# *1. Introduction*

*Guizotia abyssinica* commonly known as 'Noug' in Amharic, 'Ramtil' in Hindi and 'niger' in English is cultivated as an oil seed crop (Plate 1.1). India is one of the important niger producing countries in the world. The seeds of niger contain clear, excellent, vegetable edible oil. Niger oil is slow drying and it contributes about 3% of Indian's total oil seed production (Getinet and Sharma, 1996). In India, niger oil is frequently used as a substitute for sesame oil (Weiss, 1983). Niger oil is sweetish in taste, bluish-white in colour and has a faint pleasant odor. It is used for culinary purpose, for anointing the body, as an illuminant and for the preparation of soaps, paints, lubricant and perfumes (Panday and dhakal, 2004; Dutta *et al.*, 1994; Kandel and Potter, 2002). Niger seed oil can also be used as biodiesel through *trans* esterification of its long chain fatty acids with methanol that can partially substitute diesel oil and perform better with lower emission levels (Devi *et al.*, 2006).The seeds are used as bird seed in USA and Europe which earn foreign currency (Kandel and Potter, 2002).

The seeds contain 17-20% protein (Abebe *et al.*, 1978; Kandel & Porter, 2002) that offers an important source of protein and significantly contributes to the human dietary protein intake. It also contains 34-40% carbohydrate and 13.5% fiber and is an important source of thiamine, riboflavin, and niacin (Kandel & Porter, 2002). Niger oil is also used as substitute for olive oil. Whole plants are used as green manure in pre-flowering stage. Oil of the seed is used in rheumatism and asterosclerosis. Niger can grow on a wide range of soils, but it appears to thrive best on clayey loams or sandy clays (weiss, 1983). Average yield of recommended Indian cultivars was recorded by Getinet and Sharma(1996) as 467 kg $ha^{-1}$ which is much higher than that of Purseglove (1979) 398-$448^{-1}$ kg ha. Niger plants grow well in optimum annual precipitation of 6.6 to 17.9 dm, annual temperature of 13.6 to 27.5$^{0}$C and at pH range of 5.5to 7.5. It can grow on water logged, marginal and poor soils where most other crops fail to grow, as it is able to withstand salinity and low oxygen levels (Abebe *et al.*, 1978). Niger seeds are sown in tropical areas during September to mid-November as a winter season crop. It is a short day, self-sterile plant and requires bee for cross-pollination (Pandey and Dhakal,2004).

Crude oil and their fractions were investigated for their radical scavenging activity (SAR) toward the stable galvinoxyl radical by electron spin resonance (ESR) and by spectrometric method and showed its oxidative stability (Ramadan and Moersel, 2003). A Niger based agar medium can be used to distinguish *Cryoptococcous neoformans* (sant) Vaill, a fungus that causes serious brain aliment, from other fungus (Paliwal and Randhawa 1978). There are reports that Niger oil is used for the treatment of syphilis (Belayneh, 1991).

Due to its wide adaptability niger is often grown over vast region under vatient soil and climatic conditions which make it susceptible to attack by various fungal pathogens. Some of the diseases like Leaf spot by *Cercospora guizoticola* (Yirgu, 1964), Stem and leaf blight by *Alternaria* sp., Seed rot by *Rhizoctonia bataticola* (Yitbarek, 1992) etc. have been recorded but leaf blight of niger caused by *Alternaria* sp. is the most serious disease of niger (Gebre-Medhin & Mulatu, 1992; Getinet & Sharma, 1996). The pathogen attack the leaves of niger plants. The symptoms appear as dark necrotic spots on the leaves later leaves of whole plant is blighted and become dark brown in colour.

