (as gas or in solution) through the leaves. The natural fluoride content of plants derived from soil varies between 0.25 and 2.0 mg% (2.5 to 20 ppm).

Spierings (1968) studied the most susceptible tulip variety contains the smallest amount of F in the injured tissues as indicated by fumigation experiments with about the lowest concentration of HF (4.2 ppb) that produces injury. The toxic action of HF is determined by migration to and accumulation of F in special parts of the plants (in particular the leaf tips). During long-term exposure of leaves to extremely low atmospheric HF concentrations. HF is taken up through the leaf surface and subsequently migrates to the leaf tips, where it accumulates. The above three factors may determine the extreme sensitivity to HF of certain varieties of susceptible plant species.

Collet (1969) reported biological effect of fluoride on plants. Fluosilicates penetrate into plants more readily than the other fluoride compounds employed in this study. Boron enhances the accumulation of F provided that it is not a part of the fluorine molecule. Fluoborate is less toxicity than the other F compounds.
Lovelace et al. (1969) investigated the accumulation of fluoroacetate and fluorocitrate in forage crops collected near a phosphate plant. In their studies they present evidence that vegetation near a phosphate plant contains fluoroacetate and fluorocitrate. In control plants from unexposed areas no detectable organic fluoride was found.

Cross et al. (1970) determined high fluoride levels in a citrus grove due to gypsum pond dyke break. The break of the dam of an artificial lagoon constructed to accumulate the effluents from a fertilizer factory induced F contamination in the surrounding area. The effluent water contained up to 5150 ppm of F and up to 21,500 phosphates. Levels in soil ranged upto 384 ppm, in leaves of citrus trees from 45 to 86 ppm, in roots of citrus trees upto 1656 ppm.

Garber (1970) reported fluoride in rainwater and vegetation. Fluoride levels of rainwater in industrial areas of Germany ranged from 0.28 mg/l to 14.1 mg/l depending on the kind of industry, the distance from the industrial complexes, and the extent to which coal is used. There was a direct correlation between the magnitudes of F in rainwater and F in test plants. Plants grown near industrial complexes which process F containing raw materials contain as much as 50 to 185 mg/100 grams of F (dry) compared to normal averages of 0.7 to 1.5 mg.

Oelschlager (1971) investigated magnitude of F uptake by soil from polluted air and from artificial fertilizers. These values were compared to the amount of F removed through harvesting crops and through seepage water.

Woltz et al. (1971) found the effects of fluorides on metabolism and visible injury in cut-flower crops and citrus. Fluoride taken up by gladiolus roots caused foliar damage only when soil pH was low add F containing superphosphate was applied in relatively excessive amounts. Rose and gladiolus cut-flowers were damaged by low concentrations of F in vase water whereas the chrysanthemum was less affected.

Garee et al. (1973) carried out accurate fluoride determinations throughout polluted fir needles. By means of a new analytical method in plant biology, microanalysis by proton nuclear reaction, fluoride assays were made of the surface tissues of polluted needles of fir trees.
Farkas (1975) analyzed total fluoride intake and fluoride content of common foods. The author reviewed in current publications and textbooks most regarding the fluoride content of common foods as well as tables showing the average daily uptake of fluoride in various countries are based on work carried out up to thirty seven years ago. Such work does not allow them the effect of fluoridated drinking water on fluoride levels of processed and cooked foods.

McQuinker and Gurney (1977) pointed out worked on determination of fluoride in soil and vegetation using an Alkali Fusion Selective Ion Electrode Technique. It is evident from the results of this work that the rapid NaOH fusion – STE procedure describes in this work is suitable for the analysis of fluoride in both soils and vegetation and shoot was generally proportional to the concentration in the substance.

Sodzawiczny and Sitko (1978) carried on determination of fluoride content in plants near the Tarnobrzeg Sulfur Basin. Fluoride levels were determined in plants growing in the Tarnobrzeg Sulfur Basin, where sulfur-processing facilities pollute the air. The highest fluoride levels, approached 200 ppm, at a radius of 1.5-2 km from the source of emission. The need for establishing a protective zone around industrial sources of fluoride emissions is emphasized.

Kunmpulainen and Kvivistoinen (1979) reported fluorine in foods. The authors, in the Department of Food Chemistry and Technology, University of Helsinki, Finland, review the fluoride content of foods of animal and vegetable origin, as well as the effects of fluoridated water and of processing and preparation of food on its fluoride content.

Olschlager et al. (1979) carried out on evaluation of damage to vegetation in polluted areas. For the evaluation of the phytotoxic effect of fluoride. No single parameter by itself would be conclusive in litigation. Contrary to the views of some, one cannot obtain an adequate answer in a given situation be evaluating the appearance of plants in a polluted area in relation to the fluoride content.
Singh et al. (1979) determined the effect of Fluoride and Phosphorus on the yield and chemical composition of Rice (*Oryza sativa*) growth in soils of two sodicities. The effect of five levels of fluoride (0, 25, 50 and 100 ppm P as KH$_2$PO$_4$) on the yield and chemical composition of rice (*Oryza sativa*) grown on soils of two sodicities, ESP 30 and 70, was studied in a thrice replicated pot experiment.

Thompson (1979) pointed out fluoride accumulations in soil and vegetation in the vicinity of ERCO phosphorus reduction plant at Long Harbour, Newfoundland (47°26’M, 53°47’W) began to show symptoms of fume damage, e.g. up-burn and margin-burn. Samples of vegetation and soil were collected in the summers of 1973, 1974 and 1975 within a radius of 20 km of the plant in an attempt to assess levels of accumulation of fluoride in soil and vegetation.

Garrec and Passera (1980) assessed uptake of particulate fluorides from an aluminium smelter by plants. Studies of polluted areas near an aluminium smelter have shown that distance travelled by particulate fluoride for deposition on vegetation is one tenth that traveled by gaseous fluorides. In these areas, particulates less than 2 m in diameter collect in large quantities on conifer needles, whereas retention of larger particles is low. Fluoride from aluminium smelter dust accumulates in plant tissue but the rate of accumulation is 30 to 50 fold slower than that from a comparable treatment with HF.

Moeri (1980) observed the effects of fluoride emissions on enzyme activity in metabolism of agricultural plants. The effects of fluoride on the activity of malate dehydrogenase (MDH) in the metabolism of agricultural plants have been investigated. Fluoride, which has been absorbed from the air, seems to act differently from fluoride added to the soil.

Fisher et al. (1981) worked on skeletal fluorosis from eating soil. A woman with chronic pyelonephritis developed progressive muscular weakness and bone pain. For twenty years she had habitually ingested fluoride-rich soil. Osteosclerosis was found on x-ray examination, and fluorosis was confirmed by bone biopsy. Renal failure augmented skeletal retention of excessive fluoride intake, which, in turn,
appears to have intensified symptomatic renal osteodystrophy. Skeletal fluorosis from this unexpected source has not been previously described.

Kesaabi and Amouzigh (1981) pointed out fluoride levels in soil, water, plants and cattle in the Darmous zone of Morocco. In the Darmouse zone in Morocco, contamination of cattle by fluoride can be correlated with the duration of fluoride ingestion. From a practical point of view it can be accurately and easily evaluated by the dental lesions which, when correlated with bone fluoride levels, reflect the severity of contamination of the animal.

Mackowaik and Schneider (1981) determined the effects of gaseous hydrogen fluoride on the yield of field-growth wheat. Exposures of wheat *Triticum aestivum* L. (Olaf") to gaseous hydrogen fluoride (HF) in the field reduced yield but did not cause foliar injury. The effects on yield were modified by the stage of development at the time of exposure.

