EFFICACY OF THREE BOTANICALS AS BIO-HERBICIDE ON WEEDS ASSOCIATED WITH COWPEA AND MAIZE IN IBADAN, NIGERIA

BY

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ABSTRACT

Cowpea [*Vigna unguiculata* (L.) Walp.] and maize (Z*ea mays* L.) are main food crops widely grown in Nigeria, but their yield is reduced by weed interference. Synthetic herbicides are used to manage weeds but may be detrimental to the environment. Botanicals such as *Eucalyptus torreliana* (Et), *Eucalyptus camaldulensis* (Ec) and *Leucaena leucocephala* (Ll) have herbicidal properties and are eco-friendly. However, their efficacy in managing weeds on cowpea and maize fields have not been adequately documented. Therefore, efficacy of Et, Ec and Ll leaf extracts as bio-herbicide on weeds and grain yield of cowpea and maize were investigated in Ibadan, Nigeria.

Leaves of Et, Ec and Ll were harvested, air-dried, milled into fine powder and assayed for phytochemicals (mg/g) following standard procedures. Milled samples (144, 108, 72, 36 and 0 g) of each botanical were dissolved in 1 L distilled water to obtain Aqueous Leaf Extracts (ALE) of 100, 75, 50, 25 and 0% (control) concentrations. Ten seeds of each of cowpea (Ife brown) and maize (DTMA-Y-STR) in petri dishes were treated with the different concentrations of ALE in a Completely Randomised Design (CRD) with triplicates. Data were collected on Seed Germination-SG (%). In pots containing 10 kg soil, cowpea and maize seeds (2 plants/pot) were each sown and arranged in a CRD. The ALE of each botanicals at 100, 75, 50, 25, 0% and paraquat (5 mL/L/ha) were applied, before and five Weeks After Sowing (WAS). Data were collected on Number of Leaves-NL of cowpea and maize at 3,5,7,9 and 11 WAS, while Grain Yield-GY (g/pot) was determined at maturity. Weed species were identified and the Relative Importance Values-RIV determined following standard procedures. Data were analysed with descriptive statistics and ANOVA at $\alpha_{0.05}$.

Total phenols (32.04±0.10), tannins (27.40±0.04), saponins (20.15±0.03) were significantly higher in Ec than in Et (21.78±0.08, 17.91±0.09, 14.18±0.06) and Ll (9.47±0.08, 8.55±0.19, and 6.30±0.14), respectively. Cowpea and maize SG ranged from 80.0±0.5 (50% Ll) to 100.0±1.2 (100% Ll) and from 30.0±0.1 (control) to 100.0±0.5 (50% Et), respectively. Cowpea and maize NL ranged from 2.0±0.1 (Paraquat at 9-WAS) to 36.7±4.8 (50% Ec at 7-WAS) and from 4.4±0.2 (50% Ec at 3-WAS) to 12.9±1.5 (50% Ec at 9-WAS), respectively. Cowpea GY ranged from 0.1±0.1 (25% Ll) to 3.8±0.4 (50% Ll) and maize from 48.5±6.4 (Paraquat) to 94.3±12.0 (100% Ec). *Ageratum conyzoides, Alternanthera brasilliana, Mariscus alternifolius, Mitracarpus*

vilosus, Oldenlandia corymbosa and *Phyllantus amarus* were associated with cowpea and maize. In cowpea, *Mitracarpus villosus* had highest RIV of 52.3 (100% Ec at 3-WAS) but reduced to 28.5 (100% Ec at 9-WAS). In maize, *Mariscus alternifolius* had highest RIV of 48.7 (25% Ec) and 48.0 (50% Et) both at 3-WAS and reduced to 18.9 (25% Ec) and 14.26 (50% Et) at 9-WAS.

Aqueous leaf extract of *Eucalyptus camaldulensis* at 100% and *Eucalyptus torreliana* at 50% reduced *Mitracarpus villosus* and *Mariscus alternifolius* populations and enhanced grain yields of cowpea and maize. Also *Leucaena leucocephala* at 50% improved grain yields.

Keywords: *Eucalyptus camaldulensis*, Phytochemicals, *Eucalyptus torreliana*, *Leucaena leucocephala*, Relative importance values.

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CERTIFICATION

I, certify that this research work was carried out by Mrs. N.C. ISIENYI in the Department of Crop Protection and Environmental Biology, University of Ibadan, Nigeria

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DEDICATION

This report is dedicated to Almighty God, my beloved sick mother Mrs Roseline Omeje, who stays with me due to her sickness, for grooming me to what I am today and to all those that take care of the sick parents.

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CHAPTER ONE

1.0 INTRODUCTION

The interaction between plants in the environment could be beneficial or adverse depending on the nature of plants involved. These interactions could be a result of competition or allelopathy and usually both lead to measurable decrease in growth and yield of crops. In agro-ecosystem, weeds invasion and their interactions with crops are usually demeaning and has continued to be a challenge with the significant loss in crop quality and quantity, thus promoting the understanding of weed management (Moss, 2008).

Weeds are the most threatening pest in agriculture, hence they are usually unwanted plants that grow and reproduce aggressively; compete with agricultural crops for all resources required for their growth (Radicetti, 2012). They thrive under a broad range of conditions and exploit different mechanisms for seed dispersal (Das, 2011). It was reported that steady components of agro-ecosystems are weeds which are not to be entirely eradicated despite the devastating effects on crop quality and yield, but rather necessary is the development of management approaches that are sustainable (Marzieh *et al*., 2013).

The loss from the interference of crops by weeds varies among crop types. In grains, yield losses due to weeds in transplanted lowland rice fields ranged from 20% to 60% while direct-seeded rice ranged from 30% to 80% (Janiya, 2002). *Amaranthus cruentus* was reduced by 42% marketable yield loss when grown with *Acalypha segetalis* (Ogunyemi *et al*., 2001). The loss from weed is a global concern demanding options to circumvent the growth reduction effects and maximise yield. As a result, crop managers have devised several management approaches to tackle the menace of weeds infestation (Das, 2011; Radicetti, 2012).

Meanwhile, there are numerous approaches for weed control such as manual, mechanical, chemical and biological methods but are usually discouraging since they are labour-intensive, costly and time-consuming. More so, they cause ecological perturbation and biodiversity loss (Radicetti, 2012).

Despite the challenges, the modern agricultural practices globally adopt and found effective the chemical method of weeds' control (Rassaeifar *et al*. 2013) but their widespread injudicious and continuous use in agriculture has led to multiple toxic effects on the environment (Vishwakarmaa and Mittala, 2014). Basically, synthetic herbicides are persistent, leave residue in environment and may be phytotoxic, resulting to environmental challenges including shift in flora population, weeds' resistance, emergence of new weeds' biotypes, elimination of natural enemies of plants, groundwater pollution and health risk (Meksawat and Pornprom, 2010; Vishwakarmaa and Mittala, 2014). Exertions are being made to reduce the reliance on synthetic herbicides and to produce biological herbicides with environment friendly and desirable herbicidal properties as an effective alternative in weed management. The biological method of weed control provides an alternative through allelopathy to reduce the effects of weed-crop interference since it addresses the environmental challenges in synthetic herbicides usage (Rassaeifar *et al*., 2013).

Bioherbicide is a natural and environment-friendly method which may prove to be an incomparable tool for weed management and intensify crop yields (Fayinminnu, 2010). The process involves the use of the chemicals present in a donor plant to stim

ulate or inhibits the recipient plant. In weed management using botanicals, the donor plants are usually the allelopathic plant which inhibits or suppresses seed germination and seedling growth of the recipient plants. This is achieved through the release of chemicals called allelochemicals in form of leachates, root exudates, volatilization and residue decomposition (Cheema *et al*., 2012).

Many weeds e.g *Hyptis suaveolens* and crops e.g Sorghum had been confirmed to be allelopathy in nature. Several of these allelopathic potential of weeds and crops have been successful through aqueous extracts alone or in combination with other plants and also reduced herbicide dose (mixture of reduce concentration of herbicide and plant extract) in evaluation of phytoxicity (Iqbal and Cheema, 2008; Cheema e*t al*., 2012; Chandran *et al*., 2017).

However, different plant parts (flower, stem, leaves, root and residue) in both natural and agricultural systems are usually evaluated for their allelochemicals (Khan *et al*, 2011). Interactions of crop through allelopathy may provide weed control options in the crops by various ways such as; use of phytotoxic crop residues as mulches and cover crops, allelopathic plants in crop rotations, crop mixtures and intercropping,

germplasm selection and use of extracts allelopathic crop water extracts (Iqbal and Cheema, 2008).

Agro-forestry is the incorporation of shrubs and trees into farming landscapes to increase the farm efficiency and sustainability of farming systems as a sustainable form of land management that optimized the use of natural resources (Alao and Shuaibu, 2013). The natural environment including the agroforestry was reported to show interference in the growth of other plants. There will be need to explore the diversed agroforestry species found in their natural or plantation environment in relations to their neighouring plants. Plant species including *Eucalyptus camudulensis, Eucalyptus torreliana, Leucaena leucocephala, Prosopis juliflora* and *Acacia nilotica* have been reported to be allelopathic activity. Ataollahi *et al.* (2014) testified allelopathic effects of Eucalyptus species on weed management.

Eucalyptus spp is one of the prospective allelopathic plants having a number of allelochemicals (Ataollahi *et al*., 2014; Ziaebrahimi *et al*., 2007). The phytotoxic effects of Eucalyptus species have been assessed against a number of weed species. For example, essential oil of *Eucalyptus camaldulensis* reduced germination and seedling growth of *Amaranthus hybridus* and *Portulaca oleracea* (Verdeguer *et al*., 2009).

