2017-07-31

ALLELOPATHIC EFFECT OF Eucalyptus globulus AQUEOUS LEAF EXTRACTON ON Eragrostis teff AND Cicer arietinum

YITAYEW WORKU ABEBE, WORKU ABEBE

SCHOOL OF GRAGUATE STUDIES

COLLEGE OF SCIENCE

DEPARTMENT OF BIOLOGY

ALLELOPATHIC EFFECT OF *Eucalyptus globulus* AQUEOUS LEAF EXTRACTON ON *Eragrostis teff* AND *Cicer arietinum*

BY:

YITAYEW WORKU ABEBE

MSc THESIS

DECEMBER, 2008

BAHIR DAR UNIVERSITY

SCHOOL OF GRAGUATE STUDIES

COLLEGE OF SCIENCE

DEPARTMENT OF BIOLOGY

ALLELOPATHIC EFFECT OF *Eucalyptus globulus* AQUEOUS LEAF EXTRACTON ON *Eragrostis teff* AND *Cicer arietinum*

BY:

YITAYEW WORKU ABEBE

A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES IN PARTIAL FULFILMENT OF THE REUIREMENT FOR MASTE OF SCIENCE DEGREE IN BIOLOGY (BOTANY)

ADVISOR;-DR. BERHANU ABRAHA

DECEMBER, 2008

BAHIR DAR UNIVERSITY

Bahir Dar univverisiy

School of Graduate Studies

As a thesis research advisor , I hereby certify that I have evaluated this thesis prepared under my guidance , by Yitayew Worku Abebe entitled as ‘ Allelopathic Effect Of *Eucalyptus globulus* Aqueous Leaf Extraction On *Eragrostis teff* And *Cicer arietinum* ‘ I recomended the paper to be submitted as the partial fulfilling requirements for the degree of MSc in Biology.

Berhanu Abraha (PhD) ____________________ ______________

Advisor Signature Date

As members of the board examiners for the MSc thesis open defence examination ,We certify that we have read and evaluated the thesis to be accepted as partial fulfilling requirements for the degree of MSc in Biology

____________________ ______________ ______________

Chairperson Signature Date

____________________ ______________ ______________

Internal examiner Signature Date

____________________ ______________ ______________

External examiner Signature Date

DECLARATION

I declare that this MSc thesis is my original work that has not been presented in any university for fulfilment of degree program and all the sources used for manuscript are certainly acknowledged.

Yitayew Worku Abebe ______________ ______________

Signature Date

Candidate

ACKNOWLEDGEMENT

My grand thanks will be given to Dr. Birhanu Abrha for his successive support in my work. I like also to give my sincere gratitude the members of administrations of aferwanat secondary and preparatory school for providing laboratory instruments and allowing me to work In the school Biology laboratory room and my family and relatives for their financial and moral support. Next I would like to thank my friends Assefa Mesfin, Tessafa Gedefaw,Getnet Yilak,Tewodros G/Medihin for their moral and labour support.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

ACRONYMS AND ABBEREVIATIONS

SL.......................................shoot length

RL...root length

SR ratio............................shoot root ratio

MGT....................mean germinating time

NGS...........number of germinating seed

CSA ....central statistic agency

SHR..................seedling height reduction

Gp.......................Germination percentage

Vi.......................................vigor index

ABSTRACT

Many native forests have been destroyed by the introduction and large-scale planting of fast growing exotic tree species. Consequently, some native species have become endangered and the ecosystem services provided by native forests are diminishing (For example, continuous monoculture planting of eucalyptus may caused accumulation of phytotoxins in soil which results in soil degradation and loss of productivity. In this study the allelopathic effect of *Eucalyptus globulus* aqueous leaf extraction on germination and early growth of two agricultural crops; *Eragrostis teff* and *Cicer arietinum*, which are commonly cultivated in Ethiopia particularly in South Gonder Dera district, were studied under laboratory room and field experimental conditions . At both conditions, seeds and seedlings were watered with 0% (control), 10%, 20%, 30% and 40% extractions of *Eucalyptus globulus* in every other days. Extraction above 10% delayed mean germination time of of *Cicer arietinum* at both laboratory room and field conditions. All extractions of *Eucalyptus globulus* delayed germination time of teff during laboratory room experiment . In field experiment the mean germinating time of teff was significantly affected by above 10% extractions of *Eucalyptus globulus*. Number of germinating seeds were only affected at laboratory condition of both crops by 40% extractions . Germination percentage of both crops significantly affected by 40% of extract solutions except laboratory experiment of teff which was not affected by all extracts. All extracttions inhibited the shoot length of chickpea and teff at both conditions. Root length of chickpea at laboratory room andexperiment were significantly inhibited by all extracts. But during field conditions it was affected by above 10% extract solutions. Seedling height reduction and vigor index of both crops were significantly affected by all extracts at both conditions.These shows the toxicity of *Eucalyptus globlus* to Teff and Chickpea. So, *E. globulus* tree is toxic to *Eragrostis teff* and *Cicer arietinum* , it must not be intercropped with these plants. Besides, increasing awareness of the farmers towards allelopathic effect of *E. globulus* against chickpea and teff is necessary so that they avoid intercropping and further studies must be done on allelopathic effect of *E.globulus* on *Eragrostis teff* and *Cicer arietinum* .

KEY WORDS;- shoot length, root length, mean germinating time, Seedling height reduction, vigor index, Germination percentage

1. ITRODUCTION

1.1. Background and justification

Allelochemicals are chemicals which are secreted by plants mainly for the purpose of competitions for resources found in a habitat . the resources might be minerals ,water and other resources. Eucalyptus species are indigenous to Australia. They have been widely introduced into countries throughout the world because of their rapid growth and the rising demand for paper and timber (Pye-Smith, 2003). In the highlands of Ethiopia, eucalyptus are the species most sought for fuel wood, often in combination with other uses such as poles. Residues, exudates and leachates of many plant have been reported to effect the growth of the other plants, a wide range of injurious effect on crop growth has been reported as being due to phytotoxic products, release from leaves, stem, roots, fruit and seeds. Alam and Islam (2002) reported that plant produce chemicals which interfere with other plants and affect seed germination and seedling growth.

Many native forests have been destroyed by the introduction and large-scale planting of fast growing exotic tree species. Consequently, some native species have become endangered and the ecosystem services provided by native forests are diminishing (Sangha and Jalota, 2005). For example, continuous planting of eucalyptus in monoculture may cause accumulation of phytotoxins in soil which results in soil degradation and loss of productivity (El-Khawas and Shehata, 2005; Forrester *et al.,* 2006).

In Dera Woreda Arib Gebeya districts *Eragrostis teff* is one of the most crop which is cultivated in the area. *Cicer arietinum* is also one of the crop plants which is cultivated in this district. Eucalyptus trees might negatively impact on seed germination and growth of native species (Everett, 2000; Duarte *et al.*, 2006). Hence it is important to identify allelopathic plants which can have toxicity effect on crop plants. This research was designed to see the impact of aqueous extraction from leaf of *Eucalyptus globulus* on the germination and elongation of *Eragrostis teff* and *Cicer arietinum* .

1.2. General Objective of the study

The objective of the study was to check the toxicity of Eucalyptus globulus leaf extracts on germination and early growth of Teff (*Eragrostis teff*) and Chickpea (*Cicer arietinum)*

1.3. Specific objectives

The specific objective of this study were

- identify allelopathic effecs of *Eucalyptus globulus* on teff.
- Identify effects of *Eucalyptus globulus* on early growth of shoot and root of crop plants.
- Awaring the society in the area to reduce distributon of *E.globulus* around cultivation area.

2. LITERATUR REVIEW

2.1. Morphology and Botanical Description of *Eucalyptus globulus*

2.11. Appearance

Eucalyptus globulus Labill belongs to kingdom plantae, order myrtales, family myrtaceae and the genus eucalyptus.Eucalyptus globulus is an evergreen tree, 40-70 m tall with straight massive trunk 0.6-2 m in diameter with narrow, irregular crown of large branches and drooping aromatic, camphoraceous foliage. The roots appear to be deep and spreading with bark smoothish, mottled gray, brown, and greenish or bluish, peeling in long inner bark light yellow within thin green layer. Moreover, the leaves are alternate, drooping on flattened yellowish petioles 1.5-4 cm long, narrowly lanceolate, 10-30 cm long, 2.5-5 cm wide, mostly curved, acuminate at tip, acute at base, entire, glabrous, thick, leathery, with fine straight veins and vein inside marlin, shiny dark green on both surfaces (Munth and keck,1997).

2.12. Flowers

Solitary white flowers with many stamens arise from the axils on flattened stalks. They range from 1.6-2.2 in. (4-5.5 cm) wide. Sepals and petals are united to form a warty lid which is present on the bud and drops off at flowering. Flowers from December to May (Del Morarl and muller,1969).

2.13. Fruit

The fruit is a hard, woody globose capsule. The fruit is 0.8-1 in. (2-2.5 cm) across. The numerous seeds are approximately 0.08 in. x 0.04 in. (2 x 1 mm). Seeds are dark brown with a brownish red chaff. *Eucalyptus globulus* Labill. is an aromatic tree in the Myrtle Family (Myrtaceae) which commonly attains a height of 150-180 feet and a diameter of 4-7 feet. It has a straight trunk up to two-thirds of its total height and a well-developed crown. The central trunk and tap root are fringed with many lateral stems and roots. The tap root rarely exceeds a length of 10 feet (Munth and keck,1997).

2.14. Leaves

The leaves of the older branches are narrowly lanceolate, often curved, alternate and hung vertically. They are glossy, dark green, thick and leathery. They average in length from 1.5-2 cm. The leaves of the young shoots are ovate, opposite, sessile, and horizontal. They are covered with a grey, waxy bloom which is much thicker on the bottom surface of the leaf (Del Morarl and muller,1969).

2.15. Habitat

Eucalyptus globulus will grow on a wide range of substrates, but it is especially common and widespread on soils derived from granite. It is best developed on moderately fertile loams or heavy, well-drained soil. Most occurrences of *E. globulus* are found in areas having an annual rainfall of 60-110 mm and now it occur naturally with less than 50 mm annual precipitation. It has an altitudinal range from near sea level to approximately 1100 m. This species is found in a variety of frost situations (Krugman, 1974).

Eucalyptus globulus is one of the most extensively planted Eucalyptus. Its rapid growth and adaptability to a range of site conditions have been responsible for its popularity. It has been particularly successful in countries with a Mediterranean-type climate but has also grown well at high altitudes in the tropics. It has failed only in temperate zones with severe winters, in tropical zones at low altitudes where the temperatures are uniformly high and in regions with long, hot dry seasons. The fast growing wood has proven unsuitable for sawn timber due to excessive defeat from collapse, splitting and warping. It has been used as satisfactory firewood, fence posts, paper pulp, rayon pulp, shelter belts, and as an ornamental landscape species (Krugman, 1974).

