INTRODUCTION

SOIL is a dynamic, living matrix that is an essential part of the terrestrial ecosystem. It is a critical resource not only for agricultural production and food security but also towards maintenance of most life processes. The functions of soil biota are important to decomposition processes and nutrient cycling. Soil is considered as a storehouse of microbial activity, though the space occupied by living microorganisms is estimated to be less than 5% of the total space. Industrialization and population explosion are the two major drawbacks confined to reduction in agricultural productivity. To increase the agricultural productivity in order to meet the needs of global population, there should be a change in the current agricultural practices. The high usage of agrochemicals has made soil infertile, accumulation of toxic chemicals in the soil and food products and imbalanced nutrient cycling and ecosystem also occur. All these criteria can be achieved through application of microbial bioinoculants. Because, these microorganisms are known to possess vast range of capabilities by producing growth promoting substances, enhancing the availability of plant nutrients, biological N fixation and crop protection against stress and diseased conditions. Bioinoculants have been shown to cause very real and positive effects when matched correctly to the right plant and the right environmental situation.

Bioinoculants are the carrier based microorganisms, which help to enhance productivity either by biological nitrogen fixation or insoluble phosphate solublization or producing hormones, vitamins and other growth factors required for plant growth. Among, bioinoculants, for increasing N supply, nitrogen fixing bacteria *Azospirillum*, *Azatobacter* and *Rhizobium* has been found to increase plant growth. Raghu (2000) has demonstrated that, the positive effect of consortium of biofertilizers on coffee;
Rajendran et al., (2003) in *Casuarinas equisetifolia, Moringa oleifera.* Bioinoculants are widely used in agricultural crops. *Azospirillum* spp are important nitrogen fixing rhizosphere bacteria and fixes atmospheric nitrogen in soil and augments nitrogen fixation. Further these bacteria increase the yield of economically important cereals and grasses in different climatic region. Members of the genus *Azospirillum* are pleomorphic, gram negative, aerobic, chemoautotroph and under free living conditions, fix nitrogen at low oxygen tension in medium devoid of ammonia. The positive effect of *Azospirillum* inoculation is mainly attributed to improved root development and subsequent increase in the rate of water and mineral uptake and the effects of inoculation *Azospirillum* on yield of several crop plants have been reviewed.

However, some evidences showed that Nitrogen (N) fixation activity has been overlooked *Azospirillum lipoferum* produced catechol-type siderophores under iron-starved conditions that exhibited antimicrobial activity against various bacterial and fungal isolates. These inoculants need more attention in view of their triple action of nitrogen fixation, biocontrol and production of plant growth regulators. Similarly, *Azotobacter* also a free living, nitrogen fixing bacteria and are known to produce several plant growth promoting substances, in addition to nitrogen fixation by these bacteria fixes nitrogen equivalent to 25-30kgN/ha. It also produces hormones like indole acetic acid (IAA) and gibberellins, vitamins like biotin, folic acid are also produced. The application of *Azotobacter* supported by judicious use of organic matter ensures good germination increasing productivity.

Biofertilizers play an important role for supplementing the essential plant nutrients for sustainable agriculture, economy and eco-friendly environment. The use of biofertilizers in crops / plants has been recommended considering the effective /
sufficient dose and beneficial response on growth of plants and yield of crops. Biofertilizers are commonly called as microbial inoculants which are capable of mobilizing important nutritional elements in the soil from non-usable to usable form by the crop plants through their biological processes. From the last decade, biofertilizers are used extensively as an eco-friendly approach to minimize the use of chemical fertilizers, improve soil fertility status and for enhancement of crop production by their biological activity in the rhizosphere. Extensive research was carried out on the use of bacteria (Azotobacter and Azospirillum) and AM fungi as biofertilizers to supplement nitrogen and phosphorus fertilizers and observed considerable improvement in the growth of several crop plants.

