SYNOPSIS
INTRODUCTION:

*Carica papaya* L. is one of the most important fruit crops valued for its rich nutrient content. It is native of tropical America and it is thought to be originated from Southern Mexico and Costa Rica. It believed to be introduced into India in sixteenth century. *Carica papaya* L. belongs to family Caricaceae. The genus *Carica* has about 48 species of which only *Carica papaya* L. is grown for its edible fruits. The ripe fruits of papaya are used for table purpose, raw fruits are cooked and used as a vegetable. Immature fruits are used for the extraction of papain. It is known for its medicinal uses as it improves digestion and cure chronic constipation. It also has varied industrial uses *viz.*, tanning industry, degumming of silk etc.

*Carica papaya* L. is commercially cultivated in some African, Latin American and Southeast nations. India is the second largest producer of papaya after Brazil (Reddy, 2000). It is commercially cultivated in nine states of India. *viz.*, Karnataka, Bihar, Gujrat, Kerala, Tamil Nadu, Andhra Pradesh, Maharashtra and Madhya Pradesh. It is also a popular fruit in Goa but it is mostly confined to kitchen garden and bunds. In Goa, papaya plantations are usually seen in Government agricultural farms and with few progressive farmers because of constraints in productivity such as high mortality rate due to fungal and viral diseases. Now with the advancement in Science and Biotechnology, scientists have yet another tool and dimension to consider in their objectives to increase or maintain productivity of agricultural and forestry lands. The four dimensional system of soil, mycorrhizae, bacteria and plant if scientifically managed, possibly will help to achieve our targets of the production potential
from nutritionally deficient soil, conserve energy and minimize use of expensive chemical fertilizers.

Symbiotic arbuscular mycorrhizal association between fungi and roots of plants is a common feature and is gaining importance due the fact that it helps in plant productivity. These fungi help the host plant by increasing the uptake of nutrients particularly those whose ionic forms have poor mobility, mainly P (Manjunath and Habte, 1988) and number of other minerals like zinc and copper (Barea, 1991). They also influence soil structure stabilization process (Benthlenfalvay and Linderman, 1992; Benthlenfalvay and Schüepp, 1994), increase disease resistance by depressing root penetration and larval development of nematodes (Sikora, 1978) and enable the plants to cope up with abiotic stress by improving tolerance to drought, salinity, pollution and alleviating nutrient deficiency (Barea et al., 1993). Mycorrhizal inoculation also stimulates root growth (Barrow and Roncadri, 1977) and transplant survival (Bryan and Kormanik, 1977).

The utility of the mycorrhizal application in horticultural crop production has been evaluated in many fruit crops like *citrus* (Menge, 1978), avocado (Azcon Aguilar, 1992), apple (Branzanti et al., 1992), pineapple (Guillemin et al., 1994), and strawberry (Chavez and Ferrera- Cerrato, 1990). In India, the beneficial effects of arbuscular mycorrhizal fungal inoculation have also been reported in *citrus* (Onkarrayya and Sukhada, 1993), banana (Sukhada, 1995) and papaya (Sukhada, 1992 & 1995). But comparatively little has been learnt about arbuscular mycorrhizal fungi in fruit crops. These indigenous fungi in natural ecosystem forms an integral part of the environment which under certain set of conditions may bring about significant changes so as to confer
disease resistance against the devastating soil borne pathogens. As no
detailed investigation exists in the literature surveyed, an effort was made to
study the arbuscular mycorrhizal status of Carica papaya L. in agro-based
ecosystem of Goa.

AIMS AND OBJECTIVES:

1. To study the root colonization of arbuscular mycorrhizal fungi
   associated with Carica papaya L.

2. To determine the spore populations of native arbuscular mycorrhizal
   fungi colonizing the rhizosphere soil of Carica papaya L.

3. To study the diversity of arbuscular mycorrhizal fungal species
   colonizing the rhizosphere of Carica papaya L.

4. To study the effect of climatic and edaphic factors on distribution and
   diversity of arbuscular mycorrhizal fungi associated with Carica
   papaya L.

5. To investigate the mycorrhizal status of Carica Papaya L. as
   influenced by its phenology.

6. To study the response of selected arbuscular mycorrhizal fungi on
   growth of Carica papaya L.
METHODOLOGY:

1. Collection of rhizosphere soil samples and root samples.

2. Setting of pot cultures in the glass house using soil samples collected from the rhizosphere of *Carica papaya* L. with *Elucine coracana* L. and *Coleus sp* as host plants.


5. Isolation of arbuscular mycorrhizal fungal spores by wet sieving and decanting method (Gerdemann and Nicolson, 1963).

6. Quantification of spore density of arbuscular mycorrhizal fungi (Gaur and Adholeya, 1994).


8. Procedures for assay of phosphatase enzyme were standardized based on methodology provided by Kapoor *et al.*, (1988) and Suhkada (1992).
OBSERVATIONS:

The first chapter deals with the study of arbuscular mycorrhizal association in *Carica papaya* L. The objective of this work was to survey *Carica papaya* L. for native arbuscular mycorrhizal association. Six varieties were sampled for this study. It was observed that all the varieties selected for the study were mycorrhizal, but exhibited variation in the extent of root colonization and spore density. Root colonization was characterized by the presence of hyphae, abscules and vesicles. A total of 13 arbuscular mycorrhizal fungi were recovered from the rhizosphere soil of six *Carica papaya* L. varieties. *Acaulospora scrobiculata* Trappe was the most frequently occurring arbuscular mycorrhizal fungal species and it was encountered in the rhizosphere of all the varieties.