Sakuraj *et al.* (1983) observed the effects of airborne fluoride on the fluoride content of rice and vegetables. The three most important source of fluoride intake are water, air and food. Because the staple food in Japan is rice, the present study was undertaken to determine the fluoride content in rice and vegetable from a control area free of sources of fluoride emission and from exposed areas near factories emitting fluoride into the atmosphere.

Seth *et al.* (1983) determined effects of fluoride pollution on corn plants through phospatic fertilizer dust fallout. The effects of particulate fallout from a phospatic fertilizer factory on corn plants (*Zea mays* L.) have been studied. Definite in grain–characteristics in the polluted effects of the particulate matter on corn plants have been drawn.

Pillai (1984) worked on the impact of fluoride emission from a fluoride industry situated at Surat. Gujarat State. On chlorophyll content of 4 species of shrubs namely *Prosopis juliflora, Acacia nilotica, Calotropis procera* and *Zizyphus numularia* was studied. Chlorophyll-b was more affected the chlorophyll-a in polluted plants. In *C. Procera* the percent decrease chlorophylls was higher than
that in the other species under study. The results are discussed in the light of fluoride effect on leaves.

Pickering (1985) investigated the mobility of soluble fluoride in soil. The factors which promote retention or release of soluble fluoride species by soils have been reviewed with the aim of identifying key processes. The topics considered include fluoride levels in soils, mobility as demonstrated in leaching studies and fluoride adsorption by soils.

Haikel et al. (1986) assessed fluoride content of water, dust, soils and cereals in the endemic dental fluoride area of Khouribga (Morocco). The fluoride contents of drinking water, dust, soil, straw, raw barley (ears and stems) and barley grains in Khouribga were compared with those from Beni Mellall, 90 km east of Khouribga where no fluorosis occurs. Identical fluoride levels were found water samples from both areas, where’s high amounts of F were in soil, dust, dried straw and dried barley grown in Khouribga.

Lavado and Remaudi (1986) reported Wind-blown dust from salty areas a source of fluoride in plants. As a source of F in plants, in addition to that absorbed by roots. Wind-blown dust carrying fluoride salts was studied. The salts and F originated by capillary rise from groundwater. The F content in salts efflorescence ranges from 31 to 284 mg/kg and the F in plants growing in different soils ranged from 10 to 30 mg/kg. The F retained externally in leaves and stems ranged from 1 to 30 mg/kg.

Rathore (1987) investigated the effect of fluoride toxicity on chlorophyll content of Vicia faba and Allium cepa under modified conditions of NPK nutrition. The effects of different concentrations (0, 10, 24, 50, 100 and 250 ppm) of sodium fluoride which were sprayed fortnightly on Vicia faba (Broad bean) and Allium cepa (onion) plants were studied in randomized plots treated with varying levels of NPK fertilizers.

Troiam et al. (1987) observed soil response and alfalfa fluoride content as affected by irrigation water. Fluoride containing irrigation water used on soil and
crops during six years caused soil soluble F to increase linearly as irrigation proceeded. Total F increased only in the surface of the soil where it appears to reach a plateau.

Rathore and Agrawal (1989) worked on modification fluoride toxicity on root nodules development growth and productions of *Viera faba* Linn. by varying doses of Nitrogen Phosphorus and potassium nutrition.

Temin *et al.* (1989) studied in vitro conditions they found that appreciable fluoride uptake by adjacent enamel layer was seen. Beside that the fluoride releasing composite also having anticariogenic properties.

Ballantyne (1990) analysed fluoride and photosynthetic capacity of azalea (Rhododendron) cultivars. The ability of fluoride to reduce photosynthetic capacity of lead discs of various azalea (Rhododendron) cultivars was investigated.

Gupta (1991) carried out on chemical character of groundwater in Nagaur District, Rajasthan. Chemical analysis of ground water samples from Nagaur district showed that fluoride and nitrate concentrations increased with increase in salinity.

Grewal and Dahiya (1992) reported evaluation of spatial variation in water-soluble fluorine content of the soils of different agro-climatic zones of Haryana, India. Data on water-soluble fluorine (F) content of 470 soil samples (collected at a grid of 10 x 10 km) of the different agro-climatic zones of the Haryana State, India, were statistically analyzed for their spatial variability.

Gritsan (1992) observed phytotoxic effects of gaseous fluorides on grain crops in the southeast Ukraine. A study was carried out to determine the effects of airborne fluorides on grain crops in the south east part of the Ukraine (Dniepropetroysk region).

Rathore (1992) determined the effect of fluoride toxicity of leaf area, net assimilation rate and relative growth rate of *Hordeum vulgare* and *Zea mays*. Various concentrations of sodium fluoride (5-500 ppm) were sprayed every two weeks on *Hordeum vulgare* K-24 and *Zea mays* local dwarf.
Gritsan (1993) investigated cytogenetic effects of gaseous fluoride on grain crops. Atmospheric pollution of fluoride from a non-ferrous industrial plant has been studied for its effect on the frequency of chromosome aberrations in root tips and shoot tips of wheat and barley.

Singh (1995) studied food is a rich source of fluoride to humans and the absence of permissible and upper limits of fluoride for irrigation water, plant uptake studies were conducted using fluoride rice irrigation water. Ladyfinger was grown in sand and soil cultures for 18 week and the accumulation of fluoride in various plant parts.

Boese et al. (1995) studied the effects of fluoride on chlorophyll a fluorescence in spinach. Chlorophyll a (chl. a) fluorescence was used to determine the effects of treatments with gaseous HF or aqueous solutions of NaF on the photosynthetic apparatus of spinach prior to the appearance of visible injury.

Singh et al. (1995) reviewed plant uptake of fluoride in irrigation water by ladyfinger (Abelmorchus esculentus). Using fluoride rich irrigation water, plant uptake studies were conducted because of the suggestions that rich source of fluoride to the absence of permissible and upper limits of fluoride for irrigation water.

Anasuya and Paranjape (1996) determined the effect of parboiling on fluoride content of rice. In several endemic fluorotic zones of rural India, homemade parboiled rice is the main staple. Studies were therefore conducted to investigate whether any relationship exists between the concentration of fluoride in the water used for parboiling paddy, and in the parboiled rice.

Husaini et al. (1996) investigated the impact of aluminium, fluoride and fluoroaluminate complex on ATPase activity of Nostoc linckia and Chlorella vulgaris. This study demonstrates a pH-dependent inhibition of Mg (2+) and Ca(2+) ATPase activities of Nostoc linckia and Chlorella vulgaris exposed to AlCl₃, AlF₃, NaP and AlCl₃ + NaF together. AlF₃ and the combination of AlCl₃ + NaF were more inhibitory to both the enzymes as compared with AlCl₃ and NaF. Toxicity of the test compounds increased with increasing acidity.
Agrawal et al. (1997) found groundwater quality with species focus on fluoride and fluorosis in Rajasthan. The problem of high fluoride concentration in groundwater resources has become one of the most importunate health related geo-environmental issues in India. Rajasthan is on state where high fluoride groundwater is distributed in all 31 districts and is influenced by the regional and local geological setting and hydrological conditions for the fluoride contamination. Studies have shown that nearly three million people are consuming execs fluoride is widespread especially in the rural population and in children.

Arnesen (1997) reported availability of fluoride to plants grown in contaminated soils. Two pot experiments were carried out to study uptake of fluoride (F) in clover and grasses from soil. Fluoride concentration in *Trifolium repens* (white clover) and *Lolium multiflorum* (ryegrass) were highly correlated with the amounts of NaF were added to two uncontaminated soils (*r*=0.95-0.98, *p* < 0.001).