Arbuscular Mycorrhizal (AM) fungi are important rhizosphere microorganisms, they can increase the nutrient uptake especially immobile elements such as P, Zn and Cu and consequently they increase root and shoot biomass and improve plant growth. The application of bioinoculants like AM fungi and one of the plant growth promoting rhizobacteria such as Azospirillum, Azotobacter, Rhizobium, Pseudomonas, several gram positive Bacillus species is an environment friendly, energy efficient and economically viable approach for reclaiming wastelands and increasing biomass production. The beneficial effects of these bacteria in combination with AM fungi have been reported by number of workers (Lesueur et al., 2001; Tain et al., 2002; Patreze and Cordeiro, 2004; Domenech et al., 2004). It has been reported that these bacteria may affect AM fungi and their plant host through a variety of mechanisms that include effects on the receptivity of the root; root-fungus recognition; fungal growth; modification of the chemistry of the rhizospheric soil; and germination of the fungal propagules. On the other hands, other reports stated that the presence of AM fungi is known to enhance nodulation and N fixation by legumes
(Amora-Lazecano et al., 1998; Johansson et al., 2004). Moreover, AM fungi and NFB often act synergistically on infection rate, mineral nutrition and plant growth. Although the interaction between AM fungi and Nitrogen fixing bacteria (NFB) was previously reported, less attention was paid to bacteria-AM-legume tripartite symbioses under salinity stress. The efficiency of nutrient uptake by plants is generally attributed to the activity of mycorrhizal fungi. *Causuarinia equisetifolia* seedlings inoculated with the AM fungus *Glomus fasciculatum* showed increased shoot and root biomass. These AM fungi can be successfully used, especially when plants are in degraded soils. Many studies have demonstrated that inoculation with AM fungi improves growth of plants under a variety of salinity stress conditions (Diallo et al., 2001; Burke et al., 2003; Tain et al., 2004). Recently, Rabie, (2005) reported that, AM fungi protected the host plants against the detrimental effects of salt, when mungbean plants were irrigated with different dilution of seawater, AM plants showed higher growth than non-AM plants at all levels of irrigation. Mycorrhizae were involved in protection against salt stress, via better access to nutritional status (Zandavalli et al., 2004) and modification of plant physiology i.e. osmotic modifications (Roa and Tak, 2002) and photosynthesis (Meroguiahe et al., 2002). These AM fungi have been considered as bio-ameliorators of saline soils (Yano-Melo et al., 2003; Tain et al., 2004).

Fiber-yielding plants have been of great importance to man and they rank second only to food plants in their usefulness. In ancient times, plants were of considerable help in satisfying man’s necessities in respect of food, clothing and shelter. Although other materials like animal skin and hides were also used to meet the demands with regard to clothing, they were quite insufficient for the purpose. Further, the need for some lighter and cooler substance was keenly felt. In those days,
man also required some form of cordage for his snares, bow-strings, nets, etc, and also for better types of covering for his shelter. Tough, flexible fibers obtained from stems, leaves, roots, etc., of various plants served the above purposes very well. With the advancement of civilization, the use of plants fiber has gradually increased and their importance today is very great. Although many different species of plants, roughly about two thousand or more, are now known to yield fibers, commercially important ones are quite small in number. In commerce, ‘fibers’ include practically all small, thin, fragments of any substances. There are fibers of mineral origin (asbestos, spun glass, and so on) and of animal origin (wool and other animal hair, silk, feathers, and so on), as well as the more important plant fibers. The fibers may be grouped into two broad categories, namely, (i) natural fibers, and (ii) synthetic or artificial fibers. The natural fibers include fibers obtained from plants and animals. Wool, hairs of many of the animals, and silk are animal fibers. Nearly 90 percent of the world production of fibers is from the natural vegetable fibers. The plant fibers are among the most important of the world’s crops, and a valuable commodity in world trade because they are essential to man for the manufacture of much of his clothing, his cordage and coarse fabrics.

In the view of above mentioned importance of fibers for the human welfare the present research work has been undertaken on following commercially important four fiber yielding plants. (Plate- I).