The seeds of the eucalyptus are very small in comparison with other forest tree seeds but are produced abundantly. *Eucalyptus globulus* seeds are among some of the larger seeds in the entire genus (2 x 1 mm). Most seed is distributed by wind and gravity, but some are moved by such agents as flood, erosion and birds. Usually seed is dropped within 100 feet of the parent. Clifford (1953) reported that *E. globulus* is a species which does not require light for the mature seed to germinate. Under a Eucalyptus canopy, a 1% germination rate is good, given the more usual 0.1% germination success rate. It is difficult for blue gum seeds to germinate within a dense forest of parent trees. Not only does the presence of deep litter pose a germination problem, but there are also germination-inhibitive chemicals produced in the leaves of mature trees. If seeds do germinate, a thick duff layer may prevent adequate soil moisture conditions for radicle survival, and "it is known that eucalyptus litter tends to restrict the development of the roots of seedlings”. *Eucalyptus globulus* has a higher percent germination rate in open land and can scatter their seed while the capsules remain on the tree, or if the capsule falls to the ground intact, the seed will spill out in "little heaps" (Del Morarl and muller,1969).

2.16. Pollination

Eucalyptus flowers are mainly pollinated by insects, but birds and small mammals may also act as pollinating agents. There is no evidence that wind plays anything but a minor role in eucalyptus pollination.The flowers of eucalyptus are not highly specialized for insect pollination. The absence of specialization is reflected by the great variety of visiting insects, e.g., Coleoptera, Hymenoptera, Lepidoptera, Hemiptera, and Diptera of which the honey bee is usually regarded as the most important". When the cap covering the reproductive organs (the operculum) is shed, the anthers have mature pollen, but the stigma does not become receptive until some days later. This sequence impedes self-pollination of an individual flower (Bosch ,2007). .

2.17. Roots

The root system of *E. globulus* consists mostly of strong lateral roots. An abundant supply of moisture is demanded. Since the roots grow quickly towards water, *E. globulus* should never be planted near water pipes, irrigation ditches, sandy or gravelly soils. Large roots have been discovered at a depth of 45 feet below the surface, and surface roots frequently spread over 100 feet away from the trunk (munth, 1973).

2.2. Ecological aspects of Eucalyptus

2.21. Climate

There are effects of eucalyptus on micro-climate at the local level. These effects depend on the amount of leaf surface carried by the trees in relation to the surface area of the ground covered. The greater the leaf area and the more horizontal are the leaves, the greater the shading effect. In the shaded area, average air temperatures are lower, extremes of air and surface soil temperatures are reduced and there is a higher surface air humidity compared to areas with no trees. Eucalypts cast less shade, on average, than other broad leaved trees, but there are big differences in the amount of shade cast by different species because they have different leaf sizes and orientations (Bosch ,2007).

2.22. Hydrology

Runoff rate depends more on ground surface conditions, i.e., on slope, on soil porosity and moisture conditions of the soil and litter just before rain falls. Impervious and/or highly erodible soils will be washed away more easily than porous soils. One of the factors which can make soils under eucalyptus impervious is a non-wettable or water repellent property which is found in both natural stands in Australia (Burch *et al*. 1989) .Water repellent soils are abnormal soils which resist wetting by water , a behaviour which is caused by a hydrophobic coating of organic origin on the soil particles (De Bano 1981).

2.23. Soil Nutrients

When compared with a range of crops, the eucalyptus can achieve a high biomass production on a low nutrient uptake. The formation of ectomycorrhizae on the roots plays a major role in nutrient uptake in eucalypts (Grove et al. 1991).

2.24. Distribution of Eucalyptus

Ethiopia has lost the majority of its forest resources especially during the 20th century. This forest depletion, together with the sharply increasing human population, has resulted in a severe shortage of wood products especially fuel wood and construction wood. This also has stemmed from the very strong dependence on wood products by the society as there is poor infrastructural development in the country (Duguma et. al., 2009). One of the measures taken by the government to minimize the problem of scarcity of wood products was to introduce fast growing exotic tree species (e.g. Eucalyptus camaldulensis and Eucalyptus globulus) and establish fuel wood projects near urban and per-urban areas. It is within this scheme that Eucalyptus species were introduced into Ethiopia by the government and were distributed to the farmers for planting at farm borders (Zerfu, 2002).In northern Ethiopia, *Eucalyptus* is the most commonly grown tree species in community and household woodlots. This tree species grows well even on poor soils and grows faster compared to most indigenous tree species. Smallholders show a clear preference for *Eucalyptus* poles, which are useful for farm implements and constructing houses and fences .

The ongoing expansion of *Eucalyptus* plantations by farmers have been the focus of two major debates on the environmental impact and the economic role of the species. The former debate is related to soil acidification, nutrient depletion, allelopathic effect and excessive water utilization of the species. The later debate focuses on the importance of the species because of its fast growth, high biomass production (Kidanu et. al., 2004) and browsing resistance. In Ethiopia, where there are huge gaps between demand and supply of wood as a result of escalating deforestation, the use of fast growing species which produce large amount of biomass like *Eucalyptus* is inevitable. Nonetheless, though this genus is very important and promising, the associated environmental concerns such as impoverishment of soil fertility, aggressiveness to ground water and soil acidification are not yet quantified and evaluated from the sustainable utilization point of view based on Ethiopian specific site conditions (Zerfu, 2002).

2.3. Allelochemicals in eucalyptus

Both paper and gas chromatographic analysis showed the presence of phenolic acids as the major constituent of the leachates. The phenolic acids identified were coumaric, ferulic, gallic, hydroxybenzoic, syringic and vanillic acids, apart from catechol . Vaughan and Ord (1990) reported that most of the phenolics released from plant parts were benzoic and cinnamic acid derivatives. Jayakumar *et al.* (1990) identified the presence of chlorogenic, coumaric, caffeic and gallic acids from *E. globulus.* The presence of gentisic, ellagic, sinapic and caffeic acids, phenolic aglycons, glycosides and terpenoides from *E.baxteri* was also reported (Waller, 1987). Sivagurunathan *et al.* (1997) identified and quantified the phenolics viz., caffeic, coumaric, ferulic, gallic, gentisic, hydroxybenzoic, syringic and vanillicacids and catechol present in bark, freshleaves, litter, root and seed leachates of *E. citriodora, E.globulus* and *E.tereticornis,* at 0.02 mM and 2.45 mM concentrations. Most mature, undisturbed stands of *E. globulus* are virtually devoid of herbaceous annual species in the forest understory. This may be due to the inhibiting effects of Eucalyptus toxins present in the thick accumulation of Eucalyptus leaf litter underneath these stands. This assertion is supported by the fact that annual herbs gradually begin to appear and increase in height and density with increasing distance from the stand, in inverse correlation with the density of Eucalyptus leaf litter. However, there is also a small amount of herbs under mature trees which are well trimmed and cleared from litter periodically, suggesting that "while litter is an important source of toxins in some Eucalyptus species, it is not necessary to the development or maintenance of herb inhibition in the case of *E. globulus*". Del Moral and Muller (1969) also investigated the transfer of the Eucalyptus herb-inhibiting toxins to the soil by fog drip. The evidence presented in their report indicates that "natural fog drip from *E. globulus* inhibits the growth of annual grass seedlings in bioassays both on sponges and in soil and suggests that inhibition occurs under natural conditions." The fog drip is known to contain several physiologically active components in significant concentration, including P-consiaryfumic chlorogenic and gentisic acids. The authors conclude that in *Eucalyptus globulus* "toxin transfer by fog drip alone is capable of severely inhibiting the growth of annual herbs".

2.31. Toxicity of allelochemicals on germinaton and growth of plants

Whenever two or more plants occupy the same niche in nature, they compete with each other for various life support requirements (Caton *et al.,* 1999). Residues, exudates and leachates of many plants have been reported to effect the growth of the other plants, a wide range of injurious effect on crop growth has been reported as being due to phytotoxic decomposing products, release from leaves, stem, roots, fruit and seeds. Islam (2002) reported that plant produce chemicals which interfere with other plants and affect seed germination and seedling growth.

Allelopathic exudates from eucalyptus tree components showed an inhibiting effect on undergrowth vegetation regeneration and growth (Poor and Frfiies, 19 85).Eucalyptus can jeopardise the biological productivity, principally of arid regions due to allelopathic properties. It also has deleterious effect on other plant life, including crops, by restricting germination of other species, and is also detrimental to the soil micro and macro fauna (Lawbuary, 2006). Eucalyptus is toxic due to allelopathic properties, which serve to reduce not only other plant life, including crops, by restricting germination of other sspecies, but is also detrimental to the soil (Lawbuary, 2006).

2.32. Toxicity of allelochemicals on micro organisms

The addition of essential oil leaves in broth culture inoculated with S*taphylococcus* aureus and E*scherchia* coli inhibited the growth of micro organisms. The rate of inhibition was greater, on gram negative bacteria (E. coli) than that observed on gram positive bacterium (S. aureus). In most cases the size of inoculum and the concentration of essential oil leaves affected the growth/survival of the organisms. Some authors have reported that gram-negative micro-organisms are slightly more sensitive to essential oils when compared to gram-positive. The antibacterial activity of Eucalyptus extracts has been due to the components such as 1,8-cineole, citronellal, citronellol, citronellyl acetate, p-cymene, eucamalol, limonene, linalool, β- pinene, γ-terpinene, α- terpinol, alloocimene and aromadendrene (Bosch ,2007).

The efficacy of leaf oil of *E. globulus* against microorganisms may provide a scientific ground for the application of the herb in the prevention and treatment of bacterial infections caused by various pathogenic bacteria such as *Staphylococcus aureus* and *Escherichia coli*, which have developed resistance to antibiotics. The incorporation of this oil into the drug formulations is also recommended (Bosch ,2007).

2.33. Toxicity of allelochemicals on insects

Insects cause substantial losses to food grains, legumes, fiber crops and vegetables. Recently, they have developed resistance against chemical insecticides due to repeated use. Moreover synthetic insecticides have detrimental effects on environment and they are causing serious health and hygienic problems. Natural compounds have been identified as weapons against certain insect pests (Farooq *et al*., 2011).

2.4. Competition and Other Interactions with Flora and Fauna

Neither eucalyptus nor any other fast growing tree is able to create biomass without using soil moisture and nutrients. It has to be recognized that some eucalyptus in certain situations of relatively dry climates and nutrient-poor soils can be very competitive with other vegetation, including juveniles of the same eucalypust species. In a study in an *E. rossii* community and under other eucalyptus. Davidson (1993) found the association was maintained in a wood land form (open spaces between the tree canopies) because the eucalypts were very efficient in gathering nutrients from the soils in the open spaces and storing them in the litter and surface soils under the trees. Since annual rainfall was low and nutrients were inherently scarce in these sandy soils, this is a further example of another form of competition, analogous to allelopathy, evolved to ensure the survival of the eucalyptus in that locality. In the case of planted trees, the actual situation has to be examined on each individual site. What is a competitive weed in one place may be a saviour in another. The ability of a eucalyptus to survive harsh conditions and sprout rapidly from a cut stump without replanting may be advantageous for fuelwood production in chronically deficit areas, for control of landslips, or for wind breaks. Eucalyptus is tall plants and because of their faster growth, will tend to shade out native vegetation of the same age regenerating beneath them. Nearby crops can also be affected in this way, resulting in reduced yields. However, not all eucalypts cast shade which is heavy enough to discourage ground vegetation or understorey shrubs, and shading can be adjusted by varying the density of the trees. There are complex interactions between light and water requirements of different trees that make generalizations difficult (Mulugeta ,2014) .