Horntvedt (1997) observed the accumulation of airborne fluoride in forest trees and vegetation. The accumulation of fluoride in natural vegetation exposed to emission from five aluminum smelter plants in Norway was studied during the years 1990-93. About 2000 leaf, bark and twig samples of 60 plant species, collected mostly during the growing season were analysed. Rowan (*Sorbus aucuparia*) was widespread and in the areas studied and was used as a reference species. Fluoride concentrations in monthly samples of rowan leaves were linearly related to fluoride exposure (average fluoride concentration in ambient air×days since leaf emergence).

Maithani et al. (1998) found anomalous fluoride in groundwater from western part of sirloin district, Rajasthan and its crippling effects on human health. Anomally high concentration of fluoride (up to 16 ppm) has been observed in dug/tube well water, which is being used for drinking and irrigation purposes, around Palry, Andor and Wan villages, in western part of Sirohi district, Rajasthan.

Zohouri and Rugg-Gunn (1999) studied fluoride concentrations in foods from Iran and found that fluoride concentration in cereals group were mainly between 0.2 and 0.3 mg/g, when prepared for consumption.
Fung et al. (1999) determined fluoride contents in tea and soil from tea plantation and the release of fluoride into tea liquor during intension Flea *Camellia sinensis* (L) a perennial shrub. Is cultivated in acidic sorts, it has been noted that the occurrence of fluoride in some inhabitants of pastoral and semi agricultural semi pastoral areas of Sichuan province people Republic of China is due to drinking a large quantity of tea liquor made from brick tea.

Torma et al. (1999) pointed some observations on Fluoride problems in the Moldova Republic. Fluoride content was determined in different soil type of Moldova. The total fluoride concentration varied in soils depending on their granular composition. Fluoride sonic are characterized by the highest content of Fluoride up to 1120 ppm. The level of water soluble fluoride ranged from 0.2 to 14.6 ppm. Long term phosphoric fertilizer application and irrigation with fluoride containing water have led to fluoride accumulation in soil and plants.

Cao et al. (2000) determined fluoride concentration with a fluoride ion defective electrode. Sixty sample were randomly selected from surface and underground water sources in major population regions of north–central, cerebral southern border region of Tibet. Fluoride concentrations ranged from 0.02 to 0.18 mg F/L with the highest levels in river and well waters. The results indicated that most drinking water sources in Tibet are low in fluoride and were therefore not responsible for the widespread occurrence of dental fluorosis that appears to the caused by children intake of fluoride from high fluoride “brick area”. In the present

Cromin et al. (2000) have written a review on fluoride entitled Fluoride: A review of its fate, bioavailability, and risks of fluoride in grazed pasture systems in New Zealand. This paper reviews information on the fate of F in grazed pasture systole with the aim of assessing the potential toxicity of accumulating soil. F.A preliminary F-cycling model for grazed pastures based on the review of international Literature and F concentrations in selected New Zealand pasture soils.

Rai et al. (2000) have worked on dietary (human) intake of fluoride (F) largely through consumption of agricultural Purdue grown in F contamination
environed has recently been viewed as an important cause for several F rotated heath problems in many parts of the world cause for several F related health problems in many parts of world. Being a non essential element, F is usually taken up by plans through passive uptake – a process which is dominantly diffusion. Still very little is known regarding F.

Loganathan et al. (2001) pointed out that ingestion of soils with high fluoride (F) concentration may cause chronic fluorosis in grazing animals. Analysis of New Zealand pasture soils with long term phosphorus (P) fertilization histories showed that total surface soil (0-75 mm depth) F concentration increased up to 217-454 mg/kg with p fertilizer application. The mobility of F in the soil profile was similar to two other elements, p and cadmium derived from the fertilizer.

Dahiya and Kaur (2002) assessed fluoride in aquatic environment and its impact on plant, cattle and human health. Fluoride concentration in water has equally significant importance with respect to its toxic effects. Fluoride although beneficial when present in concentration of 0.5 to 0.8ppm, has been associated with mottled enamel of the teeth in concentrations in excess of 1.5 mg/l. Fluoride is equally harmful at higher concentrations when present either in water, air or soil. In case of animals, high fluoride concentration shows characteristic marking of mouling, staining, hypoplasia and hypocalification of bones and teeth.

Facanha and Okorokova-Facanha (2002) carried out inhibition on phosphate uptake in corn roots by aluminum-fluoride complexes. F form stable complexes with Al at conditions found in the soil. Fluoroaluminum complexes [AlF(x)] have been widely described as effective analogs of inorganic phosphate (Pi) in Pi-binding sites of several proteins. In this world we explored the possibility that the phytotoxicity of AIF(x) reflects the activity as Pi analogs.

Louw et al. (2002) reported degree of fluorosis in areas of South Africa with differing levels of fluoride in drinking water. The purpose of this study was to study the relationship between degree of fluorosis and varying fluoride concentrations in the drinking water in a relatively dry region in South Africa.
Madhavan and Subramanian (2002) found fluoride in fractionated soil samples of Ajmer district, Rajasthan. The natural abundance of fluoride in soils of the Ajmer district, Rajasthan was examined. From undisturbed soil, the top 15 cm of the profile was examined and the soil split into fractions based on sand, silt and clay particle size. Clay contained a high amount of fluoride whereas sand and silts are enriched with much less fluoride.

Srikanth et al. (2002) determined fluoride in groundwater in selected villages in Eritrea (North East Africa). Here a study was undertaken to estimate fluoride content in the groundwater in certain parts of rural Eritrea. North-East Africa, along the River Anseba. Extensive dental fluorosis has been observed in the population exposed to drinking water of high fluoride content.

Cao et al. (2003) observed Brick tea fluoride as a main source of adult fluorosis. It was found that the fluoride level of water sources in Naquin Country was 0.10±0.03 mg/L. no evidence of fluoride air pollution was found, but the brick tea water processed foods-zamba and buttered tea had fluoride contents of 4.52±0.74 mg/kg and 3.21±0.65 mg/L, respectively. The adult daily fluoride intake reached 12 mg, of which 99% originated from the brick tea – containing foods.

Hussain et al. (2003) studied fluoride distribution in Groundwater of Sirohi district in Rajasthan. Fluoride concentration in ground water samples from 148 villages of Sirohi district of Rajasthan was determined. From the analysis of 298 water samples from hand pumps of these villages, it was observed that in 43 villages of Sirohi, 28 villages of Abu Road and 22 villages of Sheoganj tehsil fluoride concentration was above toxic level i.e. > 1.5 mg/l. Sirohi tehsil is most affected showing fluoride concentration > 5.0 mg/l. Water sample of 17 villages.

Kamaluddin and Zwiazek (2003) observed the effects of sodium fluoride (0.3, 5 and 10 mM NaF) on root hydraulic conductivity, and gas exchange processes were examined in aspen (Populus tremuloides Michx.) seedlings grown in solution culture. A long-term exposure of roots to NaF significantly decreased root hydraulic conductivity (Lp) and stomatal conductance (gs). Root absorbed NaF significantly
affected electrolyte leakage in leaf tissues and substantially restricted leaf expansion. NaF did not significantly affect leaf chlorophyll contents but decreased net photosynthesis (Pn).

Lingeswara Rao (2003) studied fluoride toxicity in Raptadu Mandal, Anantapur District, Andhra Pradesh, India. The present paper reports the distribution pattern and effects of fluoride toxicity in the Raptadu Mandal of Anantpur district, Andhra Pradesh. Water samples from 50 drinking water bore wells were collected and analysed for fluoride content.

Yadav et al. (2003) studied on geochemical study of Fluoride of ground water of Behror Tehsil of Alwar District (Rajasthan). A study has been undertaken for the determination of fluoride in drinking water taken at random from Behror and its suburbs with the help of Ion selective electrode method. Fluoride concentration has been found out in irrigation and drinking water drawn from open wells, bore wells and hand pumps.