Leucaena leucocephala (Lam.) De Wit., a leguminous plant belonging to the family Fabaceae, is an allelopathic tree species that is widespread in the tropics and subtropics. It has multiple uses, with emphasis on reforestation of degraded areas, feed, green manure and for the allelopathic effect. Allelochemicals in aqueous extracts of *Leucaena leucocephala* which leave extracts at moderate concentration (40% - 50%) was reported to have had inhibitory effect on seed germination of *Raphanus sativus* (Kalpana and Navin, 2015). Similarly, *L. leucocephala* was reported to have inhibited the seed germination and seedling growth of maize (Khan, 2011)

Cowpea (*Vigna unguiculata* (L.) Walp.) is an annual legume belonging to Fabaceae family. It is widely cultivated in Nigeria mainly for its edible seeds. They are rich in protein and are very useful to man. Though, there are countless perspectives for the production of cowpea in south western Nigeria, but due to high level of diseases and pest infestations, the yields obtained by farmers are generally low (Asiwe and Kutu, 2007). Among all the constraints that limit cowpea production in Nigeria, problem of weeds appears to be the most deleterious, resulting in several degrees of yield losses ranging from 50-86% (Akobundu, 1979; Joseph *et al*., 2014). Apart from

direct influence on yield and declining quality, common weed species such as *Portulaca oleraceae*, *Solanum nigram* L., *Amaranthus spinosus* L. and *Phyllantus amarus* have been described to serve as reservoir hosts for various pests and diseases (Joseph *et al*., 2014).

Maize (*Zea mays* L.) is of the family Poaceae. It is the third most important cereal crop globally after wheat and rice (FAOSTAT, 2015; Ismaila *et al*., 2010). Also with regards to cultivation areas and total production, every part of maize plant is useful. Maize provides products for various industries including human and animal foods. It is a crop with seeds that farmers are capable of handling and using, to raise a new crop for a long time (Msuya and Stefano, 2010). However, maize production is widely affected by weed interference that prime yield loss. El Koomy (2005) reported that the reduction in maize yield due to weeds interference involves factors like inter plant, competition for light, water, nutrition and other potential yield-limiting factors.

Although, many studies have been conducted on the allelopathic activities of *Eucalyptus spp* and *Leucaena leucocephala, Prosopis juliflora* and *Acacia nilotica* but information is not sufficient on their phytoxicity in maize and cowpea cropping system in field study.

Justification

Since weeds are basic components of natural and disturbed ecosystem, they create a niche and they are usually difficult to manage thereby portend threats to neigbhouring plants. The concern about the invasion of crop fields with attendant reduction in crop yield and economics in weed management has necessitated the adoption of synthetic herbicides by farmers to manage the devastating effect of weed-crop interactions.

Therefore, the heavy reliance and indiscriminate use of these synthetic herbicides leave residue and usually their persistence in the environment results in ecological perturbations and health hazards in humans (Das, 2011; Farooq *et al*., 2013; Iqbal and Cheema, 2008). Atrazine has been detected as drinking water contaminant in the U.S in samples examined by USDA and a pervasive water contamination in Europe. It was also reported that atrazine residue was found in crops in India (Das, 2011). However, it is known that atrazine may elevate prostate cancer in males (U.S. EPA, 2006) and breast cancer in females, should there be constant exposure (Kettles *et al*., 1997).

These impacts emanating from the misuse of herbicides necessitate a search for an alternative in the use of botanicals including agro-forestry plants. Past researches have shown that extracts of *Eucalyptus species* and *leucaena leucocephala* had significant effects on the growth and yield of some crops (Adeniyi and Ayepola, 2008; Djanaguiraman *et al*., 2005). The agroforestry plant extracts are reported to have stimulatory or inhibitory depending on doses and concentrations of usage.

High demand for cowpea and maize due to their vast utilization formed the basis of using them in this experiment. Maize is an most important cereal crop globally after wheat with production turnover of 70, 76, 591 tonnes/ha annually (FAOSTAT, 2015). However, uncontrolled weeds in cereals' (e.g. maize) farms could lead to 40% to 100% yield loss (Ismaila *et al*., 2010). Similarly, cowpea is a cash crop (grain and fodder) and a valuable component of farming systems, by virtue of their high protein content and nitrogen fixation (Tarawali, *et al*., 2002). High level of diseases and pest infestations including weeds cause low yield in cowpea production in Southwestern Nigeria (Asiwe and Kutu, 2007). The aim of this research was to find an eco-friendly alternative to the problem of synthetic herbicides by using bioherbicides, evaluating their phytotoxic effects at different concentrations in cowpea and maize field.

Objectives of the study

- To evaluate farmers knowledge on the use of synthetic and bio-herbicides in control of weeds in cowpea and maize field.
- To evaluate the effects of different concentrations of the plant extracts of *Eucalyptus camudulensis, Eucalyptus torreliana* and *Leucaena leucocephala* on seed germination of cowpea and maize.
- To evaluate the effects of different concentrations of the plant extracts of *Eucalyptus camudulensis, Eucalyptus torreliana* and *Leucaena leucocephala* on seedling growth, weed flora and yield performance of cowpea and maize.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Weed Management Strategies

The main goal of weed management is to offer the most proper methods towards sustainable ecosystem and minimum negative influence on plants (Radicetti, 2012). Weeds are plants that naturally establish themselves and have been part of man's environment since the creation of nature. Consequently, weeds are found at the crop fields, lawns, forests, wetlands, roadside and even our homes (Akobundu and Agyakwa, 1998). Their presence is usually devastating and in their interaction with crops, reduces yield and may even lead to loss of crop quality and yield. Weed species are diverse and the crop managers (farmers) must contend with approximately 30,000 plant species identified as weeds, although 250 species are really important and about 80 plant species are known to reduce crop yield (Sodaeizadeh and Hosseini, 2012).

Globally, weeds infestation reduces agricultural productivity and its management to maximize yield is a serious concern to crop managers. Although weeds causes the highest potential crop losses (34%), nowadays, weeds are frequently underestimated since more attention is paid to insect pests (18% loss) or pathogens (16% loss) as reported by Oerke (2006).

Weed management is a control with other management strategy on weed. It is therefore a means of maintaining a population below threshold level, which may not cause substantial economic damage to crops. Management of weed could be considered a systematic approach for reducing the effects of the weeds and optimizing land use, combining prevention and control. There are different approaches to weed management in the crop field and these are the non-chemical and chemical methods. The non-chemical methods are cultural, mechanical and biological while the chemical methods of controlling weed involve using synthetic herbicides (Radicetti, 2012).

The methods used for managing weeds vary and adoption of a specific method is primarily for profit realization but sustainable methods will be based on the situation,

the available research information, environmental impacts, the economics, and the farmers knowledge (FAO, 2011).

Cultural weed management usually allows the integration of several strategies as options in long term strategy for weed management (Bond and Grundy, 2001). The cultural control includes crop rotation (Derksen *et al*., 2002) which increases the ability of the crop to compete, seeding time, cultivars and species competitiveness with weeds (Lemerle *et al*., 2001), climate, type of irrigation and intercropping (Shrestha *et al*., 2004). Other strategies that are used in cultural practices are; fast and uniform crop emergence through proper preparation of seedbed, using the right seed, increasing plant density and establishing the right seeding depth. Also, adaptation of planting patterns anywhere possible to crowd out weeds, localizing resource application and optimizing the management of the crop (Radicetti, 2012) are strategies that could be employed in cultural weed management. Lemerle *et al*. (2001) reported that increasing crop density and reducing row spacing, the competitive ability of crops with weeds is improved and closer spacing of the row will also improve crop competition for limited resources due to a rapid canopy closure (Whish *et al*., 2002).

The mechanical weed control is a physical approach and it includes hand-pulling, hand-hoeing, animal supported mechanical tools and lately tractors (Zimdhal, 2007). Thus, mechanical weeders array from simple hand tools to sophisticated tractor-driven devices (Radicette, 2012). However, most effective mechanical method of weed management is complete burial of seedling weeds beyond one centimetre depth, or to cut them at or just below the soil surface (Bond and Grundy, 2001). Cutting and mowing, steaming, solarization, and heat and thermal weed control (fire, flaming, hot water, steam and freezing) deliver fast weed control without leaving chemical residues in the water and soil. They are however influenced by several factors including temperature, exposure time and energy input (Ascard *et al*., 2007; Zimdhal, 2007).

Generally speaking, the problem regarding non chemical approaches is because effective control needs more frequently-repeated treatments than chemical weed-management (Elmore, 1993; Kristoffersen *et al*., 2004). Although, they have lesser impacts on the environment, they are laborious, time consuming, costly, limited in effectiveness to annual weeds and cannot be effective in the control of underground vegetative structure (Das, 2011).

The biological methods are also a non-chemical approach that involve the use of biological agents; weeds, insects, pathogens in the control of populations below threshold (Das, 2011). The biological control is eco-friendly, economically less in the long run, self-sustaining (with the exception of bio-herbicides), sustain biodiversity and effective in inaccessible habitat. A disadvantage of the biological control is that it allows the use of pesticides in meeting targets, environmental problems from introduced bio-agents, weed flora shift and conflicts of interest over target weeds (Das, 2011). The biological approach addresses the problems associated with chemical methods especially herbicide resistance, emergence of new weeds, decline in natural enemies, biodiversity dynamics, other environmental issues and health risks.

2.2 Herbicides

Currently, chemical technique provides an effective strategy for controlling weed. Synthetic-herbicides have been established as a main tool for weed-management since their finding in the 1950s (Radicetti, 2012). The use of Herbicides has increased yield and enhanced crop production through effective weed control. As a result, farmers rely on the use of an effective chemical approach to meet food demands. Undoubtedly, herbicides when used indiscriminately and continuously may hamper the functioning ecosystems by elimination of target and non-target organisms, food chain accumulation and health hazards (Farooq *et al*., 2013).