2.41. Allelopathic effect of Eucalyptus on other plants

Watson (2000) stated that *Eucalyptus* leaf extracts have inhibited the germination of several plants. Therefore, *Eucalyptus* species caused drawbacks rather than improving the performance of the undergrowth vegetation unlike the mentioned multipurpose trees. One of the most important trees in the study area (Dupuy and Dreyfus, 1992).The allelopathic effects of *Eucalyptus* have been studied extensively by various workers for example; Del Moral & Muller, 1970; Willis, 1999; Sasikumar *et al.*, 2001; Bajwa & Naz, 2005; El-Khawas & Shehata, 2005 etc. It has been found that *Eucalyptus* species release volatile compounds such as benzoic, cinnamic and phenolic acids, which inhibit growth of crops and weeds growing near it (Sasikumar *et al*., 2001; Kohli *et al*., 1998). Phenolic acids and volatile oils released from the leaves, bark, and roots of certain *Eucalyptus* spp. have deleterious effects on other plant species (Sasikumar *et al.*, 2002; Florentine & Fox, 2003). According to studies made by Yamane *et al*., (1992) all the basic plant processes such as hormonal balance, protein synthesis, respiration, photosynthesis, chlorophyll formation, permeability and plant water relations may be disturbed by allelopathy. The continuous planting of *Eucalyptus* in monoculture may cause accumulation of allelochemicals in soil, which result in soil degradation and loss of productivity (El-Khawas &Shehata, 2005; Forrester *et al*., 2000).The negative impact of of eucalyptus species are destroying water bodies and plant species ,decreasing yield of cereals that are grown close to eucalyptus tree(Etay,2010).

2.42. Effects of eucalyptus on soil

From the soil macronutrients, total nitrogen percentages in the plow zone from 0 to 20 cm depth at all distances were in the very high range near the *Eucalyptus* stand. This might be due to its allelopathic effect, which opposes the mineral uptake by the plants and low mineralization. Bernhard-Reversat (1987) reported that mineralizable N, measured by 20 days averaged 11-14 mg N kg-1 soil under *Eucalyptus* and 40-50 mg N kg-1 soil under *Acacia* soils. Nevertheless, there was very highly significant difference between the values of sampling points. The value at 5 m was the least since the *Eucalyptus* root number was the highest. values increased at the point where the competition of the *Eucalyptus* trees decreased. The available phosphorus content calculated in the first 20 cm depth at different distances from *Eucalyptus* stand was in the very low range (< 5 mg kg-1 because the acidic soil fixed the phosphorus. Similar to other Ethiopian soils, we found that the exchangeable calcium and potassium were all in the high range (Ilaco, 1985). Dedecek et al. (2007) reported that *Eucalyptus* had a small effect on K level. In the Koga Watershed, there were environmentally friendly trees like *Acacia* species. Under the important overstory tree types, the understory density was superior to *Eucalyptus* species . Fabião et al. (2002) stated that *Eucalyptus* species were usually considered as having less understory vegetation than the other types of forest stands due to its competition and hydrophobic effects.

2.43. Toxicity of of *Eucalyptus globulus* on weed plants

Weed infestation in agricultural fields results in reduction of quality and quantity of crops and huge economic losses (Rassaeifar et al. 2013, Singh et al. 2005). There are several methods for weed control including mechanical, chemical and biological methods (Rassaeifar et al. 2013). However, the intensive use of chemical herbicides has resulted in development of herbicidal resistance amongst weed and negative impacts on the environment (such as groundwater contamination) and human health (Sodaeizadeh and Hosseini 2012, Verdeguer et al. 2009). To overcome these problems, efforts are being made to reduce the reliance on chemical herbicides (Singh et al., 2005) and to produce biological herbicides with environmental coexistence and desirable herbicidal action (Rassaeifar et al. 2013, Singh et al. 2003). In recent years, the use of allelopathic plants and their products as a sustainable management strategy for crop protection against weeds has been widely noticed (Singh et al. 2003, Sodaeizadeh and Hosseini 2012). Different plants have allelochemicals that could be used for suppressing weeds growth (Singh et al., 2003). Eucalyptus (Myrtaceae), a native to Australia, is one of the potential allelopathic plants having a number of allelochemicals (Ziaebrahimi et al., 2007) and its essential oils possess pesticidal activity (Batish et al., 2008). It has been shown that *Eucalyptus* species have strong allelopathic activity (Gliessman, 2007) and it has been attributed to the production of several volatile terpenes and phenolic acids (Djanaguiraman et al. 2005, Florentine and Fox 2003, Sasikumar et al. 2002, Setia et al., 2007). The phytotoxic effects of eucalyptus species have been evaluated against a number of weed species. For example, essential oil of *Eucalyptus camaldulensis* suppressed germination and seedling growth of *Amaranthus hybrid* and *Portulaca oleracea* (Verdeguer et al., 2009). The herbicidal activity of *Eucalyptus globulus* essential oil against *Amaranthus blitoides, Cynodon doctylon* (Rassaeifar et al., 2013), and *Parthenium hysterophorus* (Kohli et al., 1998), of *E. citriodora* against *Cassia occidentalis, Echinochloa crus-galli, Phalaris minor, Parthenium hysterophorus* and *Amaranthus virids* (Batish et al., 2004).

2.44. Effects of *Eucalyptus globulus* canopy on other plants

Hanil et al. (2008) stated that the undergrowth plants might show different patterns than the shade tree species because of different responses to light level, nutrient availability and temperature. Shaded crops such as coffee have shallower roots than the other fruit trees, and thus perform well (Lehmann, 2003). This is not true for *Eucalyptus* since local farmers tried and failed growing coffee under its shade. Parker and Brown (1999) explained that multiple canopy or more specifically, the continuous distribution of foliar surfaces from the top of the crown to the ground created greater quantities and diversity of animal habitat, which enhances the decomposition of organic matter. However, allelopathy affects important soil organisms and other plant species under the *Eucalyptus* shade. Watson (2000) stated *Eucalyptus* leaf extracts have inhibited the germination of several plants. Therefore, *Eucalyptus* species caused drawbacks rather than improving the performance of the undergrowth vegetation. As it was ensured experimentally, the maize plant performs poorly in its plant height and count up to 15 and 1 m distances respectively due to the impact of *Eucalyptus* species. *Eucalyptus* hedge row was also checked that it causes severe biomass and grain yield reductions up to 15 m from woodlots. The local farmers perceived that the common crop production is depressed by the adjacent *Eucalyptus* plantation although most farmers grew *Eucalyptus* species to be as similar as their neighbours did . *Eucalyptus* reduces seedling emergence and other parameters of maize (EI-Khawas and Shehata, 2005). The reductions from the controls were 18.7-171 cm, 11.8-33.3 ton.ha-1 and 4.9- 13.5 ton ha-1 in plant height, biomass and grain yield respectively. The most important parameter, the maize grain yield was greatly determined by light intensity that is important to get energy for whatever performances the crop does. Intercepted radiation by the crop plant relates to seed yield (Ayele et al. 2007). Kotowskil et al. (2000) reported that light availability and intensity had a large effect on most plant, species biomass production even than water level. Therefore, the plant species such as maize crop, planted to the *Eucalyptus* proximity in the west direction is more seriously affected due to light shortage. In addition, *Eucalyptus* trees affected the maize plant performance by reducing available p even if the strength of belowground competition can be decreased with fertilization (James , 1999).

2.5. Medicinal value of *Eucalyptus globulus*

The medicinal plants play a crucial role in world health and that is why they have been regarded as one of the primarily used agents since the age of the treatment and prevention of a number of diseases. *Eucalyptus globulus* is a rich source of phytochemical constituents which contain flavonoids, alkaloids, tannins and propanoids, which are present in the leaf, stem and root of the plant. Numerous studies have shown that *Eucalyptus globulus* exhibit various properties like anti-inflammatory, anticancer, antibacterial, antiseptic and astringent. The present review articles critically discusses about various phytochemicals associated with the plant along with numerous pharmacological properties exhibited by the plant(James , 1999). .

2.6. Agroforestry

Agroforestry, which involves combining woody plants with annual or perennial crops, increases the biophysical and socio-economic productivity of an agricultural enterprise (Bentlay, 1985). However, farmers have voiced concern about the harmful effects of trees on cultivated lands and standing crops.Baker (1987) reported that Eucalyptus *globulus* produces volatile materials that inhibit the root and hypocotyls growth of cucumber seedlings. A similar lack of herbaceous species under *E. globulus* and *E. camaldulensis* due to their allelopathic effects was also reported by del Moral and Muller (1969). *E.microtheca* compared to *Casuarina cunninghamiana* was reported to posses a poor understorey due to allelopathic effects in central Iraq (Al-Mousawi and Al-Naib, 1976). Although *Eucalyptus* is potential industrial crop it is not being recommended as an intercrop in agroforestry systems (Bansal, 1988; Suresh and Rai, 1987). The release of phenolic compounds adversely affects the germination and growth of plants through their interference in energy metabolism, cell division, mineral uptake and biosynthetic processes (Rice, 1984). Leachates from stemflow and litterfall are responsible for such an effect (Molina *et al.*, 1991). The rains result in periodical release and accumulation of allelo-chemicals in plantations**.**

2.7. Botanical Description of *Eragrostis teff*

Scientific classification

Kingdom:	Plantae
Order:	Poales
Family:	Poaceae
Subfamily:	Chloridoideae
Genus:	*Eragrostis*
Species:	*Teff*
Binomial name	***Eragrostis teff***

Eragrostis tef, teff,(Amharic: **ጤፍ**? *ṭēff*; Tigrinya: **ጣፍ** (*ṭaff*), or **xaafii** (Oromo), is an annual grass and a species of love grass native to Ethiopia.The word "teff" is connected by folk etymology to the Ethio-Semitic root "ṭeffa", which means "lost" (because of the small size of the grain) (Molina *et al*, 1991) .

2.71. Distribution

Eragrostis teff is adapted to environments ranging from drought stress to water logged soil conditions. Maximum teff production occurs at altitudes of 1,800 to 2,100 m, growing season rainfall of 450 to 550 mm, and a temperature range of 10 to 27 °C. Teff is daylight sensitive and flowers best with 12 hours of daylight. Teff is an important food grain in Ethiopia and Eritrea, where it is used to make injera or keyta, and less so in India and Australia (Belay, 2006).

2.72. History

Between 8000 and 5000 BC, the people of the Ethiopian highlands were among the first to domesticate plants and animals for food and teff was one of the earliest plants domesticated Teff is believed to have originated in Ethiopia and Eritrea between 4000 BC and 1000 BC. Genetic evidence points to *E. pilosa* as the most likely wild ancestor. A 19th century identification of teff seeds from an ancient Egyptian site is now considered doubtful; the seeds in question (no longer available for study) are more likely of *E. aegyptiaca*, a common wild grass (Belay, 2006).

2.73. Teff and Diabetes Prevention

The other health related benefit of teff is the high fiber content of the grain. This is particularly important in dealing with diabetes and assisting with blood sugar control. Related to its small size, the grain cannot be separated into germ, bran and endosperm to create a variety of other products. Although this creates some disadvantages for the grain, it allows teff to yield much higher fiber content than other grains (Guttman, 2002).

One of the researchers in Israel Guttman, noted in 2002, "Early detection and effective management of diabetes in the Israeli Ethiopian community require in-depth appreciation of its beliefs. Recent findings indicate that within a decade, this population acquired a relatively high prevalence of diabetes (10 to 17%), which was literally unknown to it prior to immigration"and went on to say that many of the immigrants, including those with diabetes, do not know much about the disease and its management. In achieving blood glucose control among the Ethiopian immigrant population in Seattle understanding the content and variety of grains used locally to make ingera is critical.