Dhindsa et al. (2004) found hydrochemical study of groundwater quality variation in Tonk District, Rajasthan. A considerable groundwater quality variation has been observed in the location of the study point in Tonk District.

Meenakshi et al. (2004) studied groundwater quality in some villages of Haryana, India focus on fluoride and fluorosis. The fluoride concentration in underground water was determined in four villages of Jind district of Haryana state (India) where it is the only source of drinking water.

Ruan et al. (2004) determined the impact of pH and calcium on the uptake of fluoride by Tea plants (Camellia sinensis L.). Tea plants (Camellia sinensis L.) accumulate large amounts of fluoride (F) from soils containing normal F concentrations. The present experiments examined the effects of pH and Ca\(^{2+}\) on F uptake by the accumulating plant species.

Vike (2005) assessed uptake, deposition and wash off of fluoride and aluminium in/on plant foliage were studied in two experiments near an A smelter by
growing different plant species under cover with free wind-flow underneath, and in
the open, and by washing the leaves. With an average ambient air concentration of
2.2 mg F m$^{-3}$, the F and Al contents in leaves varied between species from 138 to 665
mg F kg$^{-1}$ and from 150 to 1025 mg Al kg$^{-1}$ when grown under cover.

Abdullah et al. (2006) observed industrial pollution of Jerbi grape leaves and
the distribution of F, Ca, Mg and P in them. Fluoride damaged leaves of the Jerbi
grapes vine tree (\textit{Vitis vinifera} L) growing in the vicinity of a phosphate fertilizer
manufacturing plant near Sfax, Tunisia, were used to study the distribution of the
chemical elements F, Ca, Mg and P in the leaves and stalks.

Khandara et al. (2006) observed incidences of endemic fluorosis are
increasing because of altered environmental conditions such as, decrease in rainfall.
Excessive use of ground water and lowered ground water level which lead to
increase in concentration of different elements including fluoride in ground water.

Sabel et al. (2006) studied that high fluoride uptake affects the physiological
parameters of \textit{Pisum sativum}.

Xiangehun et al. (2006) investigated industrial fluoride pollution of vegetables
in Hubei province, China. Fluoride concentrations in vegetables grown in areas 3 km
and 45 km away from the fluoride polluting Wuhan Iron and Steel Factory of Hubei
province. China were determined by ultra-sensitive single-sweep polarography.
Vegetables from as close as 3 km to the factory have about double the fluoride
content as those grown 45 km distant.

Shailaja and Johnson (2007) analyzed Fluorides in groundwater and its
impact on health. Fluor spar, Cryolite and Fluorapatite are the naturally occurring
minerals, from which fluoride finds its path to groundwater through infiltration. In
their studies they choose two groundwater samples, Station I and Station II at
Hyderabad megacity, the capital of Andhra Pradesh were investigated for one year
from January 2001 to December 2001. The average fluoride values were 1.37 mg/l
at Station I and 0.91 mg/l at Station II. The permissible limit given by BIS (1983)
0.6–1.2 mg/l and WHO (1984) 1.5 mg/l for fluoride in drinking water.
water at Station I exceeded the limit while at Station II it was within the limits. The study indicated that fluoride content of 0.5 mg/l is sufficient to cause yellowing teeth and dental problems.

Chaudhry et al. (2008) Carried out studies of sodium fluoride on the growth and yield of chick pea (*Cicer arietinum* L.). Their experiment was conducted at C.C.R. (P.G.) College, Muzaffarnagar during the years 2002-2003. Simple randomized block design with four replications and six treatments including control was followed. The concentrations of NaF were 10, 25, 50, 100 and 200 ppm. The first spray of NaF solution was done after 30 days of sowing. Subsequent sprayings and recording of data was done fortnightly till harvesting of the crop. The effect of sodium fluoride was found toxic to both the varieties of chick pea *viz.* Pusa 256 and K 850.

Chaudhry et al. (2008) have worked on the effect of fluoride toxicity on chlorophyll, protein percentage and energy content of Wheat (*Triticum aestivum* L.) and Chick pea (*Cicer arietinum* L.). They carried out an experiment which was conducted at C.C.R. (P.G.) College, Muzaffar nagar during the years 2002-2003 to studied the effect of fluoride toxicity on chlorophyll, protein percentage and energy content in wheat and Chickpea. The Chlorophyll content in green leaves was studied on 60th day of sowing. Protein and energy contents were studied after harvesting with the oven dried plant material at 80 0C temperature 100-200 ppm concentrations of NaF were found toxic to wheat and chickpea.

Juan and Cao (2008) reported tea (*Camellia sinensis*), abundant in fluoride, selectively absorb F from the soil and air in the surrounding, and accumulate mainly in the tea leaves in the form of F complex.

Salve et al. (2008) analyzed fluoride concentration along with physiochemical parameters in ground water samples was determined in various villages of Kadi tehsil at Mehsana district of Gujarat state (India), since in most of the villages it is the only source of drinking water. The fluoride concentrations in these villages varied from 0.94 to 2.81 mg/L (1.37 ± 0.56) with highest fluoride level at Visalpur
(2.08 mg/L) and lowest at Adaraj (0.91 mg/L). There was found a positive correlation of pH with fluoride.

Sabal and Khan (2008) determined fluoride contamination status of groundwater in Phulera Tehsil of Jaipur district, Rajasthan. Over the last few decades the water quality was deteriorated in arid and semi-arid regions. Phulera Tehsil were facing the problem of groundwater pollution. In their investigation, determination of fluoride (F) in drinking water was conducted in (200 samples of) 40 villages of Phulera tehsil having fluoride content more than permissible limits (>1.5 mg l-1). After the pilot survey symptoms of skeletal and gut fluorosis have been found in almost every inhabitant. The water samples were alkaline with pH ranging from 7.05 to 10.16. Electrical conductivity (EC) ranged from 157 1mhoScm-1 to 1018 1mhoScm-1. Calcium hardness (Ca-H) ranged from 10 to 127 mg l-1. Total hardness (TH) varied from 69 to 572 mg l-1. Chloride varied from 92.00 mg l-1 to 1422.00 mgl-1 and fluoride from 1.20 to 18 mg l-1. The alkalinitities of all water samples were found to be more than the permissible limit. The results envisaged that the quality of ground water of Phulera was very poor, and is not suitable for drinking purpose and can only be used after proper treatment.

Juan and Cao (2008) reported tea (*Camellia sinensis*), abundant in fluoride, selectively absorb F from the soil and air in the surrounding, and accumulate mainly in the tea leaves in the form of F complex.

Chunlei and Dejiang (2009) point out Seedlings of the tea plant, *Camellia sinensis* (L.), were grown hydroponically for 30 days to studied the effect of fluoride (F) on the chemical composition and minerals in the leaves. Polyphenols, total catechins, and protein decreased significantly with increasing exposure to F. Except for epigallocatechin, most of the monomeric catechins also decreased significantly. Those changes was not considered beneficial. On the other hand, the content of amino acids and solublesugars increased significantly, but the differences in caffeine and water-soluble extracts were not statistically significant. Except for magnesium and manganese, the uptake of most of minerals was inhibited, whereas the content of F increased markedly. Those results suggested that the main chemical constituents
of tea leaves decreased under F treatment and that individuals who consume these teas may ingest excessive amounts of F. Therefore, the direction of our further study would be to find ways to reduce the levels of F in tea plants.

Mohapatra et al. (2009) determined high fluoride concentrations in ground water, up to more than 30 mg/L, occur widely, in many parts of the world. This review article is aimed at providing precise information on efforts made by various researchers in the field of fluoride removal for drinking water.