There are diverse herbicide types depending on the type and morphology of plants and the crops, selectivity, time of planting, time of application, basis of application, choice and calibration of sprayer, dose application and residue in crop (Das, 2011). A failure to adhere to these conditions may lead to phytotoxicity in crops. Thus, the adoption of a low toxic formulation and the least effective concentration of the herbicide must be applied to reduce human and mammalian toxicity and health risks (Jurewicz and Hanke, 2008).

Herbicides are applied singularly or mixed with other herbicides to control most (but not all) types of weeds (Radicetti, 2012). However, an optimal calculation and understanding of the emergence of the weeds and crops is vital in determining the appropriate time to apply the herbicides to protect the seeded crops. Pre-planting herbicides are been applied in soil already prepared a day before or just before planting a crop with the chemical class of herbicides as dinitroanilines with the exception of pendemethalin (Das, 2011). Pre-emergence herbicides are applied 1 to 2 days after

planting or immediately after planting of a crop but before the crop emerges. While Post-emergence herbicides are applied after the emergence of both the crop and weed which are dependent on the crop species, level of infestation and nature of herbicides. It is usually applied 15-30 days after planting a crop. Das (2011) reported that, the application of post-emergence herbicide varies with crops (maize: 15-20 days; wheat 30-35 days and around 20 days after sowing in Soybeans).

On selectivity, herbicides may be selective or non-selective. The selective herbicides (Pendemethalin, Atrazine, Butachlor, 2, 4-D, Chlorsulforon etc) eradicate specific weed groups in a mixed plant population. Their effectiveness is dependent on strict adherence to recommended rates and the stage of growth to which they are assigned. However, all pre-planting pre-emergence and post-emergence herbicides in crop fields are selective with respect to crop in which they are applied. The non-selective herbicides (Paraquat, glyphosate, metham, sodium chlorate etc.) act by eradicating indiscriminately any species/plant group including crops they are in contact with. They are not recommended in agro ecosystems, but they are maximally used at non-crops areas including roads, lawns, industrial sites etc. Other herbicides classes are based on the herbicide broad spectrum, mode of action, window of application, residual action in the soil and weed control period (Das, 2011).

2.3 Environmental Impacts of Herbicides

Although, synthetic herbicides is proven to be an effective method and widely adopted approach in weed control. Synthetic herbicides proffer a significant boost in crop productivity through efficient weed management (Santos, 2009). In fact, weed management in crop field without the use of synthetic chemicals remain a challenging task for crop managers (Jodaugiene *et al.*, 2006). As a result, synthetic chemical has made other approach less important and has reduced the need for labor (replaced human), animal and mechanical energy with chemical energy (Bastiaans *et al*., 2008).

Farmers generally rely on fast and effective control measures by using synthetic herbicides which produce numerous detrimental impacts for human health due to their indiscriminate use (Kohli *et al*., 1998; Xuan *et al.*, 2004). Total reliance, indiscriminate and continuous use of herbicides (Cheema and Khaliq, 2000) is widely discouraged due to its devastating impacts on ecological, environmental, economics and health risks problems (Farooq *et al*., 2013). The ecological impacts in the use of herbicide lead to increasing herbicidal resistance (Nurse *et al.,* 2006; Farooq *et al.*,

2013). Other ecological impacts are new weeds biotypes, shift in flora, population dynamics, biodiversity threats, toxic residues in crops and food chain, elimination of non-target organisms and resistance of weeds (Jabran *et al*., 2008). However, Owen and Zelaya (2005) reported environmental problems in weed management including persistence of herbicides in the environment and in common pool (air, water and soil), groundwater and other environmental pollution (Jabran *et al*., 2008).

2.4 Botanicals (Plant Extracts) as Alternative Weed Management Approach

Plants including trees, shrubs and herbs that overpower the growth of nearby plant species in their natural habitat may be a potential for the weed management. Large number of weeds and trees possess phytotoxic properties which have growth inhibiting effect on crops (Cheng and Cheng, 2016). These plants usually contain chemicals that stimulate or inhibit the growth of plants in their vicinities. Allelopathy in plant is a holistic successful alternative to synthetic herbicides as plant chemicals do not have residual or toxic effects (Bhadoria, 2011) in the environment and to crops. These plant chemicals are present in virtually all plants and in most tissues, including leaves, stems, flowers, roots, seeds and buds, and have potential as either herbicides or templates for new herbicide classes (Duke *et al*., 2000).

The effectiveness of these chemicals in plants depends on factors like species of the plant concentration (Cheema and Ahmad, 1992), their movement, fate and persistence in the environment (Inderjit, 2001). Also, the type of extracts, solvents of extraction and extraction techniques, concentration of extracts (Rizvi *et al*., 1992) and plant parts from which the extract are prepared (Taiwo and Makinde, 2005), radiation temperature, age of plant organs, genetics and pathogens and predators are factors determining the effectiveness of plant extracts, others are seed size and weed density (Arif *et al*., 2015). Zeng *et al*. (2001) reported that the concentration of these chemicals varies in plant parts including the shoots (leaves, stems, flowers, fruits, seeds, pollen, rhizomes and stem bark) and in roots.

Based on concentration, some species at higher concentration may show stimulatory or inhibitory effect, while at lower concentration might not. Consequently at high concentrations, these chemicals may interfere with the cell division, hormone biosynthesis and mineral uptake and transport (Rizvi *et al.*, 1992). Also, the membrane permeability (Harper and Balke, 1981), stomata oscillations, photosynthesis, respiration, protein metabolism and plant water relations may arise from the chemical

interference and show substantial growth reduction (Kruse *et al.*, 2000). However, decomposition of plant residues, soil release volatilization, leaching and root exudation are the modes of release of these chemicals to the environment (ZhongQun *et a.*,*l* 2012).

Plants and crops are greatly examined for their phytotoxic activities and are rid of phytochemicals, having shown great response for inhibitory or stimulatory action on test plant species. In previous reports, allelopathy has been used for weed management in several crops including sorghum wheat, cotton, rice, maize, canola and mungbean (Cheema *et al*., 2000; Cheema *et al*., 2001; Jabran *et al*., 2008). Strategies for the implementation of crop residue allelopathy entail the application of phytotoxic residues or mulches primarily generated by intercropping of allelopathic cover, smother, rotational, or companion crops (Wu *et al*., 1999).

The aqueous extracts of the leaves and stems of sunflower was phytotoxic to seed germination and seedling growth of *Sinapis alba* and *Lolium multiflorum* and selective against seed germination of *Triticum aestivum* (Panacci *et al*., 2013). Fayinminnu *et al.* (*2*013) also reported the phytotoxic effect of crude cassava water extract as a natural herbicide on weeds of cowpea. In another study on plant phytotoxicity, Oluwafemi (2013) observed that leaf extract of *Moringa oleifera* significantly decreased germination and seedling growth in *Euphorbia heterophylla.* Also, aqueous extracts of *Parthenium* leaf and flower inhibited seed germination and caused complete failure of seed germination of Teff (*Eragrostis tef*) when the leaf extract concentration of *Parthenium* weed was 10% (Tefera, 2002).

Also, the phytotoxic actions of the plants involve the release of chemicals into the soil environment where it affects the growth and development of neighbouring plants. Soil sickness or autotoxicity of crops has emerged as a problem in modern agricultural systems (Panacci *et al*., 2013). It is attributed to phytotoxins released by donor plants into the environment that suppresses the germination and growth of that same plant species (Miller, 1996). However, the phytotoxic activity of allelochemicals in soil can be affected by their bioavailability due to their absorption, desorption and degradation processes influenced by soil characteristics (Kobayashi, 2004).

2.5.0 *Eucalyptus* species and *Leucana leucocephala* as phytotoxic plants

2.5.1 *Eucalyptus* spp

Many plants including those of agroforest may show suppressive characteristic to near leaves and stems of species in their vicinity. *Eucalyptus* trees are evergreen, and propagated only from seeds. *Eucalyptus* are family of Myrtaceae and subfamily Leptospermoideae. They are currently categorised into three genera as; *Angophora* (14 species), *Corymbia* (113 species) and *Eucalyptus* (> 740). Thus there are over 800 species of *Eucalyptus* genera (Richardson and Rejmanek, 2011) including *Eucalyptus camudulensis, Eucalyptus teriticornis, Eucalyptus citriodora, Eucalyptus grandis, Eucalyptus platyphylla, Eucalyptus torelliana, Eucalyptus globulus* etc. The poor performance of crops beneath the Eucalyptus tree species are related to the allelopathic effect of *Eucalyptus* spp (Singh and Kohli, 1992; Anaya, 1999). The suppression activity of understory plants may be attributed to their allelopathic activity especially in drier climate (Babu and Kandasamy, 1997). These plant species may release chemicals through leaching from leaves, residue decomposition, root exudates to inhibit the growth of other plants in their habitat (Maibam *et al*., 2011; Butnariu, 2012). At high concentrations the extracts of these plants may be phytotoxic and at lower concentrations may not be toxic. It was reported that, *Eucalyptus* species are plants with allelopathic activities having a number of allelochemicals (Ziaebrahimi *et al*., 2007; Reza *et al*., 2014; Sangeetha and Baskar, 2015).