2.74. Morphology and Floral Biology

Teff is a warm season annual grass, characterized by a large crown and shallow diverse root system. Teff germplasm is characterized by a wide variation of morphological and agronomic traits. Plant height varies from 25–135 cm, panicle length 11–63 cm, with spikelets numbers per panicle varying from 190–1410. Panicle types vary from loose, lax, compact, multiple branching multi-lateral and unilateral loose to compact forms. Maturity varies from 93–130 days. Grain color ranges from pale white to ivory white and from very light tan to deep brown to reddish brown purple. Teff seed is very small, ranging from 1–1.7mm long and 0.6–

1mm diameter with l000 seed weight averaging 0.3–0.4 grams. Grain and straw yieldrepresented the maximum genetic diversity among the observed teff germplasm (Ketema ,1997).

2.75. Ecology

Teff is adapted to environments ranging from drought stress to water logged soil conditions. Maximum teff production occurs at altitudes of 1800–2100 mm andgrowing season rainfall of 450–550 mm, with a temperature range of 10–27°C. Teff is day length sensitive and flowers best during 12 hours of daylight (Belay, 2006).

2.76. Crop Culture (Agronomy)

Teff can be planted in late May similar to millets. Late plantings have the advantage to control emerged weeds by tillage prior to planting, which can be significant since teff is a poor competitor with weeds during the early growth stages. Seedbed should be firm and prepared similar to planting for alfalfa. Seeding rates are 4.5 to 9.0 kg/ha using implements such as cultipackers or Brillion seeders (Twidwell et al., 1991). Teff should be seeded 12–15 mm deep either broadcast or in narrow rows. Teff germinates rapidly, and the broadcast and narrow row seeding allow for stronger weed competition. Control of broadleaf weeds should be considered, particularly *Amaranthus retroflexus*, which produces seed that cannot be separated from teff. Soil particles must be prevented from going through the combine and into the grain hopper, since it is very difficult if not impossible to separate fine soil particles from the teff grain.

2.77. Economic value of teff

There is a growing global demand for teff, and other countries are capitalizing on this through the international trade of teff. Many countries around the world have begun to produce and export. The biggest international sellers of teff include: Canada, China, India ,Netherlands, South Africa, United Kingdom, and the United States (FAO, 2013). While Ethiopia is the world’s largest producer of teff by volume, because of the export ban, it cannot currently benefit from this trade by exporting its indigenous crop.The ability to export teff could increase smallholder famers’ incomes as well as stimulate Ethiopian’s agricultural development. In addition, involvement of international players in the teff market could serve to accelerate the development of what is now a relatively immature market. Domestic issues of teff's low yields and lack of significant value-added product development could be improved significantly (Demeke , et al, 2013). Ethiopian smallholder farmers are constrained from the benefits of the ever increasing demand of the international teff market; however, the current teff export policy allows for international export of processed teff, largely in the form of ready-to-eat teff *injer*a. According to Bekabil, et al., (2011), this oversight in the policy is intended to drive value-addition of teff products in Ethiopia. However, while the export of *injera* is increasing, it remains limited. For example, in 2011, the export volume for *injera* for Ethiopia was 1,800 metric tons (Bekabil et. al., 2011). This is 0.21% of the overall national teff market production (which is roughly 3.5 million tons) and represents only 56 million Ethiopian birr (which is roughly 3.1 million USD) of export revenue (Bekabil, et al., 2011).Because teff has the highest market value among the cereals grown in Ethiopia, teff is also a source of cash income to the Ethiopian small farm households. Teff grain prices have increased annually by 12% from 2008 to 2010 (Bekabil, et al., 2011). This increased demand for teff is driven by domestic consumer preference for teff, population growth and international demand. The benefits that teff market suppliers reap from this price trend are a strong indication of the great economic potential of the international teff trade. If teff is traded internationally, global demand for teff will raise prices further and incentivize production increases, which will directly drive domestic economic growth (Rashid and Negassa, 2011).

2.8. Botanical description of chickpea (shimbra)

Scientific name:

Cicer arietinum L.

Common name:

chickpea (English); shimbra (Amharic); (Tadesse ,2010).

. Taxonomy

Kingdome; plantae
Equisetopsida
Order: Fabales
Family: Leguminosae/Fabaceae - Papilionoideae
Genus: *Cicer*

2.81. Geography and distribution

Cicer arietinum is not known as a wild plant but is believed to have originated in the central part of the Fertile Crescent (in modern Turkey, Syria and Iran).Evidence suggests that *C. reticulatum* (sometimes treated as *C. arietinum* subspecies *reticulatum*) from south eastern Turkey might be the wild progenitor of the domesticated plant. Chickpea is cultivated in tropical, subtropical and warm temperate zones, including the Mediterranean, the Canary Islands, western and central Asia and northeastern tropical Africa, including Madagascar. It is grown up to 2,500 m above sea level.It is not suited to the humid and hot lowland tropics where it fails to flower (Tadesse ,2010).

2.82. Description

Roots: Extensive root system. Roots bearing nodules containing nitrogen-fixing bacteria (including *Mesorhizobium ciceri* and *M. mediterraneum*).

Leaves: Divided into 5–7 pairs of leaflets. Leaflets up to 16 mm long and 14 mm wide with toothed margins and weak, spreading, glandular hairs. Triangular stipules (leaf-like appendages) are borne at the leaf base.

Flowers: Typical pea flowers, up to 12 mm long, borne singly, with white or lilac to violet petals.

Fruits: A small, inflated and rounded pod, up to 3 cm long and 1.5 cm wide, with glandular hairs.

Seeds: Roughly spherical, with smooth or rough surface, up to 14 mm in diameter. Variable in colour, usually creamy-whitish when dried. One or two seeds per pod.Many cultivars of chickpea have been described. There are two main groups in cultivation:

- Desi (microsperma) cultivars – producing small, angular seeds with rough, yellow-brown coats. The desi forms predominate in the Indian subcontinent, Ethiopia, Mexico and Iran. They are often used for split peas or flour after the hulls are removed.
- Kabuli (macrosperma) cultivars - producing relatively large, plump seeds with a smooth, cream-coloured coat.

2.83. Uses

Food

Chickpea is a major pulse crop with world production of well over 9 million tonnes. India is the world's main producer and consumer of chickpea. Other major producers include Turkey, Pakistan and Iran. It is also a significant export crop in Australia, New Zealand and Canada. The earliest remains of chickpea seed have been found in Syria & Turkey and date back to around 7,000 BC. Chickpea was gradually introduced to the western Mediterranean region and Asia and had reached India by 2,000 BC.

Chickpea seeds are an excellent source of protein and contain a wide range of amino acids. They are high in fibre, low in fat and contain phosphorus, calcium and iron.Immature seeds are consumed fresh, boiled or roasted and salted as snacks. Canned chickpea seeds are popular in the United States and Europe. In the Indian subcontinent, most chickpeas are processed into flour (Bengal gram, besan flour) for cooking bhajis, pakoras and breads. Chickpea flour can also be used to make gluten-free cakes (Cannarozi et al.,2007)

2.84.Traditional medicine

Glandular secretions of the leaves, stems and pods of chickpea include malic and oxalic acids. These sour-tasting acid exudates can be applied medicinally or used as vinegar. In India these acids used to be harvested by spreading thin muslin over the crop during the night. In the morning the soaked cloth was wrung out and the liquid collected in bottles.

Chickpea acid exudates have been used to treat bronchitis, cholera, constipation, diarrhoea, dyspepsia, flatulence, snakebite, sunstroke and warts. They have also been used as an aphrodisiac and to lower blood cholesterol levels. Germinated chickpea has been reported to be effective in controlling cholesterol level in rats.In Chile, a cooked chickpea-milk mixture has been fed to infants, effectively controlling diarrhoea. Chickpea seeds are considered to be anti-bilious (to combat nausea, abdominal discomfort, headache, constipation and gas caused by an excessive secretion of bile) (Cannarozi et al.,2007).

Other uses

Chickpeas can be used to make an adhesive that is suitable for plywood, although it is not water-resistant.Chickpea yields starch suitable for textile sizing and gives a light finish to silk, wool and cotton cloth. Chickpea leaves are said to yield an indigo-like dye. Chickpea is a major protein source for poor communities in many parts of the semi-arid tropical areas of Africa and Asia(Cannarozi et al.,2007)

2.8.5. **Economic value of chickpea**

Chickpea is one of the main annual crops in Ethiopia both in terms of its share of the total cropped area and its role in direct human consumption. Improvement in productivity and subsequent effective marketing of chickpea can be a major milestone in the fight against poverty in the country (Shiferaw , 2012). It is one of the main annual crops in Ethiopia both in terms of its share of the total cropped pulse area and its role in direct human consumption. The crop provides an important source of food and nutritional security for the rural poor, especially those who cannot produce or cannot afford costly livestock products as source of essential proteins. The consumption of chickpea is also increasing among the urban population mainly because of the growing recognition of its health benefits and affordable source of proteins. In the export market, chickpea contributes a significant portion of the total value of pulse exports. For example, chickpea constituted about 48% of the pulse export volumes in 2002. During this period of time, the exported volume accounts about 27% of the total quantity of chickpea production while the balance remains for domestic market (Shiferaw et al., 2007). Two types of chickpea, Kabuli and Desi, are currently under production in Ethiopia. Kabuli or garbanzo type is usually large seeded with seed size ranging from 6-8 mm and smooth cream white seed coat color. The production of Kabuli types is currently limited to few pockets, primarily in Eastern Shewa region where access toimproved varieties has been promoted through better linkages with the research and extension system. Desi type chickpea, traditionally widely grown in the country, is small seeded with seed size 3 - 6 mm, hard and reddish-brown colored seed coat.

3. MATERIAL AND METHODS

3.1. Description of the study area

The study was conducted in South Gonder Dera Woreda Arib Gebeya town in Aferwanat secondary and preparatory school. Dera is one of the woredas in the Amhara Region of Ethiopia. Part of the Debub Gondar Zone, Dera is bordered on the south by the Abbay River which separates it from the Mirab Gojjam Zone, on the west by Lake Tana, on the north by Fogera, on the northeast by Misraq Este, and on the east by Mirab Este. Towns in Dera include Amba Same, Arb Gebeya, Hamusit, and Qorata.

The Woreda consisting of Dega and Woinadega agro-climatic zones which encompasses 224.586 km2 (15%) and 1272.654 km2 (85%) respectively. The average annual rainfall and temperature is 1250 mm and 19 °C respectively. Agriculture is the major economic activity which is characterized by rain-fed and predominantly subsistence nature. Both crops and livestock productions are equally important at Dega and Woinadega agro-ecological zones of the area. The main soil types are Nitosols, Vertisols, Gleysols, Luvisols and Cambisols. The dominant vegetation type includes: *Eucalyptus* species, *Croton macrostachyus*, *Juniperus procera, Cordia africana* and *Ficus vasta*. A survey of the land in this woreda shows that 46% is arable or cultivable, 6% pasture, 1% forest or shrubland, 25% covered with water and the remaining 25.9% is considered degraded or other. Teff, corn, sorghum, cotton ,chickpea and sesame are important cash crops (Agricultural office of Dera woreda ,2014).