Yadav et al. (2009) worked on Geochemical Observation of fluoride in ground water of Tonk (Rajasthan) they studied water quality condition in Tonk district carried out to assessed risk to human health. It was found that ground water of Tonk districts were contaminated with fluoride by naturally fluoride rich rock salt system. Physicochemical analyzed has main consideration to assess the quality of water for its best utilization like drinking, irrigation. The result of this studied helps in enhancing awareness of health hazards of contaminated water.

Agarwal and Khan (2010) worked on Ground water quality and fluoride content in Sikrai Tehsil of Dausa district they were selected Sikrai Tehsil of Dausa district as study area. Water Samples were collected and analyzed for physico-chemical characteristics of ground water. It was observed that fluoride concentration ranges from 0.52 mg/L to 12.5 mg/L, pH from 7.2 to 8.84, electrical conductivity from 2610 -5050, Calcium concentration from 54-296 mg/L, alkalinity from 80-520 mg/L and chloride from 198-3379 mg/L in the study area.

Gautam and Bhardwaj (2010) analyzed bioaccumulation of fluoride in different plant parts of Hordeum vulgare (barley) var. RD-2683 from irrigation water. They investigated fluoride (F) accumulation in Hordeum vulgare (barley) var. RD-2683 and its effect on the growth and crop yield was conducted in a pot experiment. Six different concentrations of F in the water were used for irrigation ranging from 4 to 20 ppm with distilled water as the control. Potentiometric determinations of the F content in different parts of the plant were made 45, 90, and 135 days after sowing the seeds (first, second, and third harvest, respectively). At the
third harvest the highest mean plant part concentrations of F were recorded with 20 ppm F in the irrigation water: 17.36 µg/g in the roots, 13.06 µg/g in the shoots, 11.74 µg/g in the leaves, and 14.44 µg/g in the crop (grain).

Gautam et al. (2010) have worked on fluoride accumulation by vegetables and crops grown in Nawa Tehsil of Nagaur District (Rajasthan, India). Fluoride is recognized as an important trace element playing a vital role in the dental and skeletal formation in human beings. It is generally believed that organisms including human being receive fluoride largely from drinking water sources and that the total daily intake of fluoride by individuals from water and other sources varies from country to country depending on the amount of fluoride present in water and other sources including foodstuffs. Earlier it was believed that food was not a rich source of fluoride for humans but it is now well documented that certain types of food can have high fluoride content. Therefore during their investigation the eyes focus on the studied of fluoride from one tropic level to another and accumulation of fluoride in the food chain, food items were collected from nawa tehsil in nagaur district (Rajasthan) and analyzed. Leafy vegetables like spinach, radish leaves, Sarso leaves were analyzed among which spinach. (25.70 µg/g) showed maximum fluoride concentration. Cereals like barley, wheat, chana, bajra, moth, chawla, methi were also analyzed for fluoride out of which methi and chawla was found to have maximum fluoride concentration (18.98 µg/g) which was collected from Shivdanpura village where fluoride concentration in water samples was found in the range between 7.36 ppm to 13.83 ppm.

Tailor and Chandel (2010) determined To Assess the Quality of Ground water in Malpura Tehsil (Tonk, Rajasthan, India) with emphasis to Fluoride Concentration Fluoride is one of the critical chemical parameter, which influences the quality of ground water. Excessive intake of fluoride through drinking water causes fluorosis on human beings in many states of India, including Rajasthan. Their study was aimed to Identified the hydro geochemical processes influencing the high fluoride concentration in ground water of Malpura Tehsil, Tonk (Rajasthan, India). For that purposes twenty six ground water samples were collected during the post monsoon session of 2008. The fluoride concentration along with physico chemical
parameters in ground water samples was determined in various sampling sites of Malpura Tehsil, since in most of the sampling point it was only sources of drinking water. The Fluoride concentration in these sampling points varied from 0.08 to 11.30 mg/L with highest level at G7 sample (11.30 mg/L) and lowest at G8 sample (0.08 mg/L). Most people in these studied areas suffered from dental fluorosis and skeletal fluorosis such as mottling of teeth, deformation of ligament, bending of spinal column and ageing problem.

Yadav and Khan (2010) determined Fluoride and Fluorosis Status in Groundwater of Todaraisingh Area of District Tonk (Rajasthan, India): A Case Study. Excessive fluoride concentrations have been reported in ground water of more than 20 developed and developing countries including India where 18 states are facing fluoride problem. In view of this an attempts were made to find out the fluoride content in groundwater of Todaraisingh Tehsil of Tonk (Rajasthan). when study was done at tehsil level in Tonk district. In which 65.63% samples were found exceeded permissible limit (1.5mg) of Fluoride concentration in drinking water which lead to human health hazards such as dental fluorosis and skeletal fluorosis affecting millions of people. Preliminary investigation indicates that severe health disorders had been indentified in Todaraisingh area of Tonk district of Rajasthan due to excess intake of fluoride through drinking water. Most of people in this area suffer from dental & skeletal fluorosis such as mottling of teeth, deformation of ligaments, bending of spinal column and ageing problem.

Abugri and Pelig-Ba (2011) determined Assessment of fluoride content in tropical surface soils used for crop cultivation. Bongo district of the Upper East Region of Ghana relied on groundwater as the main source of potable water supply for domestic purposes. However, available literature indicated that groundwater in the area has elevated fluoride levels. Little work was done on fluoride contents in the soils of the area and its implication to plants and other living organisms. Hence the objectives of this study were to determine the level of fluoride (F) in cultivated soils and its implication to crops, since the soils form the essential medium for crops growth. Also to document fluoride concentrations in cropland soils in Ghana. Samples of selected cropland soils were collected at a depth ranged 1.0 cm to 30.0
cm and digested with aqua-regia, and analyzed for fluoride and calcium content using spectrophotometer DR/2000 and EDTA complexometric titration respectively. The mean pH of most of the soil samples ranged from 5.7 to 6.2, while the specific electrical conductivity ranged from 420.0 to 1735.0 µs/cm of soils used. The F content in the soils ranged from 219.26 to 1163.01 mg/kg-1 DW. The ions bioavailability is controlled by physical and chemical characteristics of the soils. Although, this was the first studied of its kind in the district it depicted that excess fluoride in water reported in the area has a relationship with the trend reported in this paper.

Bhargava and Bhardwaj (2011) worked on Phytotoxicity of Fluoride on a Wheat Variety (*Triticum aestivum* var. Raj. 4083) and its Bioaccumulation at the Reproductive Phase. Their studied the effects of different concentrations of NaF on different morphological characters, yield and its bioaccumulation in wheat variety (*Triticum aestivum* var. Raj.4083). In a pot experiment, a wheat variety was irrigated with 4 – 16 mg/L NaF (4, 8, 12, 16, and 20 mg/L). The experiments were carried out for the entire life cycle of 120 days of this wheat variety. Plants were harvested after 120 days of sowing of seeds. There were significant changes in morphological characters and yield attributes in plants treated with 16 and 20 mg/L NaF. In plants treated with 20mg/L, significant reductions in shoot length (by 25.16%), root length (by 32.14%), number of leaves (by 42.40%), leaf area (by 19.50%) and grain yield (by 16.26%) were observed. Bioaccumulation studies of fluoride in plant parts revealed maximum accumulation in roots (4.24µg/g) and minimum in leaves (1.45µg/g) in plants treated with 20mg/L NaF. Results of the study showed that use of groundwater containing high fluoride content for irrigating wheat plants may be detrimental to its growth and yield.

