INTRODUCTION
1. INTRODUCTION

Tillage is as old as agriculture. Tillage is the physical manipulation of soil with tools and implements so as to obtain good tilth for better germination and subsequent growth of crops. Tilth is a physical condition of soil resulting from tillage (Reddy and Reddy, 2004). Proper tillage result in soil and moisture conservation through higher infiltration, reduce runoff and increased depth of soil for moisture storage. Tillage also has considerable influence on soil physical properties like pore space, structure, bulk density and moisture retention of soil. However, these effects of tillage are lost in about one month. Nevertheless, tillage practices have great effect on seed germination seedling emergence and stand establishment.

Since centuries it is known that roots of terrestrial plants obtain nourishment from the soil. During the first half of nineteenth century, it was found that plant need certain essential mineral elements which are absorbed by roots principally as inorganic ions. These inorganic ions in soils are derived mostly from mineral constituents in the soil. The term mineral nutrients are essential for plant growth and development. The process of absorption, translocation and assimilation of nutrients by the plants is known as mineral nutrition. To meet the requirement of crop plants for their mineral nutrition the use of FYM, compost and green manure is the most important and widely used bulky organic manure and fertilizers are most important and widely used.

For attaining higher level of food production for matching the demands of the growing population, chemical fertilizers and pesticides have been
excessively used in past half century, particularly after 2nd world war. However, the technologies generated in this period proved detrimental to the natural resources, because organic matter and residue management were overlooked (Prasad and Power, 1991). Therefore, the farming practices that are ecologically fit, technically viable, socially acceptable, and remunerative to the farmers have to be adopted on large scale (Lal, et al, 2004 and Wanjari, et al, 2003).

History and Origin of Oat

Oats did not become important to man in comparison to wheat or barley. The history of oats is somewhat clouded because there are so many different species and subspecies, which make identification of old remains very difficult. The main center of greatest variety of forms is in Asia Minor where almost all subspecies exist. Oats were first brought to North America with other grains in 1602 and planted on the Elizabeth Islands off the coast of Massachusetts. As early as 1786, George Washington sowed 580 acres to oats. Between 1860s and 1870s, the westward shift of oat acreage in the United States had moved into the middle and upper Mississippi Valley, which is its major area of production today.

Oats rank around sixth in world cereal production statistics, following wheat, maize, rice, barley and sorghum. Oat grain has always been an important form of livestock feed, and provides a good source of protein, fibre and minerals, but world oat grain production declined as farm mechanization increased between 1930 and 1950. Oats remain an important grain crop for people in marginal ecologies throughout the developing world, and for specialized uses in developed economies. In many parts of the world, oats are grown for use as grain as well as for forage and feed, straw for bedding,
hay, haylage, silage and chaff. Livestock grain feed is still the primary use of oat crops, accounting for an average of around 74 percent of the world’s total usage in 1991 to 1992 (Welch, 1995).

Oats are well adapted to a wide range of soil types and on acid soils it can perform better than other small-grain cereals. Oats are mostly grown in cool moist climates and they are sensitive to hot, dry weather between head emergence and maturity. For these reasons, world oat production is generally concentrated between latitudes 35-65°N, including Finland and Norway, and 20-46°S. Most of the world’s production comes from spring-sown cultivars, but autumn sowing is practised in higher-altitude regions, including the Himalaya-Hindu Kush range, and in regions where summers are hot and dry. Where winters are severe, such as in Canada, Scandinavia and northern United States of America (USA), and higher-altitude regions in the tropics, short- to medium-season maturing oat cultivars are generally sown. In regions with temperate climates, oats are spring, winter or autumn sown, depending on regional climatic conditions, crop rotation requirements, end use and other farming practices. In warmer regions, spring-type oats are sown in autumn to avoid summer heat and drought.

Oat is an introduced crop in India. However, there are references to Oat cultivation in Ain –l- Akbari written by Abul Fazal, the court historian of Mughal king Akbar, in 1590. It is generally believed that large scale Oat cultivation started in India during the beginning of 19th century when the British established remount depots for the Indian Army. It was first introduced in the Jammu and Kashmir State by the then King, Maharaja Hari Singh (1925-1947) at his stud farms. The seeds were imported from Europe. During this period, cultivation of Oats remained confined to the King’s farms only and local farmers were not using Oats.
The introduction of oats in the Himalayan region started earnestly in late seventies, after the establishment of an Agrostology wing in Department of Agriculture in Jammu and Kashmir. Along with its introduction, some research activities were also started on Oats in the Himalayan region. These activities were further strengthened by extensive research on production technology and varietal development of Oats at the Indian Grassland and Fodder Research Institute (IGFRI) and number of Indian Agricultural Universities established in the plains. However, Berseem (Egyptian clover) became very popular in these areas but it could be cultivated only under irrigated conditions. To find an alternative forage crop suited to rainfed areas research was initiated on Oats. Until now a number of productive and nutritious varieties/cultivars of Oats have been released in India by various institutions and at all India level under the aegis of All India Co-ordinated Research Project on Forage Crops. Oats being popular crop in rainfed semi-arid as well as temperate regions of India requires due attention for its suitable crop production technologies.