Higher plants have the ability to initiate various defense reactions such as the production of phytoalexines, antimicrobial proteins, reactive oxygen species etc. when they are infected by pathogens. If the defense reaction occur too late or are suppressed, the infection process proceed successfully (Somssich and Hahlbrock, 1998). Management of disease is possible by inducing plant defense response by exogenous application of certain biotic and abiotic inducers in order to provide protection against pathogens. Endogenous defensive system of a plant can be enhanced through Immunization. Plant Immunization is the process of activating natural defense system present in plants induced by biotic and abiotic factors. Plants pre-treated with inducing agents stimulate plant defense responses that form chemical or physical barriers that are used against the pathogen invasion. Inducers used usually give the signals to raise the plant defense genes which in turn resulting to induced systemic resistance. In many plant-pathogen interactions, resistance-avirulence gene interactions results in localized acquired resistance or hypersensitive response and at distal end of plant, a broad-spectrum resistance is induced known as systemic acquired resistance (SAR) (Kothari & Patel 2004). During the last decade extensive research work has been performed for the

establishment of SAR by the application of a variety of biotic and abiotic inducers (Meena *et al.,* 2001; Ryals *et al.,*1996). SAR is a broad-spectrum resistance that can be induced in plants following a localized infection with a necrotizing pathogen or treatment with elicitors (Mauch-Mani and Metraux, 1998; Sticher *et al.,* 1997). Salicylic acid (SA) is an endogenous signal for the development of SAR and it is transported by phloem from the sites of its origin. Leaves inoculated with pathogen exhibits high level of endogenous SA (Malamy *et al.,* 1990). Foliar application of SA at the concentration of 1mM significantly increased the activity of several defense-related enzymes like phenylalanine ammonia-lyase (PAL), chitinase, β -1,3 glucanase, peroxidase, polyphenol oxidase and phenolic content in groundnut (Meena *et al.,* 2001).

Many biotic and abiotic inducers have been used for the establishment of SAR in different plants by several workers. Among the abiotic inducers, Meena *et al.* (2001) used salicylic acid in groundnut, O'Donnell *et al.* (1996) used ethylene in tomato, Smith-Beaker *et al.* (1998) used SA and 4–hydroxybenzoic acid in cucumber, Cohen *et al.* (1993) used jasmonic acid and methyl jasmonate in potato and tomato, Brederode *et al.* (1991) used UV-light in tobacco, Ernst *et al.* (1992) used ozone in tobacco, Klessig *et al.* (2000) used nitric oxide and Kaku *et al.* (1997) applied N-acetylchitooligosaccharide in barley.

Similarly, some biotic inducers have also been used to enhance in plant defense reaction. Some of them are leaf extract of *Azadirachta indica* in barley (Paul and Sharma, 2002), *Acalypha indica* in ginger (Ghosh and Purkayastha, 2003), *Allium sativum* bulb extract against many fungi (Singh *et al.*2001), plant growth promoting rhizobacteria (PGPR) in cucumber (Chen *et al.,* 2000; Liu *et al.,* 1995; Wei *et al.,* 1991*), Pseudomonas fluorescens* strain CHAO in tobacco (Maurhofer *et al.,* 1994*), Pseudomonas syringae* in cucumber (Rasmussen *et al.,* 1991*), Pyricularia oryzae* and *Bipolaria sorokiniane* in rice (Manandhar *et al.,* 1999). It has also been reported that 3 potato associated ecto- and endophytically living bacterial strains *Psuedomonas fluorescens* B1 & B2 and *Serratia plymuthica* B4 can effectively control *Rhizoctonia solani* in potato and lettuce (Groseh *et al.* 2005). *Bacillus* species as a group offer several advantages over other bacteria for protection against root pathogens because of their ability to form endospores, and because of the broad-spectrum activity of their antibiotics. The strain *B. subtilis* CE1 have been reported to

be a potential biological control agent against *Fusarium verticillioides* at the root level (Cavaglieri *et. al.* 2005).