A. *Corchorus capsularis* L.

B. *Crotalaria juncea* L.

C. *Gossypium hirsutum* L.

D. *Hibiscus cannabinus* L.
JUTE

Botanical Name: *Corchorus capsularis* L.

Family: Tiliaceae.


The *Corchorus capsularis* L., is a best fiber of great commercial importance. Jute is used extensively in the manufacture of gunny bags for packaging materials. The jute fiber is obtained from the bark of the plant. The jute is the secondary phloem fibers of the stem. There are about 40 species distributed throughout the tropics of the world. *Corchorus capsularis* L., is considered to have its origin in the Indo-Burma region. The data when the fiber yielding properties of the jute plant were utilized by the Indians is not definitely known, there is, however, evidence of trade in jute cloth in the sixteenth century in Bengal. Towards the end of the eighteenth century jute was exported to England. Subsequently, the growth of this industry was rapid and by the beginning of the twentieth century, it occupied the foremost place among the Indian industries. The crop is cultivated for fiber only in West Bangal, Bangladesh, Malaya and Sri Lanka.

Uses

*Corchorus capsularis* L. (Jute) is an important textile fiber next in importance to cotton. It is also a cheap fiber. The jute fiber is spun into yarn and yarns of good quality are used for certain fabrics and for coarse sacking and package material. Nearly 90 percent of the jute fiber goes into fabric and sack manufacture with the rest being utilized for making twines, ropes, paper and as filling material. Different types of cloth are made for the purpose of upholstery, for linoleum, for tapestries and mats.
SUNN HEMP

Botanical Name: *Crotalaria juncea* L.

Family: Fabaceae.

Vernacular: *Hindi & Sanskrit*-Sanai, Sani; *Tamil*-Sadambu, Sanapu, Shanal; *Malayalam*-Wuckoo; *Telugu*-Janumu; *Kannada*- Sanabu.

*Crotalaria juncea* L., (sunn hemp) is a bast fiber grown on a large scale in India, for local use and export, as a raw material for sacking and cordage. The plant is indigenous to India and is cultivated for fiber and for green manure in many states, viz., Andhra Pradesh, Uttar Pradesh, and Madhya Pradesh. It is also grown on limited scale in Maharashtra, Punjab, West Bengal and Orissa. The fiber has a fair demand from overseas countries and a large proportion of it is exported. A great quantity of the fiber exported is said to be used primarily in the preparation of cigarette papers and high quality tissue papers. The sunn hemp is often referred to as Bombay hemp. The fibers are stronger than the fibers of jute, but lighter in colour and more enduring than that of jute. *Crotalaria* is a large genus with many species native to the Asian tropics, but mostly concentrated in Africa. Sunn hemp is cultivated widely throughout the tropics as a green manure since it is a large, fast growing, rapidly rooting, annual legume which can be ploughed in after 8-10 weeks.

Uses

*Crotalaria juncea* L., (sunn hemp) is essentially cordage fiber and is used in the manufacture of ropes, twines, cords and marine cordage, it also finds application in the manufacture of sail-cloth, canvas, matting, sacking and rope soles of shoes and sandals, etc. being resistant to deterioration in water, sunn hemp is used for making fishing nets and marine cordage.
COTTON

**Botanical Name:** *Gossypium hirsutum* L.

**Family:** Malvaceae.

**Vernacular:** Assamese-Kapah; Bengali-Karpas; Oriya- Kapa; Telugu-Pratti; Tamil-Paruthi; Malayalam-Paruthi; Kannada-Hatti; Marathi- Kapus; Gujarati and Hindi-Kapas; Punjabi- Kapa.