The second chapter deals with the spatial variation of arbuscular mycorrhizal fungi in *Carica papaya* L. The objective of the work was to study the distribution of arbuscular mycorrhizal fungi in *Carica papaya* L. from different geographical localities. Three distinct geographic regions viz., Western Ghats, Plateaus and Coastal areas were considered for the study. Observations revealed that root colonization and spore density of arbuscular mycorrhizal fungi was higher in papaya samples from Western Ghats and low in papaya sampled from coastal areas. Twenty-three arbuscular mycorrhizal fungi were recorded during the study. *Glomus sinuosum* (Gerdemann & Bakshi) Almeida & Schenck was the most frequently occurring arbuscular mycorrhizal fungal species, common to all the sites selected for the study.
The third chapter deals with Spatio-temporal variations of arbuscular mycorrhizal fungi associated with *Carica papaya* L. The objective of the work was to study the periodical variation in arbuscular mycorrhizal fungi. Maximum average spore density was recorded during April, whereas minimum average spore density was recorded during October. Root colonization was observed throughout the study period with highest and lowest colonization levels recorded during July and April respectively. Arbuscular mycorrhizal fungi belonging to genus *Glomus* were the most representative types. *Glomus coremioides* (Berk. & Broome) Redecker & Morton and *Glomus clariodeum* Schenck & Smith emend. Walker & Vestberg were the most frequently occurring arbuscular mycorrhizal fungal species.

The fourth chapter deals arbuscular mycorrhizal status of *Carica papaya* L. as influenced by its phenology. The objective of this work was to study the colonization and distribution of arbuscular mycorrhizal fungi during different stages of growth of *Carica papaya* L. The study also intended to examine the pattern of root phosphatase activity during different growth stages of *Carica papaya* L. Observations revealed that root colonization and phosphatase activity was strongly influenced by phenology of *Carica papaya* L. Maximum root colonization and phosphatase activity was recorded during the flowering stages. However, spore density of arbuscular mycorrhizal fungi showed little or no variation during different stages of growth of *Carica papaya* L. Arbuscular mycorrhizal fungi belonging to four genera viz., *Acaulospora* (Morton & Benny), *Gigaspora* (Gerdemann & Trappe), *Glomus* (Tulasne & Tulasne) and *Scutellospora* (Walker & Sanders) were recovered from the study.
The fifth chapter deals with the taxonomy of arbuscular mycorrhizal fungi associated with *Carica papaya* L. The objective of the study was identification and documentation of arbuscular mycorrhizal fungi recovered from the rhizosphere soil of *Carica papaya* L. The study reports a rich diversity of arbuscular mycorrhizal fungi. Out the total seven genera (*Acaulospora* Morton & Benny, *Entrophospora* Ames & Schneider, *Gigaspora* Gerdemann & Trappe, *Glomus* Tulasne & Tulasne, *Paraglomus* Morton & Redecker, *Archaeospora* Morton & Redecker and *Scutellospora* Walker & Sanders), the study recorded the presence of four genera of arbuscular mycorrhizal fungi viz., *Acaulospora* (Morton & Benny), *Gigaspora* (Gerdemann & Trappe), *Glomus* (Tulasne & Tulasne) and *Scutellospora* (Walker & Sanders). A total of thirty-five arbuscular mycorrhizal fungi were recorded with *Glomus* species being the most representative types.

The sixth chapter deals with study of effect of arbuscular mycorrhizal fungal inoculation on growth of *Carica papaya* L. The objective of the work was to study the response of selected arbuscular mycorrhizal fungi viz., *Glomus intraradices* Schenck & Smith and *Glomus mosseae* (Nicol. & Gerd.) Gerdemann & Trappe on growth of *Carica papaya* L. The experiment comprised of four treatments viz., Un-inoculated control (C), inoculated with *Glomus intraradices* Schenck & Smith (GI), inoculated with *Glomus mosseae* (Nicol. & Gerd.) Gerdemann & Trappe (GM) and papaya inoculated with mixed inoculums viz., G. *intraradices* +G. *mosseae* (MI). Observations revealed definite stimulation of root and shoot growth in mycorrhizal plants as compared to the control plants. Plants inoculated with *Glomus mosseae* (Nicol. & Gerd.) Gerdemann & Trappe showed maximum increase in biomass, root phosphates activity and total P and K content of shoot.
CONCLUSIONS:

The study indicated that *Carica papaya* L. is colonized by arbuscular mycorrhizal fungi in agro-based ecosystem and this symbiosis is influenced by various factors. The study also brought about the enumeration of arbuscular mycorrhizal fungi associated with the rhizosphere of *Carica papaya* L. Arbuscular mycorrhizal fungi exhibited variation both in time and space. Root colonization of arbuscular mycorrhizal fungi and phosphatase activity of the roots were strongly influenced by phenology of *Carica papaya* L. Inoculation with arbuscular mycorrhizal fungi enhanced growth of *Carica papaya* L. seedlings over the un-inoculated control seedlings.

REFERENCES:


Signature of Guide

Signature of Student