3.2. Extract preparation

The leaves were collected from trees of *Eucalyptus globulus* in Arib gebeya town which is found in high distribution. The aqueous leaf extracts were prepared by 400 g fresh leaves by 2 litre of tap water using the same sized container. Each container were chopped and shaken and kept at room temperature.The extract was decanted into container and used to water the treatments (Dawit, 2014).

3.3. Experimental setup

The laboratory was held in the laboratory room which can get enough light for seedling grwth . The petridishes were steralized and arranged in row and the field experiment was carried on open field and the pots were arranged in row.The soil for field experiment was taken from the loam surface soil , animal dung and sand from the river.

3.4. Data collection procedures

During germination and growth of crop plants in experimental and control group data was taken by observing on the number of germinating seeds in each growth chamber (peridish) that how many seeds are germinating in each Petridish , by measuring shoot length , the root (radicle) length,by calculating vigor index , seedling height reduction ,geiminaion percentage and mean germinating time. Mean germinating time was calculated after germinating seeds were counted from beginning of the day of germinating time until 15 days for both *Cicer arietinum* and *Eragrostis teff* during laboratory room experiment and until 48 days during field conditions. But other parameters were measured during laboratory experiments after 15 days and during the field experiment the parameters were measured after 48 days (Tilahun ,2003) .

3.5. Data analysis Techniques

Data were analyzed using SAS software version 9.13. Differences among treatment means were assessed by one way ANOVA and Significant differences among means were found through fisher's LSD (least significant difference) test at $p < 0.05$.

3.6. Seed Material

Teff and chickpea seed were obtained from Amhara seed enterptrise. The variety of the teff was quncho ,category $c_{1,}$purity 96%,germination percentage 94 and its'moisture content is 11%.The variety of chickpea was Arerity,category c_1,purity 98%,germination percent 98% and its moisture content was 12 % according to the information gained from Amhara seed enterprise.

3.7. Experimental Design

Physiological parameters such as mean germinating time ,shoot length ,root length ,number of germinated seeds were measured during laboratory and field experiment. The experiment was carried in laboratory room and field. In the laboratory for germination of *Eragrostis teff* 20 petridishes in which each petridishes had 14 cm size in diameter were used and whatman filterpaper number 1 was also used in the experiment . All ptridishes were labelled with different amount of aqueous *Eucalyptus globulus* leaf extractions (0 %,10 %,20%,30%,40%).

Laboratory experiment of *Cicer arietinum* was also carried using 20 petridishes which were labelled with different amount of aqueous *Eucalyptus globulus* leaf extractions (0 %, 10 %,20%,30%,40%).Each treatment had 4 replications . In each petridishes 7 seeds were sowed for both. *Cicer arietinum* and *Eragrostis teff* during laboratory room and field conditions. Mean germinating time was calculated as $MGT = \sum(d \times n)\backslash\sum n$ where, n=number of seeds which were germinating at day d and d= number of day counted from the beginning of germination (kandil, 2012).

Total germination percentage (GP) is used to determine the number of seed germinated out of a population of seeds. It was also the estimate of the viability of number of seeds from a population of seeds (Amare,2013).Germination percentage was calculated as (number of germinated seed/total number of seed tested) x 100 (kandil *et al*.,2012).

Vigor index is the ability of crops to survive under extracts of *E.globulus* and calculated as (Average shoot length +Average root length) x germination percentage (Kandil et al.,2012). Seedling height reduction (SHR) was calculated as a plant height at control─a plant height at stress / plant height at control) x 100 (Islam and Karim,2010).

During field experiments 40 equally sized plastic pots were used for both chickpea (shimbra) and teff growth. Each pot was 40 cm height and 30 cm in diameter and labelled with different *Eucalyptus globulus* leaf extractions (0 %,10%,20%,30%,40%) .The soil used in field experiment consists surface loam soil ,sand and dung in 3:2:1 ratio respectively. Each treatment contain 4 replications. The pots were placed in row and watered every day after 24 our. The parameters studied in field experiment includes the number of germinating seed ,mean germinating time ,shoot length, root length, seedling height reduction ,vigor index and germination percentage

4. RESULT AND DISCUSSION

4.1.Effects of Eucalyptus globulus aqueous leaf extract on the parameters of laboratory experiment of chickpea

As shown in table 4.1, number of seeds which were treated by 10 %, 20%, 30 % *Eucalyptus globulus* aqueous leaf extraction were not significantly affected. But, seeds which were treated by 40 % of *Eucalyptus globulus* aqueous leaf extraction were significantly affected by toxicity of *Eucalyptus globulus* at $p < 0.05$.The highest number of germinating seed belonged to the control group, treatment 2,treatment 3. The lowest number of germinating chickpea seeds were in treatment 5 which was treated by 40 % of *Eucalyptus globulus* aqueous leaf extraction Mean germinating time of chickpea seeds were also measured during laboratory experiment. Seeds which were treated by 10 %,20%,30 % of *Eucalyptus globulus* aqueous leaf extractions (Appendix 1) were not significantly affected by toxicity of *Eucalyptus globulus* aqueous leaf extraction at $p < 0.05$.The lowest mean germinating time were belonged to treatment 2,3 and 4 which were treated by 10 %,20%,30 % of *Eucalyptus globulus* aqueous leaf extraction respectively and the highest mean germinating time was belonged to treatment 5 which was treated by 40 % of *Eucalyptus globulus* aqueous leaf extractin. So *Eucalyptus globulus* aqueous leaf extraction at high concentration was toxic because it delayed germination time of chickpea. These result was in line with Woldeamlak (2010) Who reported that *Eucalyptus globules* was toxic to under story plants. .

Shoot length of chickpea was significantly affected at 10 %,20%,30 % and 40 % of *Eucalyptus globulus* aqueous leaf extraction at $p< 0.05$. The highest mean shoot length belongs to the control group which was treated by water and the lowest mean shoot length belonged to treatment 5 which was treated by 40 % of *Eucalyptus globulus* aqueous leaf extraction. This was evidence which showed the inhibitory effect of *Eucalyptus globulus* aqueous leaf extraction. This could be because *Eucalyptus globulus* contain allelochemicals which had inhibitory effect on shoot growth of chickpea. Generally *Eucalyptus globulus* aqueous leaf extraction had toxicity effect on shot length of chickpea. This could be because the allelochemicals which may inhibit cell division. Root length of chickpea which was treated by 10 % *Eucalyptus globulus* aqueous leaf extraction were not significantly affected by toxicity effect of *Eucalyptus globulus* .

These result was in line with Zewdu (2010) Who reported that *Eucalyptus globulus* had allelochemicals which inhibit understory plant growth. .But root length of chickpea that was treated by 20% , 30 % , 40% *Eucalyptus globulus* aqueous leaf extracttion were significantly affected by toxicity effect of *Eucalyptus globulus* at $p < 0.05$ .The highest toxicity or inhibitory effect belonged to treatments 3 ,4 and 5 which were treated by 20 ,30 and 40 % of *Eucalyptus globulus* aqueous leaf extraction. The lowest inhibitory effect on root length of chickpea during laboratory room experiment belonged to treatment 2 which was treated with 10 % of *Eucalyptus globulus* aqueous leaf extraction .This showed that increased *Eucalyptus globulus* aqueous leaf extraction resulted high inhibitory effect on root length of chickpea during laboratory experiment .That means root length decreased as *Eucalyptus globulus* aqueous leaf extraction increasd .

Percentage of seedling height reduction (SHR) can be used to measure the phytotoxicity of the allelopathic plant on shoot growth. The seedling height reduction (SHR) of the two crops was calculated by using mean raw data.The increase in the percentage of seedling height reduction showed the rise in inhibitory effect of the leaf extraction of *Eucalyptus globulus*. There were significant difference of seedling height reduction between all treatments of laboratory experiment of chickpea .That means the growth of chickpea under laboratory was significantly affected by toxicity of *Eucalyptus globulus* aqueous leaf extraction. Except the control group which was treated by tap water other treatments' were adversely affected by toxicity of *Eucalyptus globulus* at $p <0.05$.

Vigor index is the ability of crops to survive under stressed condition. In this case it is the ability of crop plants to survive under different amount of *Eucalyptus globulus* aqueous leaf extraction. So it was used to know whether *Eucalyptus globulus* had toxicity effect on the two plants. Vigor index of treatment 2 and 3 which were treated with 10 % and 20 % of *Eucalyptus globulus* aqueous leaf extraction were not significantly different from each other. But, other treatments were significantly different from each other. So, the ability of chickpea crops under *Eucalyptus globulus* aqueous leaf extraction was less than chickpea crops under the control group. The highest vigor index belonged to the control group and the lowest vigor index was belonged to treatment 5 which was treated with 40% of *Eucalyptus globulus* aqueous leaf extraction. The high germination percentage has been decreased by increasing concentration of *Eucalyptus globulus* aqueous leaf extraction. The higher *Eucalyptus globulus* aqueous leaf extraction the less germination percentage will be.

This showed that *Eucalyptus globulus* aqueous leaf extraction had allelopathic effect on germination of chickpea. Germination percentage of treatment treatment 2 and treatment 3 which were treated by 10 % and 20 % of *Eucalyptus globulus* aqueous leaf extraction were not significantly different from each other. That means there was no significant toxicity effect on the viability of number of seed in these treatments. But , treatment 4 and 5 which were treated by 30 % and 40 % of *E.globulus* aqueous leaf extraction were significantly different from each other and from the other treatments. So , the viability of number of seeds (number of germinated seed) were significantly affected by *Eucalyptus globulus* aqueous leaf extraciont. This result was in line with Amare (2013) who reported as the leaf extract of *Eucalyptus globulus* was toxic on the germination of three Ethiopian crop plants (Barley ,Wheat, maize).

Table 4.1- Effects of *Eucalyptus globulus* aqueous leaf extract on the parameters of laboratory experiment of chickpea

Treatment	*E.globulus* aqueous extract	NGS	MGT	SL	RL	SHR	VI	GP
1	0%	7^{A}	3^{B}	24.09^{A}	6.51^{A}	0^{A}	2886^{A}	100^{A}
2	10%	7^{A}	3^{B}	16.24^{B}	4.77^{A}	32.00^{B}	1977.88^{B}	100^{A}
3	20%	7^{A}	3^{B}	11.34C	3.53^{C}	52.79^{C}	13377^{B}	100^{A}
4	30%	6.5^{A}	3^{B}	7.28^{D}	2.42^{C}	68.9^{D}	1134.5^{C}	92.85^{A}
5	40%	4.75^{B}	3.75^{A}	2.95E	0.42^{C}	87.6^{E}	249.3^{D}	67.62^{B}
Df	4	4	4	4	4	4	4	4
List significant difference	-	1.08	0.27	1.66	3.86	5.982	612.45	15.46

Means with the same letters are not significantly different from each other with column at $p < 0.05$

KEY- NGS=Number of germinating seed ,MGT=Mean germinating time,SL=Shoot length,RL=Shoot length ,RL=Root lkengh,SHR=Seedliung height reduction,VI=Vigor index, GP=germination percentage

4.2.Effects of *Eucalyptus globulus* aqueous leaf extract on the parameters of field experiment of chickpea

As shown in table 4.2 there were no significant difference of number of germinated seed in all treatments (all seeds were germinated in all treatments which were treated by tap water and *Eucalyptus globulus* aqueous leaf extraction).So, there was no significant effect of toxicity effect of *Eucalyptus globulus* aqueous leaf extraction on number of germination of chickpea during field experiment of chickpea at $p < 0.05$ (Appendix 2).