A sum of volatile and non-volatile allelochemicals have been reportedly released from Eucalyptus trees and involved in allelopathic effects (Kohli, 1990). Several phenolic compounds such as caffeic, coumaric, gallic, gentisic, hydroxybenzoic, syringic, ferulic and vanillic acids have been identified in the leaves of Eucalyptus (Kohli 1990). Also, methanol was found in the aqueous leaf extracts of three *Eucalyptus* hybrids which showed allelopathic potential (Chapius-Lardy *et al*., 2002).

2.5.1.1 *Eucalyptus camudulensis*

Eucalyptus camudulensis is one of the many species of *Eucalyptus* spp which belongs to the family Myrtaceae. It is a shrub native to Australia with potential allelopathic activities and its essential oils possess pesticidal activity (Reza *et al*., 2014). The phytotoxicity of *Eucalyptus* spp may be related to production of several volatile terpenes and phenolic acids (Djanaguiraman *et al*. 2005; Setia *et al*. 2007;

Reza *et al*., 2014). The toxic effects of *Eucalyptus* spp are also shown in the inhibition of some physiological processes such as nutrient uptake, cell division, synthesis of carbohydrates, proteins and nucleic acids and phosphorylation pathways (Sasikumar *et al.*, 2002). These inhibitory effects can mediate by phenolic compounds (El-Darier, 2002).

The phytotoxic properties of *Eucalyptus* spp have been assessed against a number of weed and crop species. For example, essential oil of *Eucalyptus camaldulensis* suppressed germination and seedling growth of *Portulaca oleracea* and *Amaranthus hybridus* (Verdeguer *et al*., 2009). Niakan and Saberi (2009) also reported that aliquot extract of *E. camaldulensis* decreased fresh and dry weights of *Phalaris minor* seedlings which corroborated the report that, *E. camaldulensis*, *Acacia nilotica* and *Prosopis juliflora* significantly affected seed germination and seedling growth of several crops and/or weed species (Reza *et al*., 2014).

Many studies have evaluated the allelopathic effects of Eucalyptus species and confirmed the strong inhibitory effects of Eucalyptus extracts on some crops (Zhang and Shenglei, 2010). Leaf extract of Eucalyptus inhibited seed germination and reduced root and shoot lengths of cucumber and maximum inhibition was observed in higher concentrations of the extract (Allolli and Narayanareddy, 2000).The allelopathic effect of extract from *Eucalyptus camaldulensis* was tried on tomato; the extract significantly inhibited germination and growth of this plant (Fikreyesus *et al*., 2011).

2.5.1.2 *Eucalyptus torelliana* F. Muell.

The Eucalyptus torelliana, commonly called Cadaga Eucalyptus and Torell's Eucallyptus, is an evergreen tree belonging to the family Myrtaceae. It is about 30 m tall and originates from Queensland, Australia (Brown, 2014). The leaf is usually wider than other *Eucalyptus* spp. However, the leaf stem of *Eucalyptus torelliana* is usually covered with reddish or white hairs and forms a light to dense canopy shade tree. They are usually found growing in disturbed sites and open woodlands. However, they are used globally as re-afforestation trees, improvement of marshlands and as ornamental trees. In Nigeria, it was used to treat gastrointestinal disorders as reported by Adeniyi *et al.* (2006). Other medicinal utilization includes leaves for sore throat, urinary tracts and other bacterial infections of the respiratory system (Bruneton, 1999). Many studies in Australia, Mali, and Benin on the essential oils of *Eucalyptus torelliana* reported presence of varying monoterpenes hydrocarbon. In Nigeria,

however, Babayi *et al* (2004) also reported the presence of phenols, cardiac glycosides, tannins, saponin, saponin glycosides, volatile oil, steroid and balsam gum. Adeniyi and Ayepola (2008) reported the presence of some phytochemicals (tannins, Saponnins and cardic glycosides) in *Eucalyptus torelliana* and *Eucalyptus camaldulensis* which actually showed inhibition of the growth of the test organisms. Phytotoxic activities and bioactive components of *Eucalyptus camudulensis* have also been reported (Niakan and Saberi, 2009; Verdeguer *et al*., 2009).

2.5.2 *Leucaena leucocephala* (Lam.) De Wit

The leucaena (Leucaena leucocephala (Lam.) De Wit is a leguminous tree belonging to the family, Fabaceae. It originates from Mexico and native to alkaline soils of Central America. It is an allelopathic tree species that is widespread in the tropics and subtropics. Its ability to grow in different environments in the tropics increased *Leucaena leucocephala* economic importance. This plant has a great attribute as a pasture specie providing sources of crude protein and other vital nutrients for livestock production (Aganga and Tshwenyane, 2003).

Leucaena leucocephala is grown for soil improvement and prevention of soil erosion (Hong *et al*., 2003; 2004). Other uses are numerous with emphasis on reforestation of degraded areas, feed, green manure and for allelopathic effect. Many phytotoxic allelochemicals are responsible for the suppressive activity of *Leucaena leucocephala* such as mimosine and certain phenolic compounds, including p-hydroxycinnamic acid, protocatechuic acid, and gallic acid which have been identified in the leaves of the species (Chai *et al*., 2013).

Mimosine in *L. leucocephala* is the greatest chemical constituent that is liable for the strong allelopathic potential of the plant (Xuan *et al*, 2006). Mimosine can be transformed into DHP [3-hydroxy-4(1H)-pyridone], which has less toxicity by the HCl hydrolysis process (Tawata, 1990; Xuan *et al* 2006) or ruminants consuming Leucaena degrades mimosine to DHP by specific ruminant microorganisms (Jones and Lowry, 1984). Different plant parts of the *Leucaena leucocephala* contain substantial amount of mimosine. However, greater amount of mimosine are gotten from the early plant parts than the mature parts, except for the mature seeds, which gave the second greatest amount of mimosine (2.38% of dry weight). This was only less than the amount from the young leaves, which had the major quantity of mimosine (2.66% of dry weight).

Mimosine in *L. leucocephala* showed a suppressive effect on some tested floras (Tawata, 1990; Xuan *et al*, 2006)

2.6.0 COWPEA (*VIGNA UNGUICULATA* (L) Walp) AND MAIZE (*ZEA MAYS* L.) AS TEST CROPS

2.6.1 Cowpea

Cowpea (*Vigna unguiculata* (L) Walp) is a vital leguminous crop, native to Africa and belongs to the family, Fabaceae (Imran *et al*., 2010). It is one of the world's di-cotyledonous leguminous food crops and a main food crop of millions of people in the developing countries especially Nigeria (Ogbemudia *et al* 2010). Cowpea is one of the most widely versatile, adapted, and nutritious of all the cultivated grain legumes. It is an annual legume that is widely cultivated as a cover crop. More than 60% of cowpea world's production is estimated to be from the West and Central Africa. The world's production of cowpea was estimated to be 2.27 million tons, of which, Nigeria produces about 850,000 tonnes (FAO, 2002; Adaji *et al.*, 2007). Egho (2009) revealed that, Nigeria is the second greatest consumer of cowpea globally. A more recent and reliable statistics, by Food and Agricultural Organization (FAO) and cited by IITA, reported that about 7.56 million tons of cowpea were produced annually on about 12.76 million hectares of land (Omovbude and Udensi, 2013). Sub – Saharan Africa was reported to account for about 70% of total world production, Nigeria, with about 2 million tonnes produced per annum, is said to be the world largest cowpea producer. This is followed by Niger (650,000 tons) and Mali with 110, 000 tonnes (Omovbude and Udensi, 2013).

In countless parts of West Africa, cowpea is a popular staple food utilized to fortify cassava, plantain, cereal-based meals and yoghurt (Henshaw *et al*., 2005), while in Nigeria, it is mostly cultivated for its edible grains with high economic value. It is a main source of protein in similarity to most edible legumes and value at about 25% (Ndakidemi and Dakora, 2007. It contains 62% soluble carbohydrate, vitamins (Islam *et al*., 2006) and small amount of other nutrients. Cowpea plays an important role in many communities in Africa (Singh *et al.*, 2002; Langyintuo *et al*., 2003) such as in human nutrition (Saidi *et al*., 2010). Rural kin derive food and animal fodder as well as cash from the production of this crop (Asiwe and Kutu, 2007, Joseph *et al*., 2014).

On its health benefits, Ofuya (1993) reported that daily consumption of 100 – 135 g of dry beans reduces serum cholesterol level by 20%, thereby, reducing the risk

for heart diseases by 40%. It was also reported that cowpea is a cash crop, by feature of their high protein content and bringing nitrogen into farming system through symbiosis with nodule bacteria and fixing atmosphere nitrogen (Shiringani and Shimeles, 2011). As a result of the high nutritive value, environmental protection (especially nitrogen fixation) and economic viability of cowpea, there is participation in its production (Agbogidi and Egho, 2012).

Cowpea is a tremendously resilient crop and cultivated under some of the most extreme agricultural conditions in the world especially at the semiarid of the tropics where other food legumes do not perform well (Owolade *et al.*, 2006; Muoneke *et al*., 2012). In Nigeria, cowpea is dominantly produced in the North in the savannah belt. Its yield in the Southwestern is affected by some environmental factors including rainfall, hence, it is seasonal (Agbogidi and Egho, 2012). Weed infestation appears in cowpea to be the most deleterious, resulting in various degrees of yield losses ranging from 50-86% especially in southwestern Nigeria with high rainfall (Akobundu, 1979; Agbogidi and Egho, 2012; Joseph *et al*., 2014). Apart from direct effect of weeds on yield and quality reduction, common weed species such as *Portulaca oleraceae*, *Solanum nigrum* L., *Amaranthus spinosus* L., *Phyllantus amarus and Euphorbia heterophylla* have been stated to serve as reservoir hosts for various pests and diseases (Fayinminnu, 2010; 2014; Joseph *et al*., 2014). High level of diseases and pest invasions are great constraints to cowpea production in south western Nigeria (Asiwe and Kutu 2007). Also, the crop yields obtained by farmers are commonly low, due to lack of knowledge of good cultural practices, use of local varieties which are generally low yielding coupled with low soil fertility and problem of weed management (Jabran *et al*., 2008). The great demand for this leguminous multipurpose crop plant is not met in the Southwestern part of Nigeria. The production of cowpea devoid of weeds infestation and all year round cultivation in all parts of Nigeria is expected in order to improve nutrition, contribute to food security as well as increase income of the producers and create employment opportunities; also, to enhance the efficiency of utilization of labour (Agbogidi and Egho, 2012).