Oats producing main countries are USA, former USSR, Canada, Germany and France. In European countries oats is used for cattle feeding as well as in human diet. Besides its medicinal value in India the oat is gaining popularity as fodder crop in past half century. The most important cultivated oat species is *Avena sativa*. Most farmers are least interested for improved production technologies for oat. Without the use of improved methods of production it is not possible to get better yield in oat. It is conceivable that C cycling could be manipulated through rotation choice, residue management techniques, nitrogen application methods, etc., with the goal of raising carbon dioxide partial pressures in the crop canopy. It is possible as C cycling effects are partially responsible in soils with high
organic matter content which normally produce higher yields than those with less organic matter. Similarly, fields that have recently been converted from perennial crops or from sod into crop production might produce superior yields for the same reason. Almost every season no-till farmer has had instances where a crop yielded much better than expected based on the water saving aspects of no-till alone. Something else had made a contribution. Perhaps no-till and crop rotations are not as we now have best means or tools available to manage the carbon cycle in our cropping systems. Carbon cycling is largely out of our control in tilled systems since much of the carbon dioxide cycling (loss from the soil and plant residue) occurs within days of tillage events. Very few people, including scientists think of carbon as an essential plant nutrient to be managed as such (Cotreefo, et al 1994). Cycling nutrients is nothing new, but almost everyone forgot about the most important nutrient, carbon. May be because little could be done about it in tilled systems. Now these have changed.

Uses of Oat

Oats have been used as feed and fodder to livestock and human foods since ancient times. It is used as pasture, hay or silage; Oat straw has also been used as bedding for livestock. In Samuel Johnson's dictionary, oats were defined as "eaten by people in Scotland, but fit only for horses in England." The Scotsman's retort to this is, "That's why England has such good horses, and Scotland has such fine men!". While using Oats, think oatmeal for breakfast. Be creative and vary the toppings.

Oats grains have higher crude protein, ether extract, crude fiber and digestible crude protein. The use of oats in breakfast could get popularity in America and Europe continents due to its beneficial effects. Moreover, large number of drugs have been isolated by Homeopathic industry in India and
abroad particularly for sterile males that otherwise increase sperms activity and their population. Due to its number of properties oats could gain popularity for feeding to horses that, otherwise are used for breeding purpose by different dairy farmers (Lal, et al, 2004). Oats are highly nutritious as it contains soluble fiber. Oats are traditional Scotland food. The whole oats are used as animal fodder in many countries. But it comes in different forms also such as oat bran, rolled oats, oat meals, quick oats, etc. All forms of oats are whole grain products. Oats are high in vitamin B-1 and contain a good amount of vitamins B-2 and E. 40 gram of oat bran roughly contains 3 g fat, 4 g fiber, 27 g carbohydrate, and 5 g protein.

N nutrients is one of the major essential nutrients required for optimum plant growth and higher biomass and grain production. Due to continuous use of nitrogenous fertilizer alone and in combination with phosphatic fertilizers, the potassium has become deficient especially in intensive cropping system (Tiwari and Tiwari 1996). In the concept of integrated plant and nutrient management system, the maintenance and possible increase in soil fertility in order to sustain increased crop productivity is outlined. The major components in the concept are fertilizers, organic manures, and biofertilizers. (Anonymous, 1998)

Sheesam (Dalbergia sissoo Roxb) makes first class cabinetry and furniture. The leaves are used for fodder. Social plantation systems could gain popularity on large area in India covered under the plantation of Dalbergia sissoo on road, canal and other community adopted lands. While its allelopathic effect on field crops is meagerly known to the farmers as it release number of phytotoxins (Lal and Singh, 1998, Narwal, 2004). The present study was therefore conducted to generate information on the allelopathic effect of Dalbergia sissoo litter on under story oats crops grown in
interspaces of *Dalbergia sissoo* in social forestry or intensive crop production. Thus to study the allelopathic effects of *Dalbergia sissoo* tree biomass on field crop was undertaken.