During field experiment of chickpea there were no significant difference in mean germinating time of seeds between treatment 3 and 4 .Except treatment 2 which was treated by 10 % of *Eucalyptus globulus* aqueous leaf extraction other treatments were significantly affected by toxicity effect of *Eucalyptus globulus* aqueous leaf extracton. The highest Mean germinating time belonged to treatment 5 which was treated by 40% of *Eucalyptus globulus* aqueous leaf extraction and the lowest Mean germinating time belonged to the control group and treatment 2, which was treated by 10 % of *Eucalyptus globulus* aqueous leaf extraction. Generally , *Eucalyptus globulus* aqueous leaf extraction delayed germination time of chickpea crops during field experiment.

Except the control group shoot length of seedling plants of chickpea were significantly affected by toxicity effect of *Eucalyptus globulus* aqueous leaf extraction during field experiment at $p < 0.05$. Root length of each treatment was significantly different from each other. As amount of *Eucalyptus globulus* aqueous leaf extraction increased the shoot length of chickpea plant was decreased. This showed that *Eucalyptus globulus* toxic for the growth of chickpea plant during field experiment. The highest root length was belonged to the control group and and the lowest root length was belonged to treatment 5 which was treated by 40% of *Eucalyptus globulus* aqueous leaf extraction. This served as evidence for toxicity of *Eucalyptus globulus* on root growth of chickpea during field experiment .The highest shoot length was belonged to the control group and the lowest shoot length was belonged to treatment 5 which was treated by 40% of *Eucalyptus globulus* aqueous leaf extraction. This ensured that *Eucalyptus globulus* inhibited the shoot growth of chickpea.

Percentage of seedling height reduction (SHR) can be also used to measure the phytotoxicity of the allelopathic plant on shoot growth during field experiment of chickpea (Etay Gttet,2010). The seedling height reduction (SHR) of the two crops was calculated by using mean raw data.The increase in the percentage of seedling height reduction showed the rise in inhibitory effect of the leaf extract of *Eucalyptus globulus*. Seedling height reduction (SHR) increased As amount of *Eucalyptus globulus* aqueous leaf extract increased. There was no significant difference between Seedling height reduction of treatment 3 and 4 which were treated with 20 % and 30 % of *Eucalyptus globulus* aqueous leaf extraction respectively .But there was no seedling height reduction in control group. These showed toxicity effect of *Eucalyptus globulus* on the growth of chickpea plants.

Vigor index (VI) in field experiment of chickpea was decreased because the toxicity of *Eucalyptus globulus* increased as its' extraction amount increased. So, the ability of chickpea survive under this stress condition decreased because of toxicity effect of *Eucalyptus globulus*. The highest Vigor index (VI) was belonged to the control group and the lowest Vigor index (VI) was belonged to treatment 5 which was treated with 40 % of *Eucalyptus globulus* aqueous leaf extraction. This showed that increased *Eucalyptus globulus* aqueous leaf extraction decreased the ability of the survival of chickpea plants under this stressed conditions. Generally , *Eucalyptus globulus* aqueous leaf extraction had inhibitory effect on Vigor index (VI) of chickpea seedlings during field experiment of chickpea .Total germination percentage(GP) is used to determine number of seed germinated out of a population of seed. It also estimate of the viability of number of seeds from a population of seed (Amare,2013). Germination percentage (GP) of chickpea was not significantly different between treatment 1(control group) ,2,3,4 which were treated with 0% ,10 % ,20 % ,30 % of *Eucalyptus globulus* aqueous leaf extraction respectively .But , treatment 5 which was treated by 40 % of *Eucalyptus globulus* aqueous leaf extraction was significantly affected than the other treatment. This showed less viability of seed because of increased toxicity effect of *Eucalyptus globulus*.

The highest germination percentage(GP)was belonged to the control group ,treatment 2 ,3 and 4 and the lowest germination percentage(GP) was belonged to treatment 5 was treated by 40 % of *Eucalyptus globulus* aqueous leaf extraction. This showed that increased amount of *Eucalyptus globulus* aqueous leaf extraction decrease germination percentage(GP) of chickpea during field experiment. These results were in with (Etay Gttet,2010) who reported that *Eucalyptus globulus* was toxic to plant biodiversity.

Table 4.2- Effects of Eucalyptus globulus aqueous leaf extract on the parameters of field experiment of chickpea

Treatment	*E.globulus* aqueous extract	NGS	MGT	SL	RL	SHR	VI	GP
1	0%	7^{A}	3^{C}	26.5^{A}	4.75^{A}	0^{D}	3125^{A}	100^{B}
2	10%	7^{A}	3.12^{C}	19.25^{B}	4.12^{B}	25.96^{C}	2337.5^{B}	100^{B}
3	20%	7^{A}	4.5^{B}	12.25^{C}	3.75^{B}	53.36^{B}	1600^{C}	100^{B}
4	30%	7^{A}	4^{B}	12^{C}	3.25^{C}	53.42^{B}	1537.5^{C}	100^{B}
5	40%	7^{A}	4.87^{A}	9.5^{D}	3^{C}	70.93^{A}	1164.1^{D}	92^{A}
Df	4	4	4	4	4	4	4	4
List significant difference		0	0.29	2.11	0.46	11.08	247.64	5.607

Means with the same letters are not significantly different from each other with column at $p < 0.05$

KEY- NGS=Number of germinating seed ,MGT=Mean germinating time,SL=Shoot length,RL=Shoot length ,RL=Root lkengh,SHR=Seedliung height reduction,VI=Vigor index, GP=germination percentage

4.3. Effects of Eucalyptus globulus aqueous leaf extract on the parameters of laboratory experiment of teff

As shown in table 4.3 there were no significant difference between number of germinating seeds in treatment 2 ,3 and treatment 4 which were treated with 10 % ,20% ,30 % *Eucalyptus globulus* aqueous leaf extraction. But, treatment 5 which was treated with 40 % of *Eucalyptus globulus* aqueous leaf extract was significantly affected by toxicity effect of *Eucalyptus globulus*. The highest number of germinating seed was found in control group and the lowest number of germinating seed was found in treatment 5 which was treated by 40 % of *Eucalyptus globulus* aqueous leaf extraction. This showed that increased *Eucalyptus globulus* aqueous leaf extract had inhibitory effect on germination of teff during laboratory experiment. Mean germinating time was also used to describes the time duration or number of days required for a seed to germinate during laboratory room experiment of teff. Mean germinating time of laboratory experiment of teff was significantly affected by toxicity effect of *Eucalyptus globulus* aqueous leaf extraction.There were no significant differences between treatment 2,3 and 4 which were treated with 10 % ,20% ,30 % of *Eucalyptus globulus* aqueous leaf extraction .Treatment 5 which was treated with 40 % of *Eucalyptus globulus* aqueous leaf extract was significantly affected by toxicity effect of *Eucalyptus globulus* than the other treatments at $p < 0.05$. Generally, *Eucalyptus globulus* aqueous leaf extraction delayed germination time of teff during laboratory room experiment. Shoot length of laboratory experiment of teff was also affected by *Eucalyptus globulus* aqueous leaf extract .There were no significant difference between treatment 3 and 4 which were treated with 20 % and 40 % of *Eucalyptus globulus* aqueous leaf extraction. Because toxicity of *Eucalyptus globulus* germinating time of teff delayed as the amount of extracttion increased at $p < 0.05$. The highest Shoot length belonged to the control group and the lowest shoot length was found in treatment 5 which was treated with 40 % of *Eucalyptus globulus* aqueous leaf extraction. This proved that toxicity of *Eucalyptus globulus* extraction shoot growth of teff.

Root length of teff during laboratory experiment was significantly affected by the toxicity effect of *Eucalyptus globulus.* There were no significant difference between treatment 3 ,4 and 5 which were treated with 20% ,30 % and 40 % of *Eucalyptus globulus* aqueous leaf extraction and they were significantly affected by *Eucalyptus globulus* aqueous leaf extraction. Treatment 2 which was treated with 10 % of *Eucalyptus globulus* aqueous leaf extraction was also affected by *Eucalyptus globulus* extraction.

Percentage of seedling height reduction (SHR) can also be used to measure the phytotoxicity of the allelopathic plant on shoot growth. The seedling height reduction (SHR) of the two crops was calculated by using mean raw data.The increase in the percentage of seedling height reduction showed the rise in inhibitory effect of the leaf extract of *Eucalyptus globulus*. Seedling height reduction (SHR) was increased as amount of *Eucalyptus globulus* aqueous leaf extract increased. There were no significant difference treatment 3 , 4 and 5 which were treated with 20% ,30 % and 40 % of *Eucalyptus globulus* aqueous leaf extraction at $p < 0.05$. This showed that *Eucalyptus globulus* was toxic to teff.

Vigor index (VI) decreased as *Eucalyptus globulus* aqueous leaf extraction increased .This showed that the ability of teff plant to survive under this stress decreased because of toxicity effect of *Eucalyptus globulus* aqueous leaf extraction. There were no significant difference between treatment 3 and 4 which were treated with 20% and 30 % of *Eucalyptus globulus* aqueous leaf extraction. The experimental groups had less vigor index than the control group. These proved that *Eucalyptus globulus* aqueous leaf extraction decreased the ability of teff crop plants during laboratory room experiment to survive under this stressed condition.

There were no significant difference between germination percentage (GP) of 2 ,3 and treatment 4 which were treated with 10 % ,20% ,30 % of *Eucalyptus globulus* aqueous leaf extraction. But treatment 5 which were treated with 40 % of *Eucalyptus globulus* aqueous leaf extraction was significantly affected by toxicity effect of *Eucalyptus globulus* . The highest germination percentage of teff during laboratory experiment belonged to the control group. The Lowest germination percentage belonged to treatment 5 which was treated with 40% of *Eucalyptus globulus* aqueous leaf extraction.So, *Eucalyptus globulus* aqueous leaf extraction decreased germination percentage which revealed that *Eucalyptus globulus* aqueous leaf extraction was inhibited germination of teff (Appendix 3). These results were in line with James (2014) who showed that *Eucalyptus globulus* was toxic to tomato.

Table -4.3. Effects of Eucalyptus globulus aqueous leaf extract on the parameters of laboratory experiment of teff

Treatment	*E.globulus* aqueous extract	NGS	MGT	SL	RL	SHR	VI	GP
1	0%	7^{A}	2.62^{C}	3.25^{A}	2.22^{A}	0^{D}	553.25^{A}	100^{A}
2	10%	7^{A}	4^{B}	3.22^{B}	1.92^{B}	31.51^{C}	414.5^{B}	100^{A}
3	20%	7^{A}	4^{B}	1.42^{C}	1.07^{C}	56.35^{B}	249^{C}	100^{A}
4	30%	7^{A}	4^{B}	1.23^{C}	0.97^{C}	61.54^{B}	221.25^{C}	100^{A}
5	40%	5.5^{B}	5.2^{A}	0.92^{D}	0.9^{C}	71.5^{A}	183^{D}	78.55^{B}
Df		4	4	4	4	4	4	4
least significant difference		0.38	0.71	0.34	0.24	8.69	54.31	21.45

Means with the same letters are not significantly different from each other with column at $p < 0.05$.