In weed management of cowpea the use of plant based products may be phytotoxic. Musyimi *et al.* (2015) studied the effects of fresh aqueous extracts of *Tithonia diversifolia* on both inhibitory and stimulatory performance of cowpea and reported that the fresh shoot aqueous extracts contain allelochemicals which significantly affect germination and cowpea growth. Cowpea extracts exhibited the

presence of neochlorogenic acid, chlorogenic acid and caffeic acids (Muhammad *et al*., 2013) which may be explored for their phytotoxicity.

2.6.2 Maize

Maize (*Zea mays* L.) is a member of the family Poaceae. Maize is a key staple food crop grown in varied agro-ecological zones and farming systems and is the second most vital cereal crop globally after wheat (FAOSTAT, 2015). In the year 2012, a total area of 34, 075, 972 MT was cultivated for maize with a production turnover of 70, 076, 591 MT in Africa (FAOSTAT, 2015). Maize is consumed by people with variable food preferences and socio-economic backgrounds in the world and especially in sub-Saharan Africa (SSA). It is estimated that 208 million people in sub-Saharan Africa depend on maize as a source of food security and economic wellbeing (Harold, 2015). As a result, maize like many other cereals is widely cultivated worldwide in Europe, Africa, America, Carribean and Asia. The leading maize producing continents of the world are USA, Brazil, South Africa, India, Philippines and Indonesia (FAO, 2014). In India, Maize is grown over an area of 9.23 m ha with total production of 25.66 metric tonnes and average productivity of 25.64 q/ha (Anonymous, 2015). Maize are used for human consumption, for corn starch, feed for poultry and livestock, extraction of edible oil, in agro and glucose industries (Kumar *et al.*, 2017; Gautam *et al*., 2017).

The massive potential for export has added the demand for maize all over the world (Gautam *et al*., 2017). Nigeria is presently the tenth largest producer of maize in the world and the largest maize producer in Africa (IITA, 2012). In Nigeria, traditionally, maize was grown in the south (forest ecology) but large scale production has moved to the savannah belt, especially the Northern guinea savanna where the yield/production is higher (Olaniyan, 2015). Maize is most productive in the middle and Northern belts of Nigeria due to adequate sunshine and moderate rainfall (Obi, 1991).

Maize accounts for almost half of the calories and protein consumed in East Africa, and one-fifth of the calories and protein consumed in West Africa. All parts of maize can be used as food and non-food products (IITA, 2009). Maize provides benefits including human, animal foods and raw materials for industry (including the production of drinks and food products) (Olaniyan, 2015). In Nigeria, maize may be used alone or in combination for making food materials for man consumptions like

Ogi, tuwo, donkunnu, maasa, akple, egbo, aadun, kokoro, elekute etc (Abdulrahhaman and Kolawole, 2006).

Biotic and abiotic factors are the constraints to the production of maize. The biotic factors are pests, weeds and diseases. There have been sufficient reports that weeds are major threats to the production of maize (Cheema and Irshad, 2004) and there are critical periods in the life cycle of the crop in which it must be kept weed-free to prevent weeds reduction effects (Das, 2011). However, maize yield is widely affected by weed competition. El Koomy (2005) reported that the reduction in maize due to weeds is as a result of the effects of inter-plant competition for light, water, nutrition and other potential yield limiting factors. Other factors that militate against the production of maize are; the slow turnover of maize varieties and hybrids on farm, coupled with limited availability of good quality improved seed, fertilizer and other inputs which have minimized the potential yield recorded on farm in Nigeria (Adenola and Akinwumi, 1993). The attainments by breeders in the development and release of superior maize varieties with higher yield potentials and better resistance to insect pests and diseases have played a vital role in maize production growth in the country (Obi, 1991).

In the use of botanicals in the management of weeds, the incorporation of *Eucalyptus* residue at lower rate of (0.5%) induced a stimulatory effect in all growth parameters of both root and shoot of *Zea mays* (Hegab *et al.,* 2016). Jayakumar *et al* (1990) recorded the irrigation of groundnut and maize with 5, 10, 15 and 20% aqueous leaf extracts of *Eucalyptus globulus* greatly reduced height of the plant and leaf area. The lowest level of *Eucalyptus* leaf residue which was not above 0.5% induced an accumulation of the total phenolic compounds which was more pronounced in phenolic glycosides than phenolic aglycones throughout the experimental periods of 10, 20 and 30 days. The total phenolics increased with increasing concentrations of the *Eucalyptus* leaf residue. Phenolic glycosides production may be effective in protecting maize with lowest *Eucalyptus camaldulensis* (0.5%) against the external stress conditions. This was observed where high accumulation of phenolic glycosides, reduced the phytotoxic effects of *Eucalyptus* allelochemicals (Hegab *et al*., 2016).

It was found that, in legume plants, the total chlorophyll content was ultimately affected and its accumulation was significantly reduced in plants treated with both aqueous seed and leaf extracts of *Datura stromium* (Elisante *et al*., 2013). Abrahim *et al.* (2000) found that relatively more lipophilic monoterpenes exhibited

less activity compared to water soluble oxygenated monoterpenes towards germination and root growth, despite the fact that they had a higher activity on oxidative metabolism of isolated mitochondria of *Zea mays*. It was also reported that concentration of chlorophyll was reduced by fresh shoot extracts of *Tithonia diversifolia* on seedlings of *Zea mays* (Oyerinde *et al*., 2009).

CHAPTE THREE

3.0 MATERIALS AND METHODS

3.1 Field Survey: Herbicide Use Types and Knowledge on Bioherbicides by Farmers in Oyo State

3.1.1 Study site

The survey was conducted at three Local Government Areas (LGAs): Ibarapa Central, Oyo West and Iseyin, which were randomly selected from the registered maize and cowpea farmers' record with Agricultural Development Programme in Oyo State, Nigeria. Oyo State is a characteristic humid environment and is located in Southwest, Nigeria. It has 33 Local Government Areas and 5% of the population was selected using proportionate random sampling method. Ibarapa Central, Oyo West and Iseyin areas are predominantly rural towns in small and commercial scale. However, Ibarapa Central lies on latitude 7^{o} 25' 19.45'' N and longitude 3^{o}14'50.57'' E, Oyo West lies on latitude 7^{o} 57' 09.68'' N and longitude 3^{o}49'32.12'' E and Iseyin lies on latitude 7^{o} 51' 27.04'' N and longitude 3^{o}33'15.59'' E. All locations were at altitude of 50 to 200 metres above sea level. The climate of the studied areas is typical of lowland Rainforest-Savannah zone characterised with wet and dry seasons with annual rainfall of 905-1063 mm (OYSG, 2017) as shown in Figure 3.1.

3.1.2 Field Survey

The list of registered farmers was obtained from Oyo State Agricultural Development Programme record (ADP, 2015), 5% of the 4250 population was selected using proportionate random sampling method. Ibarapa Central, Oyo West and Iseyin (Figure 3.1) were administered with 80, 65 and 68 questionnaires respectively, giving a total of two hundred and thirteen (213) structured and open-ended questionnaires. The questionnaires were administered to farmers to ascertain the type of chemical herbicides used and their knowledge about bio-herbicides. Validation of questionnaire was done by Dr K. A. Thomas of Department of Agricultural Extension and Rural Development, Faculty of Agriculture, University of Ibadan.