*Gossypium hirsutum* L., (cotton) is the oldest and the most important commercial crop of the world. It has been grown in India in the Indus valley for more than 5000 years. It is considered to be indigenous to south-east Asia and also to south Central America. The crop is grown chiefly for fiber in many countries of the world, of which principal ones are USSR, USA, China, India, Brazil, Pakistan, Turkey, Egypt, Mexico and Sudan. These countries account for nearly 85 per cent of the total world production, in acreage, India ranks first among the cotton growing countries. The cotton goods, in the trade with the West, were carried either on camels or in boats which plied between India and the Middle East.

*Gossypium hirsutum* L., fiber is a single celled hair, a delicate tubular prolongation of the epidermis of the outer integument of seed. It may be of varying lengths, the maximum being about 51-mm. The fiber has characteristic twists and is commonly referred to as lint fiber. The lint hairs are mixed with some much shorter hairs known as fuzzy hairs, which do not exceed 10 mm in length and, unlike the former, lack the twists.
Uses of Cotton

*Gossypium hirsutum* L., is a major cash crop which gives three important products fiber, food and feed. Lint fiber is used for clothing, household and industrial articles. Articles of clothing include shirting, outer-wear, underwear, gloves, hosiery etc. Household articles include bed sheets and covers, pillow cases, towels, table clothes, mosquito nettings, flannel, blankets etc. Industrial articles include bags, belting, industrial thread, awnings, tents, tarpaulins, insulation, cellulose, plastics, etc. The linter is used for stuffing cushions, pillows, mattresses, etc. It also finds wider application in the manufacture of high quality paper cellophane, rayon, varnishes and absorbent cotton. Figure1 gives the manifold uses of cotton seed in detail. The cotton seed is used for extracting oil. Cotton seed oil is used in the manufacture of Vanaspati. Cotton flour is obtained from the seed and used for brad and biscuit making in USA. Cotton seed cake after extraction of oil is good organic manure.
**KENAF**

**Botanical Name:** *Hibiscus cannabinus* L.

**Family:** Malvaceae.


*Hibiscus cannabinus* L., (kenaf) is an important jute substitute. It is a common wild plant of tropical and subtropical Africa and is wild or naturalized in Asia. It has been widely introduced recently as a potential fiber crop. Cultivations have been established in China, Russia, Thailand, South Africa, Egypt, Mexico and Cuba. An Indian origin for kenaf is suggested by some authors but the peoples of Western Sudan domesticated the plant before 4000 B.C. (Murdock1959). Wild forms occur in several parts of Africa, especially in the upper Niger and Bani valleys. Wild collections have also been made in Angola and Tanzania. The Angolan collections appear primitive and may indicate Angola as the centre of origin of kenaf (Simmonds, 1976). Kenaf is an important fiber crop in South India. It is cultivated as a rainfed crop in large areas in Madhya Pradesh, Andhra Pradesh and Tamil Nadu. It is sown on the bunds of irrigation channels and in small patches in garden lands. It is stronger than jute, but not so flexible and soft. The plant is said to have been introduced from South Africa and it is grown in India from time immemorial. Cultivated forms are annual, erect herbs, largely self-pollinated.
Uses

*Hibiscus cannabinus* L., fiber is widely used for rope and cordage. Large quantities are used in making fishing nets and strings for training rafters. It is also used for coarse canvas, sacks and gunny bags, floor matting, rug backing, etc. The stalks left after fiber extraction can be used as fuel. Leaves are used as green vegetable.
Main objectives of the present research work.

1. Isolation, Identification and classification of AM fungal spores form rhizospheric soils of four experimental plants

2. Selection of efficient AM Fungi for four experimental plants to understand the growth response.

3. Effect of plant growth promoting microorganisms and AM fungus on four fiber yielding plants.

4. Effect of fly ash and AM fungus (*Glomus fasciculaum*) on four Fiber yielding plants.

5. Effect of AM fungus (*Glomus fasciculatum*) and a balanced phosphate fertilization on four fiber yielding plants.

6. Effect of AM fungus (*Glomus fasciculatum*) and carrier materials on four experimental plants under greenhouse conditions.

7. Biochemical changes in the four experimental plants inoculated with AM fungus (*Glomus fasciculatum*).