KEY- NGS=Number of germinating seed ,MGT=Mean germinating time,SL=Shoot length,RL=Shoot length ,RL=Root lkengh,SHR=Seedliung height reduction,VI=Vigor index, GP=germination percentage

4.4. Effects of Eucalyptus globulus aqueous leaf extract on the parameters of field experiment of teff

As shown in table 4.4 during field experiment of teff there was no significant difference among all treatments. There was no significant effect of *Eucalyptus globulus* aqueous leaf extract on number of germinating seed. All seeds sowed in each pot were germinated even if the mean germinating time varied among treatments .This showed that *Eucalyptus globulus* aqueous leaf extract dide not have inhibitory effect on the number of germinating seed during field experiment of teff (Appendix 4).

There was no significant difference between mean germinating time of treatment 3 ,4 and 5 were treated with 20% ,30 % and 40 % 0f *Eucalyptus globulus* aqueous leaf extraction but they are significantly different from treatment 1 and 2. So, teff seedlings which were treated with 20% ,30 % and 40 % 0f *Eucalyptus globulus* aqueous leaf extraction were significantly affected by toxicity effect of *Eucalyptus globulus*.That means the time needed for germination of teff delayed as *Eucalyptus globulus* aqueous leaf extraction increased.

Shoot length of teff in each treatment was significantly affected except the control group. 10 %20% ,30 % and 40 % of *Eucalyptus globulus* aqueous leaf extract had adverse effect on shoot length of teff at $p< 0.05$.This could be because *Eucalyptus globulus* contain allelochemicals such as β- pinene , α-pinene,rene and cineole or phenols like ellagic ,chlorogenic , gentistic and gallic acid (Moral and muller 19 70).These compounds thought to have interfered with the phosphorylation pathway or inhibit the activation of ATP_{ase} or decreased synthesis of total protein nucleic acid (DNA and RNA) or interfere in cell division.ion

There was no significant difference in root length of treatment 1 and 2 which were treated with 10 % of *Eucalyptus globulus* aqueous leaf extract. And there was no significant difference between 3 , 4 and 5 which were treated with 20% ,30 % and 40 % 0f *Eucalyptus globulus* aqueous leaf extraction and they were significantly affected by toxicity effect of *Eucalyptus globulus* at $p< 0.05$. So the higher *Eucalyptus globulus* aqueous leaf extraction the lesser growth of root of teff. This cobuld be because allelelochemicals interfere with cell division mineral uptake and biosynthetic process (Saikumal et al.,2002).

Percentage of seedling height reduction (SHR) can also be used to measure the phytotoxicity of the allelopathic plant on shoot growth. The seedling height reduction (SHR) of the two crops were calculated by using mean raw data. The increase in the percentage of seedling height reduction showed the rise in inhibitory effect of the leaf extract of *Eucalyptus globulus*. Seedling height reduction (SHR) was increased as amount of *Eucalyptus globulus* aqueous leaf extraction increased .This showed adverse toxicity effect of *Eucalyptus globulus.* There was no significant difference between seedling height reduction of treatment 3 and 4 which were treated with 20% and 30 % 0f *Eucalyptus globulus* aqueous leaf extraction at $p< 0.05$.

Vigor index (VI) decreased as amount of *Eucalyptus globulus* aqueous leaf extraction increased .These showed the toxicity effect *Eucalyptus globulus* . The highest vigor index belonged to the control group and the lowest vigor index belonged to treatment 4 and 5 which were treated with 305 and 40% *Eucalyptus globulus* aqueous leaf extraction. These showed that as *Eucalyptus globulus* aqueous leaf extract increased the ability of teff seedling to survive under these stressed condition decreased because of inhibitory effect of *Eucalyptus globulus* extraction. Generally , *Eucalyptus globulus* aqueous leaf extraction increased Vigor index (VI) index decreased.

There were no significant difference between germination percentage (GP) of all treatments of field experiment of teff at $p< 0.05$.These ensured that *Eucalyptus globulus* aqueous leaf extraction at any amount did not affect germination percentage of teff during field experiment.

Table 4.4- Effects of Eucalyptus globulus aqueous leaf extract on the parameters of field experiment of teff

Treatment	*E.globulus* aqueous extract	NGS	MGT	SL	RL	SHR	VI	GP
1	0%	7^{A}	3^{A}	24.5^{A}	3.87^{A}	0^{D}	2825^{A}	100^{A}
2	10%	7^{A}	3^{A}	22.25^{B}	3.75^{A}	9.25^{C}	2600^{B}	100^{A}
3	20%	7^{A}	4^{B}	18^{C}	3.12^{B}	26.45^{B}	2112.5^{C}	100^{A}
4	30%	7^{A}	4^{B}	15.5^{C}	3.2^{B}	36.75^{A}	1812.5^{D}	100^{A}
5	40%	7^{A}	5^{B}	14.5^{D}	3.12^{B}	26.45^{A}	1862.5^{D}	100^{A}
Df		4	4	4	4	4	4	4
least significant difference		0	0.49	1.44	0.38	5.13	164.24	0
P value	$P < 0.05$	$P < 0.05$	$P < 0.05$	$P < 0.05$	$P < 0.05$	$P < 0.05$	$P < 0.05$	$P < 0.05$

Means with the same letters are not significantly different from each other with column at $p < 0.05$.

KEY- NGS=Number of germinating seed ,MGT=Mean germinating time,SL=Shoot length,RL=Shoot length ,RL=Root lkengh,SHR=Seedliung height reduction,VI=Vigor index, GP=germination percentage

5. CONCLUSIONS

This study which was carried in Dera Woreda showed the that *Eucalyptus globulus* aqueous leaf extraction was toxic to chickpea and teff. Extractions above 10% delayed mean germination time of both crops at both laboratory and field conditions except 10% of *Eucalyptus globulus* aqueous leaf extraction which only delayed germination of teff during laboratory experiment. Number of germinating seeds were only affected at laboratory condition of both crops by 40% extractions.

Germination percentage of both crops significantly affected by 40% of extraction solutions except laboratory experiment of teff which was not affected by all extractions. All extractions inhibited the shoot length of chickpea and teff at both conditions.

Root length of chickpea at laboratory room and field experiment were significantly inhibited by all extractions. But during field conditions it was affected by a bove 10% extractions . Seedling height reduction and vigor index of both crops were significantly affected by all extractions at both conditions.

Generally, *E. globulus* aqueous leaf extracttion inhibited germination and seedling growth of teff (*Eragrostis teff)* and chickpea(*Cicer arietinum).*

6. RECOMENDATIONS

- Because *E. globulus* tree is toxic to *Eragrostis teff* and *Cicer arietinum* , it must not be intercropped with these plants.
- Instead of *E. globulus* other alternative trees must be used For intercropping.
- The distribution of *E. globulus* tree must not be high because it increases toxicity effect on teff and chickpea.
- Increasing awareness of the farmers towards allelopathic effect of *E. globuls* against chickpea and teff will decrease loss of products.
- Further studies must be done on allelopathic effect of *E. globulus* tree

7. Reference

Ayele Belay (2007). Teff (*Eragrostis abyssinica*). Bul. of Miscellaneous information 1:2–6.

Almousi (1976) Effects of artificial vegetation on soil conservation of littoral hilly slopes. *Acta Botanica Sinica* **19**:182-189.

Baker, T.g and Att,twill,(1987) Fluxes of elements in rain passing through forest canopies in south-eastern Australia. *Biogeochemistry* **4**(1):27-39.

Bansan, kapoor,Nath and Bansen, (1987) Allelopathic influence: an assessment on the response of agricultural crops growing near *Eucalyptus tereticornis*. *Indian Journal of Forestry* **10**(4):267-271.

Batish, G. & van der Maesen, L. J. G. (2008). *Cicer arietinum*. In: Proota 1*: Cereals and Pulses/Céréales et Légumes Secs [CD-Ro1m]*, M. Brink & G. Belay (eds),Prota.

Belay Tadesse(2006)."Participatory Variety Selection in the Ethiopian Cereal Tef (*Eragrostis Tef*)".*Experimental Agriculture* **42**: 91–101. doi:10.1017/S0014479705003108

Bekabil Hilie , (2011) *Guidelines for Development Agents on Soil Conservation in Ethiopia*. Community Forests and Soil Conservation Development Department (CFSCDD), Ministry of Agriculture, Ethiopia.

Cannarozzi et al. (2014). "Genome and transcriptome sequencing identifies breeding targets in the orphan crop tef (*Eragrostis tef*)". *BMC Genomics* **15**: 581. doi:10.1186/1471-2164-15-581.

Caton , Fabio A, Fabio G, Quaglio P. Effect of Eucalyptus essential oil on respiratory bacteria and viruses. Curr Microbiol. 19 99;56:89

Cliford , M. (1953) Analyse de l'efficacite aerodynamique de divers types de brise-ventvivants en climat aride. Research Note - Institut National de Recherches Forestieres No. 19. 16 pp.

Chipendale, G.M. (1988) *Myrtaceae - Eucalyptus, Angophora*. Flora of Australia Vol. 19. Canberra, Australian Government Publishing Service. 542 pp.

Bosch, C. H., Borus, D. J. & Brink, M. (eds) (2007). *Cereals and Pulses of Tropical Africa - Conclusions and Recommendations based on Prota 1: 'Cereals and Pulses'*. *Prota* Foundation, Wageningen, Netherlands.

Burch , G.J., Moores, I.D. and Burns, J. (1989) Soil hydrophobic effects on infiltration and runoff. *Hydrological Processes* **3**:211-222.

Davidson, J. (1993) Overview of the Regional Symposium on Recent Advances in Mass Clonal Multiplication of Forest Trees. **In**: *Regional Symposium on Recent Advances in Mass Clonal Multiplication of Forest Trees for Plantation Programmes*. Proceedings of the Symposium held 1 - 8 December 1992, Cisarua, Bogor Indonesia. Field Document No. 4, Project UNDP/FAO RAS/91/004, FAO, Los Banos, Philippines.

Debano, L.F. (1981) Water repellent soils: a state-of-the-art. USDA Forest Service General Technical Report PSW-46. 21pp.

Del Moral, R. and C.H. Muller. 1969. Fog drip: a mechanism of toxin transport from *Eucalyptus globulus*. Bulletin of the Torrey Botanical Club 96(4):467-475.

Etay Gittet (2010) seed germination and emergency patterns ,species diversity and impactof Eucalyptus plantaions in eastern Tigray. A theisis work BDU,Bahir Dar,Ethiopia

Eldridge, K., Davidson, J., Harwood, C. and Vanwyk, G. (1993) *Eucalypt Domestication and Breeding*. Clarendon Press, Oxford. 288 pp.

Demeke , K. (2013) Social forestry: performance and issues. *Economic Affairs* **35**(1):32-40.

Duguma, J.,Rose, C.W., Cameron, D.M., Rance, C.J., Talsma, T., Charles, E.D. and Wards, D.A. (2009) Tree/pasture interactions at a range of tree densities in an agroforestry experiment. III. Water uptake in relation to soil hydraulic conductivity and rooting patterns. *Australian Journal of Agricultural Research* **41**(4):709-718.