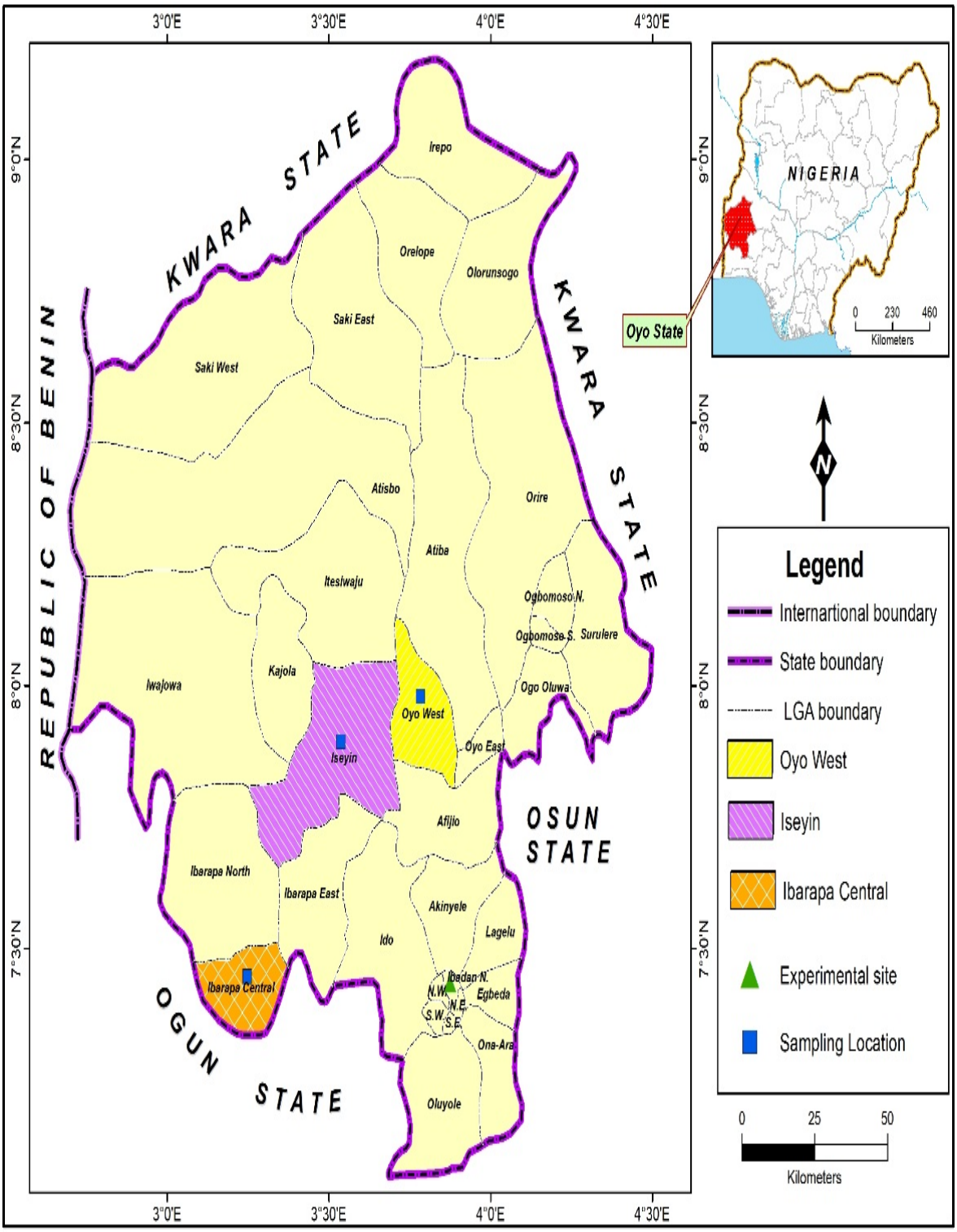


Figure 3.1: A map of Oyo State showing sampling location and experiment sites.

3.1.3 Data analysis

Responses obtained from questionnaire were collated and data were analysed using descriptive statistics.

3.2. Experiment 1: Determination of Phytochemical Constituents of *Eucalyptus camadulensis, Eucalyptus torelliana* and *Leucaena leucocephala* Extracts

3.2.1 Sample Collection and Preparation

Fresh leaves of *Eucalyptus camaldulensis, Eucalyptus torelliana* and *Leucaenia leucocephala* were collected at Forestry Research Institute of Nigeria premises (FRIN) and identified in FRIN Herbarium with 111807, 111806 and 111808, respectively for authentication. Forestry Research Institute of Nigeria (FRIN) is located in tropical forest between Latitudes 7° 23' 20" to 7 °23' 40" North and longitude 3° 51' 23" to 3° 51' 52" East. The leaf parts were air dried for six (6) weeks under room temperature (27±2 ^{0}C), after which the leaves were milled to powder form using Thomas milling machine at 1425Hz revolution per minute at Department of Agronomy, Faculty of Agriculture, University of Ibadan.

The sample preparation was further carried out at the Toxicology and Ecology Research Laboratories of the Department of Crop Protection and Environmental Biology, University of Ibadan following Ahn and Chung (2000) and Fayinminnu and Shiro (2014) procedure. Two grams of *Eucalyptus camadulensis, Eucalyptus torelliana* and *Leucaena leucocephala* were dissolved in 100 mL of distilled water for 24 hours. The solutions were filtered separately and the filtrates obtained as the extracts were subjected to phytochemical screening at the International Institute of Tropical Agriculture (IITA). Calibration of each element was carried out using a standard solution before carrying out the analysis.

a. Quantification of Total Phenol Composition

The Total Phenol Composition of the *Eucalyptus camadulensis, Eucalyptus torelliana* and *Leucaena leucocephala* extracts was assayed according to the Folin–Ciocalteu method as described by Chan *et al.* (2007). Extracts of *E. camaldulensis, E. torelliana* and *L. leucocephala* were separately dispensed into test tube of 300 µL, thus dispensary of extracts was done in triplicates. Thereafter, 1.5 ml of Folin–Ciocalteu reagent was added to each extract and was diluted 10 times with distilled water. This

was followed by the addition of 1.2 mL of Na_2CO_3 solution (7.5% w/v). The reaction mixture was shaken, allowed to stand for 30 minutes at 28^{o}C. The absorbance of the solution was measured at 765 nm against a blank prepared by dispensing 300 µL of distilled water instead of sample extract.

b. Quantification of Total Flavonoid Content

Total Flavonoid Content was assayed following Kale *et al.* (2010). An extract of 0.5 mL of the extract was measured into a test tube and 1.5 millilitre of methanol, 0.1 millilitre of aluminium chloride (10%), 0.1 millilitre of 1M potassium acetate and 2.8 millilitre of distilled water were added. The reaction solution was shaken vigorously and allowed to sit at room temperature for 30 minutes. The absorbance of the solution was measured at 514 nm.

c. Determination of Total Tannin Content

The method of Amorim *et al.* (2008) was used to assay Total Tannin. A 0.1 mL each of the extract of *E. camaldulensis, E. torelliana* and *L. leucocephala* were added to 7.5 mL of distilled water, Reagent of Folin-ciocalteus phenol (0.5 mL) and 1 millilitre of 35% sodium carbonate solution. Distilled water was used to dilute the reaction mixtures to 10 mL, properly shaken, and reserved at 28^{o}C for 30 minutes. The absorbance of the solution was measured at 725 nm.

d. Quantification Total Saponin Composition

The method described by Makkar *et al.* (2007) was used to assay Total Saponin. An aliquot of 0.25 millilitre of each of the extract of *E. camaldulensis, E. torelliana* and *L. leucocephala* was measured into separate test tube. 0.25 millilitre vanillin reagent (8% vanillin in ethanol) and 2.5 millilitre of 72% aqueous H_2SO_4 were added to the extract. The reaction mixtures in the tube were heated for 10 minutes in a water bath at 60 °C. The tubes were cooled in ice for 4 minutes and allowed to cool to 28^{o}C. The absorbance of the solution was measured at 544 nm using UV/Visible spectrophotometer.

e. Quantification of Total Alkaloid Composition

Composition Total Alkaloid of the leaf samples was assayed following Singh *et al.* (2004) procedure. A millilitre of the extract of *Eucalyptus camaldulensis, Eucalyptus*

torelliana and *Leucaena leucocephala* were mixed with 1 millilitre of 0.025 M $FeCl_3$ in 0.5 M HCl and 1 millilitre of 0.05 M of 1.10 millilitre phenanthroline in ethanol. The mixtures were incubated for thirty minutes in hot water bath at temperature of 70 ± 2^{o}C. The absorbance of the red coloured complex formed was determined at 510 nm using UV/Visible spectrophotometer.

f. **Quantification of Mimosine Level**

The samples were assayed for Mimosine Content according to the method described by Lalitha *et al.* (1993). Two grammes each of *E. camaldulensis, E. torelliana* and *L. leucocephala* were boiled in distilled water at 100^{o}C for 5 minutes. The mixtures were cooled to 28^{o}C and 20 mL of 0.2M HCl (pH 2.0) was added to each extract in the test tube. The mixtures were shaken properly, and centrifuged at 5000 rpm. A portion of 10 mL of the supernatant of each extract was mixed with 10 mg activated charcoal, and boiled for 10 minutes. Thereafter, the mixture was cooled, filtered, and the volume made up to 10 mL. An aliquot of 3.5 ml of the filtrate of each extract was mixed with 1 millilitre phosphate buffer (pH 7, 0.25M) and 0.5 ml diazotized p-nitroaniline reagent (1:1, p-nitroaniline in methanol and Na-nitrite). The mixture was kept at 28^{o}C for colour development for 15 minutes. The absorbance was read at 400 nm against a blank reagent.

3.3 Phytotoxicity of Extracts of Leaves of *Eucalyptus camudulensis, Eucalyptus torelliana* and *Leucaenia leucocephala*

3.3.1 Sources and Collection of Materials

Freshly harvested matured leaves of *Eucalyptus camudulensis*, *Eucalyptus torelliana* and *Leucaena leucocephala* were harvested from the Forestry Research Institute (FRIN), Ibadan, Oyo State, Nigeria. They were packed in sample polyethylene bags and taken to the Ecology Research Laboratory of the Department of Crop Protection and Environmental Biology (CPEB), University of Ibadan. Maize-DTMA-Y-STR variety and Cowpea (Ife-brown variety) were obtained from IITA (International Institute of Tropical Agriculture).

3.3.2 Soil Sample Collection and Physico-Chemical Analysis

3.3.2.1 Soil Sample Collection

Samples of top soil (0 - 15) were randomly collected using auger from the CPEB Crop Garden, University of Ibadan, Ibadan. Soil samples were collected, homogenised and carefully mixed to form a composite soil sample. The sample was air-dried for 4 weeks at 27 ± 2^0C, and later taken for physico-chemical analysis at the Department of Bioscience, Forestry Research Institute of Nigeria, using the standard procedures (AOAC, 2001).