Plant growth promoting rhizobacteria (PGPR) can suppress the disease caused by foliar pathogen by triggering plant-mediated resistance mechanism called induced systemic resistance, so called ISR (Dube, 2001). Systemic resistance induced by rhizobacteria differs mechanically from SAR and it is designated by a separate term ISR proposed by Kloepper *et al.* (1992). SAR is dependent on the synthesis of SA by the plant that acts as an inducer signal and is associated with the accumulation of novel pathogenesis–related (PR) proteins, POX (peroxidase), PR-1, PR-2 (β -1,3 glucanase), PR-3 (chitinase), PR-4 and PR-5 etc. (Van Loon, 1999).

Among PR-proteins, two plant hydrolases, β-1,3 glucanase and chitinase are given special importance by the workers because many pathogenic fungi contain β-1,3 glucans and chitin as major structural cell wall component (Wessels and Sietsma, 1981). Several authors (Bishop *et al.*, 2000; Arlorio *et al.*, 1992; Mauch *et al.*, 1988) have demonstrated the activity of β-1,3 glucanase and chitinase to degrade fungal wall components *in vitro*, resulting in growth inhibition of fungi.

Search for effective biocontrol agents for the management of plant diseases have been intensified in recent years to reduce the dependence on ecologically hazardous chemicals (Sharma *et al.*, 2001). Out of 2,50,000 known higher plant species which exist on earth, only relatively few have been thoroughly studied for their therapeutic potential (Deans and Svoboda, 1990). Currently, Secondary metabolites of plants are being tapped for use as pesticides. Numerous defensive chemicals, such as terpenoids, alkaloids, phenols, tannins are very effective in the control of phytopathogenic fungi. Even though many antifungal and antibacterial compounds are reported in literature, plant products have not been used to any significant extent for the control of diseases. In India no such product has been registered till 2002 for the control of phytopathogenic fungi (Narasimhan and Masilamani, 2002). Although several inducer chemicals, antagonistic microorganisms and botanicals are known from different plants through literature but no such information is available for controlling the *Alternaria* leaf blight of niger caused by *Alternaria alternata.* Hence, the present work has been undertaken to find out an environment-friendly alternative strategy for controlling alternaria-leaf blight disease of niger.

A host and a pathogen have been reported to share common antigens, which play an important role in determining compatible/incompatible interactions. Thus, absence of the common antigen leads to incompatible interaction and presence of common antigens lead to compatible interaction. Even within the compatible interactions the degree of compatibility might be determined by the sharing of the common antigens (Dasgupta *et al.*, 2005). At the onset of the present study it was considered to select at least one resistant and one susceptible variety cultivated in India by conventional pathogenicity test as well as by levels of common antigens using serological techniques (Dasgupta *et al.*, 2005).

Sub-Himalayan West Bengal, the present study area (Fig.1.1) is prone to disease caused by *Alternaria* sp. Although several inducer chemicals, antagonistic microorganisms and botanicals are known from different plants through literature but little information is available for controlling the *Alternaria* blight of niger. Hence, in the present study environment-friendly strategies have been taken into consideration for control of the *Alternaria* blight disease of niger. Therefore, the basic objectives of this study are:

**Objectives:**

1. To determine the pathogenicity of *Alternaria alternata* in different varieties of niger and to select susceptible and resistant varieties of niger.
2. To study morphological and physiological characteristics of the fungus.
3. To determine the common antigenic relationship between *Alternaria alternata* and different varieties of niger by serological techniques.
4. To study whether the disease reactions could be altered in susceptible niger varieties by some SAR inducers.
5. To control the leaf blight disease of niger by SAR inducers, eco-friendly botanicals and biocontrol agents.
6. To select potential SAR inducers, botanicals and biocontrol agents, if any, for preparation of field applicable formulations and field assessment of the formulations.