Ibrahim et al (2011) observed the Effects of Fluoride Contents in Ground Water: A Review. Ground water is the major source of freshwater on the earth. Groundwater containing dissolved ions beyond the permissible limit is harmful and not suitable for domestic use. Fluoride beyond desirable amounts (0.6 to 1.5mg/l) in groundwater is a major problem in many parts of the world. The fluorides belong to the halogen group of minerals and are natural constituents of the environment. Fluoride is the most electronegative of all chemical elements and is never
encountered in nature in the element form. Though fluoride enters the body through water, food, industrial exposure, drugs, cosmetics, etc., drinking water is the major source (75%) of daily intake. World Health Organization (WHO) and IS: 10500 recommend that the fluoride content in drinking water should be in the range of 1.0 to 1.5 ppm. Intake of more fluoride, results in multidimensional health manifestations, the most common being dental and skeletal fluorosis. This problem is severe in India and need immediate attention of government, donors and philanthropists to save our people. Suitable measures such as defluorinating the groundwater before use and recharging the groundwater by rainwater harvesting need to be practiced to improve the groundwater quality in this area. Many Defluoridation devices and techniques, which includes Actinated Alumina, Red mud, Nalgonda technique, Magnesia & Montmorillonite have been referred with various limitations. Comparing all defluoridation devices, the most feasible option for fluoride removal for rural regions seems to be magnesia. It is selective for fluoride removal as it binds well with fluoride ions.

Gautam et al. (2011) carried out Study of fluoride content in groundwater of Nawa Tehsil in Nagaur, Rajasthan. There was a severe fluoride problem in Nawa tehsil of Nagaur district. Villagers were suffered from dental fluorosis and skeletal fluorosis. So an extensive geochemical study of 27 villages of eastern, south-eastern and southern zone of Nawa tehsil was done. Total 46 ground water samples were collected and analyzed for various physicochemical parameters as well as fluoride content. The fluoride concentration in the three different zones ranged from 0.64 to 14.62 mg l-1 where 13.04% samples were found within permissible limit while 86.96% had fluoride beyond permissible limit (> 1.5 mg l-1). It was found that among the three different zones south-eastern zone was under serious fluoride contamination where fluoride concentration ranged between 1.10 to 14.62 mg l-1. In the easternzone fluoride concentration was recorded from 1.52 to 5.13 mg l-1 whereas in the southern zone it was found between 0.64 to 3.63 mg l-1.

Sharma et al. (2011) carried out worked on Emerging Challenge: Fluoride Contamination in Groundwater in Agra District, Uttar Pradesh. Agra district in Uttar
Pradesh is one of the region where high concentration of fluoride is present in groundwater. Their carried out study to understand the status of groundwater quality in Agra and also to assess the possible caused for high concentration of fluoride in groundwater. Most of people in this area suffer from dental & skeletal fluorosis such as mottling of teeth, deformation of ligaments, bending of spinal column and ageing problem. Overall all water quality was found unsatisfactory for drinking purpose without any treatment. The fluoride concentration in groundwater of this region ranged from 0.1 to 14.8 mg/l. weathering of rocks and evaporation of groundwater are responsible for high fluoride concentration in groundwater of Agra.

Abida (2012) Analyzed Soil Profiles and Fluoride Adsorption in Intensely Cultivated Areas of Mysore District, Karnataka, India. In their study water and soil samples had been analyzed from 5 agricultural locations across Mysore district that represented different soil types in the region. At each site composite soil samples were taken and analyzed for all physicochemical parameters. Mean water-extractable soil fluoride concentration from a depth of 5 cm to 20 cm in each location was in the range, sandy (3-1.9 mg/L), black (4-2.3 mg/L), laterite (4.5-3.6 mg/L), alluvial (9-6.3 mg/L) and red (loam) (11.2-7.9 mg/L). Fluoride in the groundwater in the experimental location is in the range 25.5 mg/L for sandy soil and 1.5 mg/L for loam soil. Also an epidemiological study among 20 school going children in each area was conducted on the prevalence of fluorosis. Results revealed that on 4/20 children from Mahadevapura east were having mottled teeth. This may be due to fluoride in ground water (25.5 mg/L) or might be due to health and hygiene.

Kartick et al. (2012) Found Incorporation of fluoride in vegetation and associated biochemical changes due to fluoride contamination in water and soil: a comparative field study. A study has been conducted to estimate fluoride concentrations and water quality along with the translocation of fluoride into vegetables through soil and the stress effect of fluoride on some biochemical parameters in this area. The result has been compared with a non-contaminated area of Burdwan university farm of the burdwan district as a control zone by collecting equal numbers and types of samples. The results showed a positive correlation of
fluoride concentration with depth, indicating higher concentrations of fluoride in drinking water drawn from deep tubewells in this semi-arid region. A high bioconcentration factor (BCF) of fluoride in vegetables imposes a high health risk due to fluoride intake both from water and vegetation. Probable exposure to the inhabitants of these villages is speculated due to changed biochemical parameters like chlorophyll, sugar, amino acid, ascorbic acid and protein in the vegetables as a result of fluoride stress. In the future, ground water monitoring to supply safe drinking water may be an effective way against the negative impact of fluoride on the inhabitants.

Joshi and Bhardwaj (2012) analyzed the effect of fluoride on growth parameters and its accumulation in *Triticum aestivum* var. Raj 3675. They studied the growth of wheat, *Triticum aestivum* var. Raj 3675, which was observed to be adversely affected by irrigation with various levels of waterborne fluoride. Reduction occurred in fresh and dry weight, number of leaves, leaf surface area, number of branches, and growth. Although crop yield was not much affected, the chlorophyll content was reduced by 43.7% at 13.0 ppm fluoride in the water. Whereas accumulation of fluoride was relatively low in roots and stems, crop seeds retained the highest amount of fluoride. The susceptibility to effects of fluoride might differ greatly in varieties, clones, and even cultivars of the same species.

Pal *et al.* (2012) carried out worked on fluoride contamination status of groundwater in Mudhol taluk, Karnataka, India: correlation of fluoride with other Physico-chemical parameters. Their studied deals with the physic-chemical parameters of ground water quality in Mudhol taluk of Bagalkot district, Karnataka, India. Research found fluoride content in drinking water reveals that, all the samples analyzed were found to be not exceeded the WHO 1995 drinking water standards and it reflects on health status of the consumers. The pH of the all samples was acidic to alkaline. The total dissolved solids and hardness were beyond permissible limit in the some samples.

Pal *et al.* (2012) have worked on incorporation of fluoride in vegetation and associated biochemical changes due to fluoride contamination in water and soil: a
comparative field study during their studied they choose high fluoride concentrations in natural groundwater of nowapara and junidpur villages of the birbhum district in India that was recently been highlighted as a serious environmental concern. a study had been conducted to estimate fluoride concentrations and water quality along with the translocation of fluoride into vegetables through soil and the stress effect of fluoride on some biochemical parameters in this area. The result had been compared with a non-contaminated area of burdwan university farm of the burdwan district as a control zone by collecting equal numbers and types of samples. The results showed a positive correlation of fluoride concentration with depth, indicating higher concentrations of fluoride in drinking water drawn from deep tubewells in this semi-arid region. a high bioconcentration factor (bcf) of fluoride in vegetables imposes a high health risk due to fluoride intake both from water and vegetation. Probable exposure to the inhabitants of these villages was speculated due to changed biochemical parameters like chlorophyll, sugar, amino acid, ascorbic acid and protein in the vegetables as a result of fluoride stress. In the future, ground water monitoring to supply safe drinking water may be an effective way against the negative impact of fluoride on the inhabitants.

Yadav et al. (2012) Observed the effects of fluoride accumulation on growth of vegetables and crops in dausa district, Rajasthan, India. Their study was carried out to assess accumulation of fluoride in vegetables and cereal crop grown in potentially fluoridated area in Dausa district, Rajasthan, India. Earlier it was believed that food was not a rich source of fluoride for humans but it is now well documented that certain types of food can have high fluoride content. In his investigation food items were collected from Dausa district and analyzed. Variable fluoride accumulation occurs in crop (wheat) and vegetables (potato and tomato). The fluoride content of cereal crop was found to be higher than that of vegetables. Maximum fluoride concentration was found in wheat i.e. 14.3 µg/g where fluoride concentration in water samples was found 6.2 ppm.