3.3.2.2 Soil Physico-Chemical Analysis

A. Physical Parameters Using Bonyoucos Hydrometer Method 1962

Forty grammes (40 g) of the collected soil sample was weighed into a beaker, forty millilitres sodium hexametaphosphate and 200 millilitres of water were added. Solution was thoroughly stirred for one minute and allowed to stay overnight. The following day, electric stirrer was used to stir the mixture for 10 minutes and rinsed into a hundred millilitres measuring cylinder, up to 950 millilitre mark. The temperature of the solution was taken and thoroughly stirred for one minute. The first hydrometer reading was taken after forty seconds, while the second was taken without further stirring, two hours after the first reading. The values obtained were calculated as;

i. Percentage (%) Sand: $100 - (\frac{T1\,corrected + D1}{50} \times 100)$

ii. Percentage (%) clay: $(\frac{T2corrected + D2}{50} \times 100)$

iii. % Silt: $100 - (\%\ clay + \%\ sand)$

Where:

T_1 is the first temperature reading

T_2 is the second temperature reading

T_1 Corrected = $(T_1 - 18)\ 0.25$

T_2 Corrected = $(T_2 - 18)\ 0.25$

B. Chemical Analysis

(a) Percentage (%) Organic Carbon (Walkley Black Method, 1934)

A 3.0 g of well ground soil sample was weighed and after sieving with non-ferrous sieve (0.2 mm). 10 mL of one molar of Potassium dichromate was added, followed by 20 millilitres of concentrated H_2SO_4 from an acid dispenser. It was shaken gradually

and allowed to cool. Diphenylamine indicator (8 drops) was added and the colour was monitored. Blank determination in duplicate, was carried out using 10 millilitres of 1M potassium dichromate. The Organic carbon composition in the soil sample was calculated as.

Organic carbon (%) = (B - S) x 0.0006)/ m)*100

Where:

B = Volume of ferrous solution used in the blank titration,

S = Volume of ferrous solution used in the sample titration,

m = Mass of the sample in gr used in the analysis.

(b) Determination of Exchangeable Bases.

A 2.5g of sieved air-dried soil was weighed and 25 mL of the extracting solution, 1M ammonium acetate of pH 7.0 was measured. The mixture was agitated for thirty minutes and sieved through Whatman No. 1 filter paper. Flame photometer was used to determine the Potassium (K) and sodium (Na), while the Atomic Absorption Spectrophotometer (AAS) was used to analyse magnessium (Mg) and calcium (Ca).

C. Determination of Trace Elements in Soils using standard method

(i) Available Iron Determination

A 5.0 gramme of air-dried soil was measured and passed through 2 mm sieve. The soil was weighed into the extraction bottle. Twenty five millilitres of ammonium acetate of pH 4.8 was added and agitated for 30 minutes on the mechanical shaker. Iron (Fe) was assayed using the AAS.

(ii) Quantification of Manganese Availability (Mn)

A 5.0 gramme of air-dried soil was weighed and sieved with 2 mm sieve into extraction bottle. Twenty-five millilitres of ammonium acetate pH 7.0 was added and shaken for thirty minutes on the mechanical shaker. Manganese was assayed using AAS.

(iii) Quantification of Available Zinc (Zn)

A 3.0 gramme of air-dried soil was weighed and sieved with 2 mm sieve into extraction bottle with 25 millilitre of 0.1N HCI added and shaken for 30 minutes on the mechanical shaker. The mixture was sieved through Whatman No.1 filter paper. Zinc (Zn) was determined using AAS.

(D) Quantification of Total Nitrogen

A 0.5 gramme of soil sample was weighed into 50 mL digestion tubes, mixed uniformly before weighing and the readings were taken to nearest 0.001g. Four millilitres of sulphuric acid with one tablet of Kjeldahl was added. The solution was positioned in the rock of tubes in the HD forty blocks digestor and for one hour thirty minutes it was digested at 350 ^{o}C. The block from the digestor was removed and cooled. Distilled water (500 millitres) was added to the solution, mixed vigorously and rinsed into a 100-millitres flask and made up to mark. The flask was shaken appropriately, allowed to cool, settle down and read on spectrophotometer at 630 nm. Blank contained all reagents.

The concentration of Nitrogen was inferred from the calibration curve and calculated as follows

$$\text{Percentage Nitrogen} = \frac{MHCI \times VHCI \times TV \times 4 \times 100}{VS \times 1000 \times Ws}$$

M_{HCI} represents Molality of HCI used in titration

V_{HCI} represents Titre value

TV represents Total volume made up after the digestion (Volume of Extract)

Vs represents Volume of sample used (aqueous)

Ws represents Weight of sample

(E) Quantification of Phosphorus Availability using Bray-1 Method

The substances that were used in the determination of phosphorus are;

Preparation of Phosphorus solution A reagent

Thirty millilitres of 2 molar NH_4F and 25 millilitres of 2 NH_4CI were added together and 145 mL of distilled water was used to make it up to 2 litres. A thirty seven gramme of ammonium fluoride was weighed in 450 millilitres of distilled water, then made up to 500 millilitres. 176.8 millilitres of 2M HCI was added to the solution, then it was made up to 1 litre with distilled water.

Preparation of Phosphorus solution B re-agent: Ammonium Molybdate Solution

Ammonium molybdate (twenty gramme) was dissolved in 170 millilitres of distilled water, heated to 60 ^{o} C, filtered and allowed to cool. It was mixed with 340 millilitres of concentrated HCI with thirty-two millilitres of distilled water and cooled. Reagents A and B were added gradually and cooled. A 20 grammes of H_4BO_3 were added into 500 millilitre flask and made up to mark.

Preparation of Phosphorus solution C reagent – Reducing Agent

A two and half grammes of 1-amino-2-naphtal-4-sulphonic acid, five gramme of Sodium Sulphite and 146.25 grammes of $Na_2S_2O_3$ was mixed thoroughly together. Eight gramme of the mixture was liquefied in fifty millilitres of warm distilled water, and allowed to stand overnight prior to use.

Preparation of Standard Phosphorus Solutions

Standard stock (1000 µg/ mL): 4.390 gramme of KH_2PO_4 was liquefied in nine-hundred millilitres of distilled water in a 1000 millilitres volume flask, distilled water was used to made up to mark. Standards of 1.0, 2.0, 3.0, 4.0 and 5.0 ppm were made from the 100 ppm.

For the phosphorus determination, 5 gramme of air dried soil was measured into extraction-cup and twenty five millilitres of reagent A was added. The mixture was sited on mechanical shaker and stirred for 5 minutes, and allowed to stand for two minutes. It was centrifuged for 5 minutes at 3000 rpm. Eight millilitres of solution was measured into a set of cups followed by 5 drops of phosphorus (B) solution reagent and mixed thoroughly. Five (5) drops of phosphorus (C) reagent was added and homogenised. The mixture was permitted to stand for thirty minutes, and the absorbance was measured using colorimeter at 650- 660 nm wavelength and values were determined from standard curve.

(F) pH Determination

A known weight of soil was sieved through 2 mm sieve and measured into a known volume of water. For thirty minutes, it was permitted to stand and stirred with a glass rod and the pH was measured. pH 7.0 and 3.0 buffers was used to calibrate the pH meter.

3.3.3 Plant Sample Preparation

Mature leaves of *Eucalyptus camaldulensis, Eucalyptus torelliana* and *Leucaena leucocephala* were harvested, air dried for six weeks in the laboratory at CPEB and milled to fine powder using milling machine. The extraction procedure was carried out at the Toxicology Research Laboratory, CPEB according to the methods described by Fayinminnu and Shiro (2014) with modifications. Leaf powder (144 g) of each of *E. camaldulensis, E. torelliana* and *L. leucocephala* were separately soaked in one litre of distilled water for 48 hours. The solution was vigorously shaken and filtered using a muslin cloth. The filtrate served as the stock solution at 100% (w/v) concentrations.

Other lower concentrations (75%, 50% and 25%) of the powder and the distilled water mixture were obtained as; 108 g/L, 72 g/L and 36 g/L, respectively while the 0% concentration contained only distilled water. The different aqueous concentrations of *E. camaldulensis, E. torelliana* and *L. leucocephala* obtained were stored in the refrigerator at 20^{o}C for 24 hours to prevent putrefaction and degradation of the extracts before the bioassay usage (Fayinminnu and Shiro, 2014).

3.4 Experiment 2: Phytotoxic Effect of *Eucalyptus camudulensis* and *Leucaena leucocephala* Extracts on the Seed Germination of Cowpea and Maize

The toxic effects of five different concentrations (100 %, 75 %, 50 %, 25 % and 0 %) of the powder extracts of *E. camaldulensis, E. torelliana* and *L. leucocephala* on the germination and seedling growth of seeds of *Vigna unguiculata* and *Zea mays* were studied in-vitro at the Ecology Research Laboratory, CPEB. The seeds of test crops (*Vigna unguiculata* and *Zea mays*) were surface sterilized with 5 % (w/v) sodium hypochlorite for 90 seconds, removed and washed thrice (3 minutes per wash) with distilled water (Owoseni and Awodoyin, 2013). Ten seeds each of *Vigna unguiculata* and *Zea mays* were put inside 9 cm petri dish containing Whatmann No. 1 filter paper.

A total of 96 petri dishes (48 petri dish for each of maize and cowpea) were used and arranged in a completely randomized design on laboratory bench of the Ecology laboratory of CPEB replicated three times. Then, 2.0 mL of the aqueous extract concentrations (100 %, 75 %, 50 % and 25 %) of *E. camaldulensis, E.*

torelliana and *L. leucocephala* extract and 0% (distilled water) were added into the petri dishes. The petri dishes were observed daily for seven days and the experiment was carried out in 2 trials.

Data were collected from each petri dish for number of germinated seeds, length of radicle and plumule. Percentage germinations were calculated (Owoseni and Awodoyin, 2013).

$$\text{Percentage Germination} = \frac{\textit{No of germinated seeds}}{\textit{Total No of seeds plated}} \times 100$$

All data on treatments were compared using analysis of variance (ANOVA) and means were separated using Duncan multiple range test at 5% level of probability.