**PLATE 1.1**

**fig. a :** Healthy niger plants in flowering condition at farmer's field at Jalpaiguri

**fig. b :** Young niger plant

**fig. c :** Niger seed of local variety (LV)

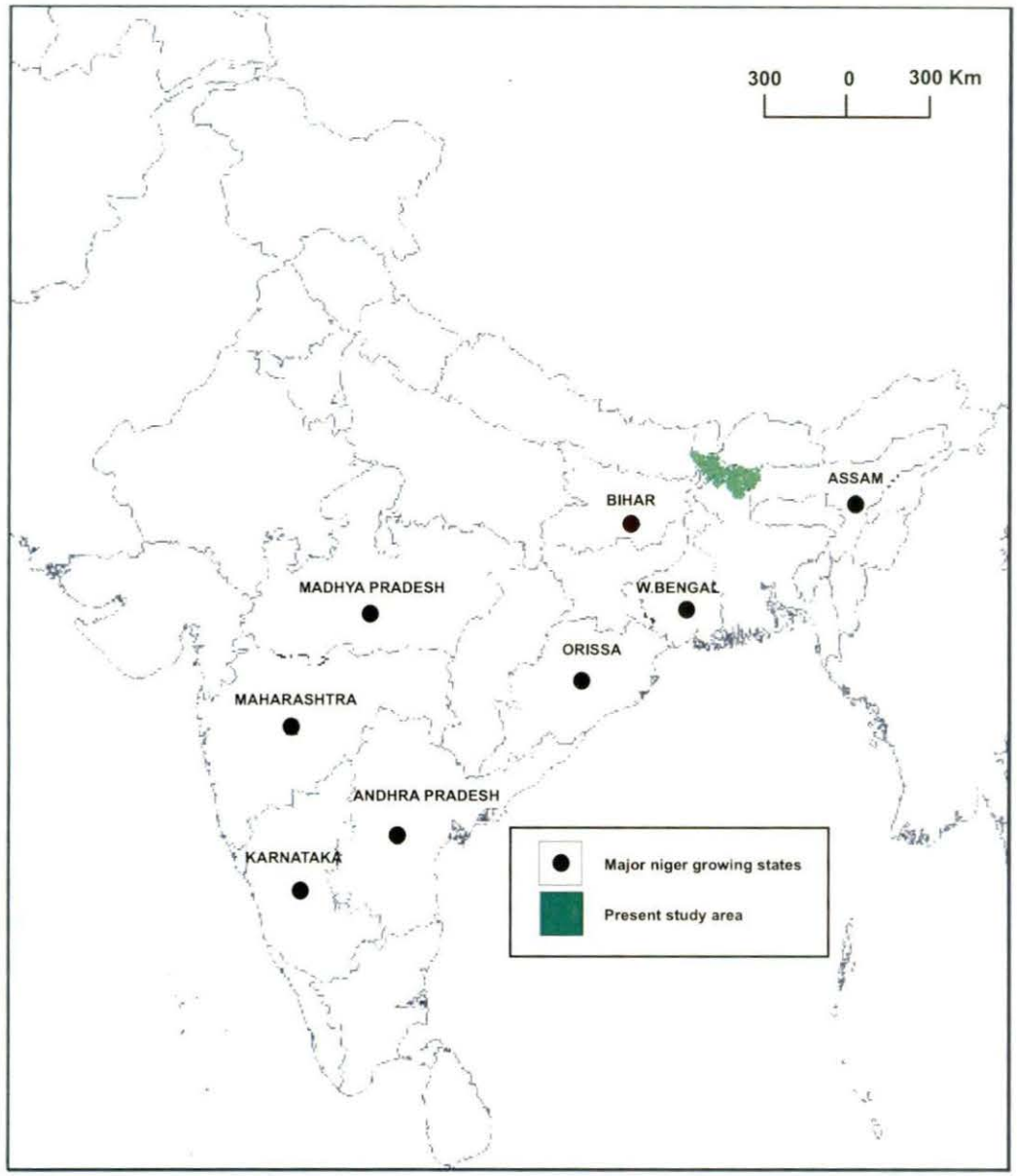


**Fig. 1.1 : Major niger growing regions in India**