Hussain et al.(2012) Studied Fluoride contamination in drinking water in rural habitations of Central Rajasthan, India. Fluoride concentration in groundwater sources used as major drinking water source in rural area of block Nawa (Nagaur
District), Rajasthan was examined and the toxic effects by intake of excess fluoride on rural habitants were studied. In block 13, habitations (30%) were found to have fluoride concentration more than 1.5 mg/l (viz. maximum desirable limit of Indian drinking water standards IS10500, 1999). In five habitations (11%), fluoride concentration in groundwater was at toxic level (viz. above 3.0 mg/l). The maximum fluoride concentration in the block is 5.91 mg/l from Sirsi village. As per the desirable and maximum permissible limit for fluoride in drinking water, determined by World Health Organization or by Bureau of Indian Standards, the groundwater of about 13 habitations of the studied sites is unfit for drinking purposes. Due to the higher fluoride level in drinking water, several cases of dental and skeletal fluorosis have appeared at alarming rate in this region. There were instant needs to take ameliorative steps in this region to prevent the population from fluorosis. Groundwater sources of block Nawa can be used for drinking after an effective treatment in absence of other safe source.

Hussain et al (2013) assessed An Investigation of Fluoride Distribution in Ladnu Block of Nagaur District, Central Rajasthan. They worked on assessment of water quality with special reference to fluoride in Ladnu block of Nagaur district in Rajasthan. Fluoride concentration of groundwater samples from forty villages of Ladnu Block was monitored and Thirty one villages were found to have a fluoride concentration above 1.5 mg/l. The maximum fluoride concentration (7.1 mg/l) was recorded in groundwater of the Roja, while minimum (0.5 mg/l) was recorded in Hudas. As per the desirable and maximum permissible limit for fluoride in drinking water, recommended by the WHO and BIS, the groundwater of thirty one villages is unfit for drinking purpose.

Singh et al (2013) carried out studies on the impact of fluoride toxicity on growth parameters of Raphanus sativus L. The studied which was concluded during 2011-2013 on the effect of various concentrations 50, 100, 200 and 400 mg NaF/kg soil on different growth parameters in Raphanus sativus L. at Different concentrations of sodium fluoride inhibited seedling germination percentage, length of root, length of shoot, plant height, number of leaves, size of leaf, number of flowers per plant, fruit-set percentage and seed-set percentage. The plants growth in soil supplemented
with 400mg NaF/kg soil were shows maximum reduction in their growth parameters as compared to control plants.

Rao et al. (2013) observed the Effect of Fluoride on Protein Profiles in Two Cultivars of Mulberry Leaves. They determined Fluoride and its effects on the physiology and metabolism of plants has been the subject of various reviews slow accumulation of fluoride over days or weeks leads to symptoms of chlorosis at leaf tips and margins. The total protein content declined progressively in tissues and was registered in both cultivars on exposure to fluoride. SDS-PAGE gel electrophoresis also clearly, demonstrated the variability in protein profiles in M5 and V1 mulberry strains on exposure to different concentrations of fluoride over period of exposure which indicates that v1 is sensitive than M5 in senescing mulberry leaves on exposure to fluoride. The decreased protein content can be explained by decrease in protein synthesis and enhanced protein degradation.

Aske and Iqbal (2014). Carried out Laboratory Study of Fluoride toxicity on Wheat (*Triticum aestivum* Var. lok-1) In ground water which is used for drinking purpose 1.5mg/l of fluoride is permissible. Isdu and Ajanda villages of Alirajpur district of Madhya Pradesh was completely affected with fluoride content. The experiments were carried out for the entire life cycle of 120 days of wheat. Irrigation treatment was given with different concentration of NaF 4 -18 mg/l. Their Studied showed that when the concentration of NaF increases the root and shoot length decreases. Number of seeds is also decreased. Germination percentage and vigour index was found 83.60% and 33.22% respectively. This indicated that it was decreased by NaF and it was also affect the morphological characters of wheat.

Annadurai et al. (2014) point out Incidence and effects of fluoride in Indian natural ecosystem: A review. Fluoride contamination in drinking water due to natural and anthropogenic behavior has been documented as one of the major problems worldwide impressive a serious threat to human health. Fluoride in drinking water has an intense effect to teeth and bones. The WHO and BIS has been decided fluoride concentration up to 1-1.5 mg/L as a permissible limit for drinking. concentration of fluoride in the level of 1.5-4mg/L result in dental fluorosis whereas
with prolonged consumption at still higher fluoride concentrations (4-10mg/L) dental fluorosis leads to skeletal fluorosis. High fluoride concentrations in ground water occur widely in many parts of the world. They reviewed an article to provide us precise information about fluoride effects and contamination in soil and water Indian states such as Andhra Pradesh, Rajasthan, Haryana, Uttrapradesh, Madhya Pradesh, Gujarat, Maharashtra, Tamil Nadu and Karnataka was also reviewed.

Datta et al (2014) determined Fluoride Contamination of Underground Water in West Bengal, India. The levels of the anions fluoride (F), bromide, chloride, nitrate, and sulphate were measured in 51 underground water samples, collected from 33 places in West Bengal, India, using the ion-chromatographic method. The F concentrations were within tolerable limits except for the villages of Kapileswar, Haringhata, (1.24mg/L); Palta, 24 Parganas (North), (1.75 mg/L); Rondia, near Panagarh, (1.61 mg/L); Midnapore (1.38 mg/L); Hijli (1.08 mg/L); and Laxmanpur, Purulia, (1.06 mg/L). The ground water samples of these villages were found, in general, to be alkaline in nature. The F concentrations appeared to be related to the physiographic and geological nature of the soils. A forensic investigation into the death of a 25-yr-old male from sodium fluoride overdose, results in F levels in the gastric contents and blood of 35.05 and 4.341 mg/L, respectively, was also noted.

Umarani and Ramu (2014) reported Fluoride Contamination Status of Groundwater in East Coastal Area In Tamilnadu, India. They studied to investigate the fluoride pollution of groundwater in the South east coastal regions of Tamil Nadu, India. Totally 36 ground water samples have been collected from open dug well, hand pump and bore wells in the east coastal region from Rameshwaram to Thiruvanmiyur in the year 2011. Samples were analysed to find out the fluoride ion along with physical and Chemical Parameters. The fluoride content of ground water ranges from 0.02 to 1.54ppm suggested domestically not suitable. All the samples observed low amount of fluoride (< 0.5mg/l) in the study area. Four out of 36 samples (Kottaipaattinam, Vedharaniyam, poombukar and Aaraiyankuppam) observed within the permissible WHO limit for safe drinking water (O.5-1.5 mg/l). Two samples (Adhirampattinam (1.54mg/l), Aalappakam (1.53mg/l)) exceed the limit for fluoride in drinking water set by the WHO.
Yadav et al. (2014) found out high fluoride concentration in the groundwater of Niwai region, Tonk: A comparative study. Their investigation was to study the level of fluoride in the groundwater of Newai tehsil in Tonk district of Rajasthan state and its comparison with the water of bore wells, hand pump and surface water by collecting ten samples of the water from seven different villages during April 2013 to January 2014. The fluoride level in the underground water of Newai region was exceeding the permissible limit (>1.5mg/L). It was found that all the ten villages of Newai region was under serious fluoride contamination than bore well and hand pump water which causes adverse effect like dental and skeletal fluorosis.