Elkhawas, J.L.A., D.M. Wichman, J. Scheetz, M. Majerus, L.E. Welty, G.F. Stallknecht, R. L. Ditterline, R.L. Dunn, 1993. Teff: a potential forage and grain crop for Montana. Montana AgResearch 10:38–41.

Everret, A, Hadj Salah K, Mabrouk S, Mohamed Larbi K, Chemli R, Skhiri FH. Antibacterial activity and chemical composition of 20 Eucalyptus species' essential oils. Food Chem. 2000;129(4):1427–1434.

FAO (1989) *Agroforestry Initiatives by Farmers in Thailand*. Bangkok, FAO Regional Office for Asia and the Pacific, Publication No.1989/13.

FAO. 1981. Eucalypts for planting. Food and Agriculture Organization of the United Nations, Rome. 677 pp .

Farook, P. (2011). Utilization of chickpea in India and scope for novel and alternative uses. In: *Uses of Tropical Grain Legumes: Proceedings of Consultants' Meeting, 27-30 March, 1989*, pp. 47–54, ICRISAT Center, Patancheru, Andhra Pradesh, India.

Eriskine Greenwood, E.A.N., Klein, L., Beresford, J.D. and Watson, G.O. (2006) Differences in annual evaporation between grazed pasture and *Eucalyptus* species in plantations on a saline farm catchment. *Journal of Hydrology, Netherlands* **78**(3/4):261-278.

Forester , J. (2006) Community forestry in Ethiopia: the Bilate Project. *Rural Development in Practice* **1**(4):7-8.

Grove, T.S., Malajczukc, N., Burgess, T., Thomson, B.D. and Hardy, G. (1991) Growth responses of plantation eucalypts to inoculation with selected ectomycorrhizal fungi. pp86-93 **In**: Schonau, A.P.G. (ed.) *Proceedings of the IUFRO Symposium* *on Intensive Forestry - The Role of Eucalypts*. Vol 1. SAIF, Pretoria, South Africa.

Guttman N and Jaffe A. "We didn't have it in Ethiopia": Preliminary Findings on Attitudes and beliefs of Ethiopian immigrants to Israel regarding diabetes. Abstract #40695. The 130th Annual Meeting of APHA, November 12, 2002.

Hanil, L. S. (2008) Tropical forests: identifying and clarifying issues. *Unasylva* **42**(166):19-27.

Islam, M.A. (1986) *The Red Gums and Their Potential in Bangladesh*. UNDP/FAO Project BGD/79/017, Occasional Paper No. 4. Dhaka, FAO. 171 pp.

IlacoL, Doyle JJ (1985). "The origin and evolution of *Eragrostis tef* (Poaceae) and related polyploids: Evidence from nuclear waxy and plastid rps16". *American Journal of Botany* **90** (1): 116–122. doi:10.3732/ajb.90.1.116.

Jaykumar, M., Eyini, M. and Pannirselvam.S.,(1990) Allelopathic effects of *Eucalyptus globulus* Labil in groundnut and corn. *Comparative Physiology and Ecology* **15**(3):109-113.

Ketema Tessema ,(1997). Tef. *Eragrostis tef* (Zucc.) Trotter. Promoting the conservation and use of underutilized and neglected crops. 12. Institute of plant genetics and crop plant research, Gatersleben/Int. plant genetic resources institute, (IPGRI) Rome Italy.

KIdan Goshu.(2004).The root system of Jarrah (*Eucalyptus marginata*). Research Paper, Forests Department of Western Australia. No. 10. 5 pp.

Kohli, P.K., Parveen Chaudhary, and Anitakumari. (1988) Impact of *Eucalyptus* on *Parthenium* - a weed. *Indian Journal of Range Management* **9**:63-67.

Jamew, J. (2014) Forest agency, Shell plan *Eucalyptus* deal. *The Nation (Bangkok)*, February 8, 1989:13, 24.

Krugman, S.L. 1974. Eucalyptus l'Herit. In C.S. Schopmeyer (ed.), Seeds of woody plants in the U.S. Agricultural Handbook #450, USFS-USDA, Washington, D.C.

Laubuary, D. and Florence, R.G. (2008) Soil moisture and the distribution of two eucalypts. *Australian Forestry* **36**(2):138-145.

Mollha, M.P. (1999) The effect of a New Zealand beech forest canopy on the kinetic energy of water drops and on surface erosion. *Earth Surface Processes and Landforms* **7**(2):103-107.

Mulugeta Limenih , 2014. Effects of land use change on soil quality and native flora degradation and restoration in the highlands of Ethiopia. Implication for sustainable land management. Ph.D Thesis. Swedish university of Agricultural Science. Uppsala, Sweden. 1-48p

Munth & Keck (1997). Genetics of chickpea. In: *The Chickpea*, M.C. Saxena & K.B. Singh (eds), pp. 99–125, CAB International, Wallingford, UK.

Parker and Brown, *In vitro* antibacterial effect of aqueous and ethanolic *Moringa* leaf extracts. Asian Pac J Med. 1999;4(3):201–204 .

Pye-smith , L.D. and Johnson, L.A.S. (2002) *Eucalyptus*, the Universal Australian. pp 499-536 **In**: KEAST, A. (ed.) *Ecological Biogeography of Australia, Vol. 1*. The Hague, Junk.

Singh, K., Yadav, J.S.P. and Sharma, S.K. (2001) Performance of shisham (*Dalbergia sissoo*) in salt affected soils. *Indian Forester* **116**(2):154-162.

Sagoha A. and Jalota , R. V. (1991) Maize production under an intercropping system with fast growing tree species: a case in the Philippines. *Japan Agricultural Research Quarterly* **24**(4):319-326.

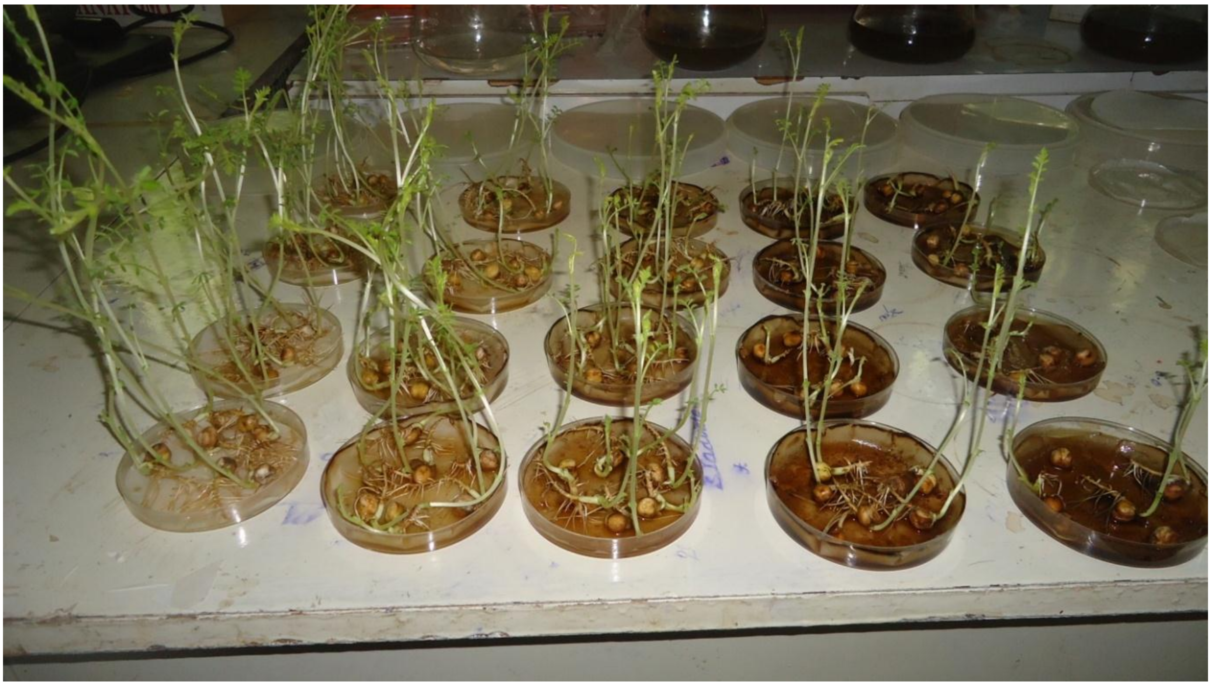
Tilahun Abebe, (2003). Natural resource degradation and environmental concerns in the Amhara National Regional State: Impact on Food Security. Ethiopian Soils Science Society. 1-12p

Woldeamlak Pawlos, (2010). Soil and water resources and degradation factors affecting their productivity in the Ethiopian highland agro-ecosystems. Michigan State University Press. 8(1): 1-18p

Zewdu (2010). Reversing the degradation of arable land in the Ethiopian highlands. Managing Africa's soils No. 23. International center for research in agro forestry. 1-20p

8. Apperndices

Appendix 1. Germination and seedling growth of chickpea at laboratory conditions



0% 10% 20% 30% 40%

Appendix 2. Germination and seedling growth of chickpea at field conditions

0% 10% 20%

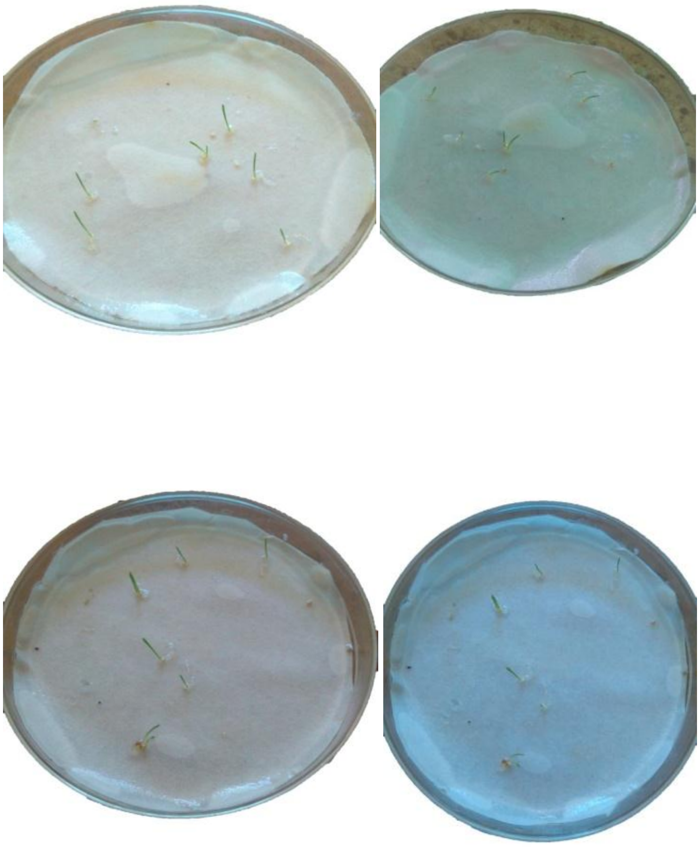
30% 30%

Appendix 3. Germination and seedling growth of Teff at laboratory conditions.

(control group)

Treatment 2 treated by 10 % of *Eucalyptus globulus* extract

Treatment 3 treated by 20 % of *Eucalyptus globules* extract



Treatment 4 treated by 30 % of *Eucalyptus globulus*

Treatment 5 treated by 40 % of *Eucalyptus globulus*

Appendix 4. Germination and seedling growth of Teff at field condtions

0%   1 0%

20%   30%   40%