Indian Rosewood has delicate, light green, oval pointed leaflets and can quickly reach 60 feet in height with a 40-foot spread (Parrotta, 1989). The litter biomass produced from *Dalbergia* sp. contain 2.2 to 3.3 % nitrogen with other essential plant nutrients, that otherwise could be better source of organic matter for food—fodder and fuel production on the farmers fields. *Dalbergia* is a large genus of small to medium-size trees, shrubs and lianas in the pea family, Fabaceae, subfamily Faboideae. The genus has a wide distribution, native to the tropical regions of Central and South America, Africa, Madagascar and southern Asia. The size of the genus is disputed, with different authorities citing between 100-600 species. Many species of *Dalbergia* are important timber trees, valued for their decorative and often fragrant wood, rich in aromatic oils. The most famous of these are the rosewoods, so-named because of the smell, but several other valuable woods are yielded by the genus. The pre-eminent rosewood appreciated in the western world is *D. nigra* known as Rio, Bahia, Brazilian Rosewood, Palisander de Rio Grande, or Jacarandá; heavily exploited in the past, it is now CITES-listed. The second most desired rosewood in the western world is *D. latifolia* known as (East) Indian Rosewood or Sonokeling. Most rosewoods are a rich brown with a good figure. Note that only a small part of all *Dalbergia* species yield rosewood. The (Brazilian) Tulipwood (*D. decipularis*) is cream coloured with red or salmon stripes. It is most often used in crossbanding and other veneers; it should not be confused with the "tulipwood" of the American Tulip Tree *Liriodendron tulipifera*, used in inexpensive cabinetwork.
The similarly used (but purple with darker stripes), and also Brazilian, Kingwood is yielded by *D. cearensis*. Both are smallish trees, to 10m. Another notable timber is Cocobolo, mainly from *D. retusa*, a Central American timber with spectacular decorative orange red figure on freshly cut surfaces which quickly fades in air to more subdued tones and hues. To re-export products made from Brazilian rosewood (*D. nigra*), a CITES permit is required. The Indian souvenirs trade sells objects made of *Dalbergia sissoo* (sometimes stained purple) as if they were rosewood. The wood of some species can be used for tool handles, at best. African Blackwood (*D. melanoxylon*) is an intensely black wood in demand for making woodwind musical instruments. *Dalbergia* species are used as food plants by the larvae of some Lepidoptera species including *Bucculatrix mendax* which feeds exclusively on *Dalbergia sissoo*. The *Dalbergia* species are notorious for causing allergic reactions due to the presence of sensitizing quinones in the wood (Dalbergia http://en.wikipedia.org/wiki/Dalbergia).

*Dalbergia* sp is known as katu, tikta, kashnya and ushnaveerya; helps to arrest emaciation, reduces obesity; efficacious in the treatment of leucoderma and other skin diseases; antiemetic and anthelmintic; cures urinary diseases, dyscrasia and ulcer; alleviates burning sensation; expectorant; abortifacient. Parts Used: Leaves, bark, wood and root. Therapeutic Uses: Leaves: stimulant; decoction beneficial in gonorrhoea; mucilage mixed with oil useful in excoriations; Bark: alterative; dried bark; haemostatic; efficacious in bleeding piles, menorrhagia and in varicose veins; Wood: alterative and antiemetic; Oil derived from the wood applied externally in skin diseases.

Development of giant or K varieties of *Leucaena leucocephala* gave impetus to its extensive cultivation. However, of late the foresters in India
have challenged its suitability and tall clime performance. Thus in the current study the subabool was taken with multiple objectives to get green fodder for livestocks, improve the physico-chemical properties of soil and providing fuel for house-holds of common Indians. Reis et al, 1999, could found Mimosine as a non-protein amino acid found in leaves, pods and seeds of tropical legumes of the genus *Leucaena*. Mimosine is degraded in the rumen to 3-hydroxy-4 (1H)-pyridone (3,4DHP), a goitrogen. *Leucaena* consumption in ruminants may cause poor growth, alopecia, swollen and raw coronets above the hooves, lameness, mouth and esophageal lesions, depressed serum thyroison levels, and goiter.

The basic concept of integrated nutrient management (INM) is the maintenance or adjustment of soil fertility and of plant nutrient supply to optimize the benefits from all possible sources of plant nutrients in an integrated manner. The appropriate combination of mineral fertilizers, organic manures, crop residues and N - fixing crop varies according to the system, land use and ecological, social and economic conditions play a major role in deciding the appropriate crop production technologies. In spite of increased use of fertilizer nutrients, there is a gap between the nutrients application and nutrients harvesting, which is likely to widen further with achievement of targets, leading to mining of soil overuse in certain potential areas and sub-optimal use in larger areas which are crucial issues. Discriminate use of chemical fertilizers is creating lot of problems especially of soil degradation and pollution in certain areas.

To overcome these effects, organic source viz. FYM is major source of nutrients for food fodder crops in many parts of the tropics. Cattle dung is also a potential source of plant nutrients, but only in areas where animals are tethered or penned, so that dung could be collected. For better utilization of
bio-wastes composting is a low-cost efficient method of processing crop residues and household wastes through biological decomposition in vermicompost getting maximum popularity for organic farming. The use of farm manure as a nutrient source for food-fodder crop production depends largely on the prevailing farming system, while inorganic fertilizer play an important role in increasing productivity of cultivated crops in our country (Wanjari, et al 2003). Soil is the most important environmental factor known to influence the plant growth and production. Thus it is most necessary to develop and implement soil, crop and nutrient management technologies to obtain higher productivity and also to monitor the environmental consequences of the production technologies.

Keeping in view the above facts the research programme entitled “Effect of tillage and tree biomass on growth, yield and quality of oats (Avena sativa L.)” was planned and undertaken with the following objectives.

**OBJECTIVES**

1- To study the allelopathic effects of tree biomass on oat crop.
2- To study the effect of integrated Nutrient management under different tillage systems on growth and fodder yield of oats.
3- To determine quality parameters in forage oats.
4- To determine the energy requirement of oats crop in various farm operations.
5- To find out the most economic and beneficial tillage and tree biomass treatment for maximum return/ha.