Mahawar and Chauhan (2014) have reported bioaccumulation of fluoride in different plant parts of Brassica juncea (mustard) from irrigation water. They were studied, the growth of, mustard (Brassica juncea), which was observed to be adversely affected by irrigation with various levels of waterborne fluoride. Its effect on the growth and crop yield was conducted in a pot experiment. Nine different concentrations of F in the water were used for irrigation ranging from 3 to 24 ppm with distilled water as the control. Potentiometric determinations of the F content in different parts of the plant were made 45, 90, and 135 days after sowing the seeds (first, second, and third harvest, respectively). At the third harvest the highest mean plant part concentrations of F were recorded with 24 ppm F in the irrigation water: 19.864µg/g in the roots, 17.250µg/g in the shoots, 15.114µg/g in the leaves, and 18.427µg/g in the crop (grain).

Anbuvel et al. (2015) determined fluoride accumulation on paddy (oryza sativa) and black gram (phaseolus mungo linn.) in cultivated areas of Kanyakumari District, Tamilnadu, India. They were evaluated the accumulation of fluoride in more consumable produce, samples of paddy (Oryza Sativa, main crop) and black gram (Phaseolus Mungo Linn., pulse crop) were randomly collected from 18 villages near the bank of Thovalai and Nanchilnadu Puthanar Channel in Kanyakumari District, Tamilnadu where fluoride concentration in the ground water was found beyond permissible limit (>1.5 ppm). The concentration of the fluoride in samples was determined using ion-selective electrode coupled to an ion analyzer. The result showed that the fluoride content of the paddy-I (Ambai-16) contains 0.74-2.40
mg/kg during southwest monsoon. Paddy-II (TPS-3) contains 0.65-2.40 mg/kg during northeast monsoon. Black gram contains 0.228-0.780 mg/kg during summer. The highest concentrations of fluoride in paddy-I and paddy-II were found in Sankaranputhur village (2.40 mg/kg) and Azaganpuram village (2.40 mg/kg). Fluoride were more soluble in acid soils due to which its uptake by plants was enhanced. Phosphate fertilizers especially the superphosphates were most important sources of fluoride in agricultural lands. Many farmers was unaware of the hidden presence of this highly toxic substance.

Das et al. (2015) determined fluoride toxicity effects in potato plant (solanum tuberosum l.) grown in contaminated soils. There studied was to check the tolerance potential of Solanum tuberosum to accumulate fluoride (F). For this work S. tuberosum were grown for 87 days under five different concentrations of F viz. control, 11.05(T1), 22.11(T2), 44.21(T3), 110.53(T4) and 221.05(T5) mg per Kg NaF. Study results revealed that maximum reduction of root biomass (82.5%) at the fluoride dose 95 mg NaF/Kg soil. However, growth ratio and tolerance index showed opposite trend with concentration of F. On the other hand, F accumulation pattern was recorded highest in leaves and% of total F translocation from soil to plant linearly decreases with increasing added fluoride in soil. The F accumulation in leaves, root, shoot and potato tuber is 3.96 mg NaF per Kg, 3.02 mg NaF per Kg, 2.8 mg NaF per Kg and 1.56 mg NaF per kg, respectively.

Joshua Amarnath et al. (2015) Worked on Evaluating Fluoride Contamination in Ground water of Dharmapuri district in Tamilnadu. There study were provide an overview of the fluoride content in drinking water and the extent of human exposure to different level of fluoride contamination in the blocks of dharmapuri district, tamilnadu. Most of people in this area suffer from dental & skeletal flurosis such as mottling of teeth, osteosclerosis of pelvis and vertebral column, chronic joint pain.

Kumar and Singh (2015) observed the effect of fluoride contaminated irrigation water on eco-physiology, biomass and yield in gossypium hirsutum l. there study was conducted to assess the response of a cash crop Gossypium hirsutum L. to the irrigation of fluoride (F) contaminated water. Different concentrations of F i.e.
100, 200, 500 and 1000ppm were used to study the effects of these concentrations of this element on CO2 assimilation, stomatal conductance, chlorophyll fluorescence, biomass and yield of *G. hirsutum*. Photosynthesis (*PN*), stomatal conductance (*gs*), chlorophyll fluorescence (*Fv/Fm*), plant growth and biomass accumulation in terms of fresh and dry weight were decreased significantly with the application of F. The results were concentration dependent. However, a significant increase in harvest index was noticed even at 200ppm concentration of F. There was no any significant phytotoxic effect noticed on morphology of plant in terms of necrosis, tip burning and curling of leaf. Moreover, the parameters studied were decreased but the crop yield was increased slightly cultivated with the application of F contaminated water, the studied cultivar of this crop may be recommended for the cultivation in the fluoride contaminated zones.

Dash et al. (2015) carried out worked on Fluoride concentration in ground water of Kalahandi and Nuapada District, Odisha, India. Their studied deals with ground water quality with respect to the fluoride content in water resources of Kalahandi and Nuapada districts of Odisha, India. Water samples were collected in different locations covering tap water, open wells, tube wells and river waters. Ground waters of tube wells are highly polluted with fluoride in comparison to open wells. In Nuapada district out of 4920 tube wells 399 contains 1.5-3.0 (mg/L) and 114 are from 3-5(mg/L) and 22 are from 5-6.5> (mg/L). A survey reported show that 22557 people were affected with fluorosis and nearly 2 lakh people was in risk. In Kalahandi district Karalkot, Kerijhola and Binapur water supply contains objectionable fluoride content i.e. 3.88 mg/L. Dental fluorosis was observed among school children in Boden and Sonapalli blocks.

Kumari (2015) determined the overall assessment of quality and quantity of drinking water with focus on fluoride in the areas of extreme western parts of Jharkhand. Palamu and Garhwa is located in extreme parts of Jharkhand. Geologically the gneisses and granites are the most predominant rocks of the whole palamu area these rocks have fluoride bearing minerals which was leached out to the groundwater and contribute high fluoride concentration in the groundwater. Total 84 water samples are collected from rural areas of selected blocks and their physical chemical
parameters are tested in the laboratory and was statistically analysed too. Fluoride concentration ranges from 0.14 – 6.98 mg/l with an average of 1.1379 mg/l and standard deviation of 0.6927. The 9.993% of samples having fluoride concentration above desirable limit (1 mg/l) and 23.192% samples having fluoride concentration above 1.5 mg/l. Rest of the samples were within desirable limit. To assessed the health impact, checked for dental and skeletal fluorosis was also done and it were found that the most of the people from Chukru, Bakhari, Kauria and Jorkat villages consumed groundwater as their drinking water source which have reportedly high fluoride content in their groundwater and thus morbidity of dental fluorosis was always very high in many villages. Dean indices were analyzed for fluoride affected 8 villages.

Kumar and Kumar (2015) analyzed fluoride contamination in drinking water and its impact on human health of kishanganj, Bihar, India. They were study the fluoride concentration varied from 0.61-3.74 mg/l in different groundwater resources of various villages. Among 150 hand pump/tap water samples of all 5 blocks of kishanganj district 110 (73.33%) sites (villages and town areas) are safe, 28(18.67%) villages are under dental fluorosis and 12(8.0%) villages are under skeletal fluorosis, whereas among 150 open/ring water samples, 121 (81%) sites are safe, 14(14%) villages are under dental fluorosis and 8(5.0%) villages are under skeletal fluorosis. The results were on the basis of the questionnaire survey conducted in five blocks of Kishanganj district. During the study, 2500 people were examined, of which 53.6% people were affected by dental fluorosis and 11.2% people were suffering from skeletal fluorosis. Fluorosis was found to be high in males compared to females. High ph, low calcium concentrations and high temperatures of the study area may contribute to high fluoride concentrations in groundwater.