3.5 Experiment 3: Evaluation of Phytotoxic Effects of *Eucalyptus camudulensis, Eucalyptus torelliana* and *Leucaena leucocephala* extracts on the Weeds of Cowpea and Maize

This research was carried out at CPEB, Open Roof Top Garden, University of Ibadan. The toxic effects of *E. camaldulensis, E. torelliana* and *L. leucocephala* on growth of cowpea and maize were evaluated through this experiment as follows.

Top soil of 10 kg was filled into 120 pots (22 cm by 28 cm) for each of the test crops (cowpea and maize). Each set up was treated separately with distilled water (control 1) and Paraquat (control 2) and varying concentrations (100%, 70%, 50%, and 25% w/v) aliquot extract of *E. camudulensis, E. torelliana* and *L. leucocephala* that were prepared. The experiment was laid out in a completely randomized design and replicated three times. Before the sowing of seeds, pre-emergence application of the six treatments was carried out. However, two seeds each of cowpea and maize were sown in different pots at 5 cm depth. Two hundred (200 mls) of each of the extract of *E. camaldulensis, E. torelliana* and *L. leucocephala* were applied at 100%,75%, 50%, 25% and the distilled water and paraquat as controls to the seedlings of cowpea and maize before and after plant emergence. One week after sowing (WAS), seedlings were thinned to one seedling stand per pot. The agronomic parameters of the cowpea and maize were done at 3, 5, 7, 9, 11 weeks after sowing (WAS).

Data were collected on plant height and stem diameter using meter rule and Vernier caliper, respectively, while numbers of leaves were obtained by visual counting. However, the cobs per plant, number of pods and 100 seeds weight per plant

were determined for yield. The dry weight matter accumulation was determined by uprooting each plant of the treated pot out with some of the soil and placed in bowl of water to loosen the soil in order to fully recover the root system as much as possible (Awodoyin, 2010). Each of the plant treated was divided into the root and shoot, packed in well labelled paper envelope and oven dried at 80^{o}C to a constant weight in a Gallenkemp oven for 10 days and weighed using Metler balance (model-P1210).

3.6 Statistical Analysis

All data obtained were analyzed using Analysis of Variance (ANOVA) and means values were separated using Duncan multiple range test at 5% probability level. The density of the weed was determined by identification of weeds at each treated pot at two weeks interval starting from the third week after-sowing (3 WAS) to nine week after-sowing (9 WAS) using a weed flora by Akobundu and Agyakwa (1998) and Akobundu *et al* (2016). The data collected were analysed for Relative Importance Value (RIV) (Kent and Coker, 1992), Species diversity/ population (using palaentological software) (Hill, 2012) and dry weed biomass was measured (g).

CHAPTER FOUR

4.0 RESULTS

4.1: Demographic Information of the Respondents

The result in Table 4.1 reveals that 84.9% of the farmers are male, while only 15.1% are female. Age distribution of the farmers shows that most of them are between the ages of 46 years and above (73.1%). It was also observed that majority of them were Moslems (53.8%) and 98.6% were married. The result of educational background shows that 54.7% of the farmers had no formal education and 16 -30 years farming experience recorded 85.8%. It was also very clear that 204 (96.2%) farmers responded that weed affects their plants.

4.1.1: Farmer's Knowledge and Usage of Bio-Herbicide

A total of two hundred and thirteen (213) questionnaires were administered to farmers to evaluate their knowledge about the use of bio-herbicide and two hundred and twelve (212) were returned. In response, two (2) farmers (0.9%) out of two hundred and twelve responded that they have knowledge on bio-herbicide and its use in weed control while, two hundred and ten (210) farmers (99.1%) responded that they have no knowledge of bio-herbicides and its use (Figure 4.1).

4.1.2: Common herbicides used in weeds control in Cowpea and Maize field

There were thirteen (13) commonly used herbicides in the control of weeds in cowpea cultivation areas surveyed in Oyo State in 2015, though, most (61%) farmers did not use herbicides but practised hand weeding. Among the farmers that use synthetic herbicides for weeds control, paraforce (paraquat) was the highest (13.1%) in cowpea as the most commonly used. This was followed by paragon, dragon, mixture of paraforce and glyphosate at 6.1%, 4.7% and 3.8%, respectively (Table 4.2).

In maize field, there were eleven (11) commonly used herbicides in the areas surveyed in Oyo State in 2015, though some (25%) farmers used hand weeding. Among the farmers that use chemical herbicides for weeds control, paraforce (paraquat) was the highest (29.2%) value as the most commonly used.

Table 4.1: Demographic information of the respondent

Characteristics	Categorise	Frequency (%), n=212
Age(years)	26 - 35	1.4
	36 – 45	24.5
	46-above	73.1
Religion	Christianity	46.2
	Islam (Moslems)	53.8
Sex	Male	84.9
	Female	15.1
Marital status	Single	0.9
	Married	98.6
	Widow	0.5
Education background	No formal education	54.7
	Primary	30.2
	Secondary school	12.7
	Tertiary	2.4
Years of farming experience	1-15	3.3
	16 – 30	85.8
	31 – 45	8.5
	46- Above	2.4
Effect of weed on plant	Yes	96.2
	No	3.8

Field survey (2015)

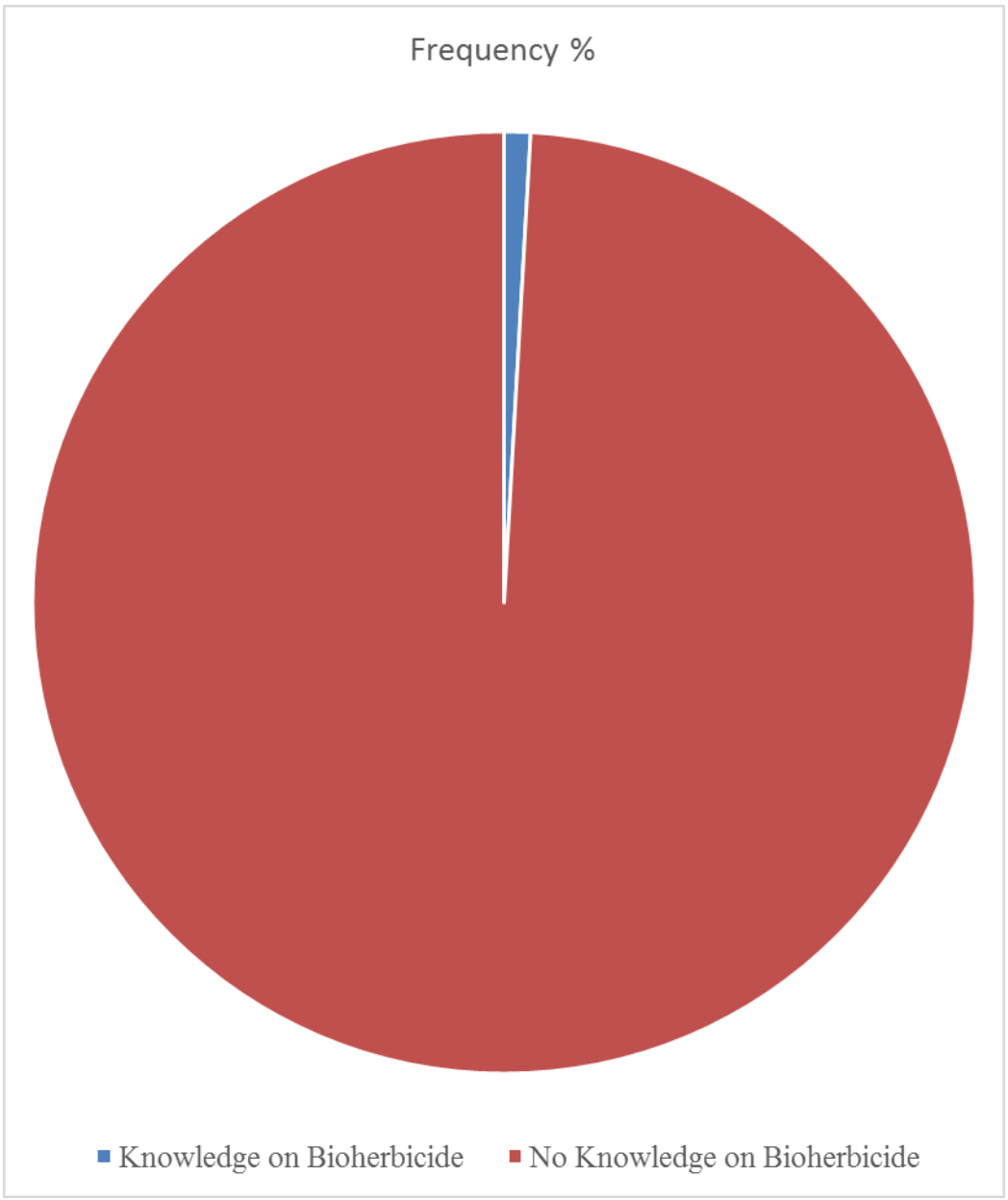


Figure 4.1: Farmer's knowledge on bioherbicide usage in Ibadan 2015

Table 4.2: Commonly used chemical herbicides in weed control in cowpea and maize

Common names of chemicals (Trade name)	**Percentage of usage (%)**	
	Cowpea	Maize
Dragon (Paraquat Dichloride)	4.7	6.1
Fiscosate + Paraforce (paraquat)	0.0	3.0
Glyphosate (Roundup/ Glyphomate)	1.5	0.0
Gramoxone (Paraquat)	0.5	1.5
Hand weeding	61.0	25.0
Paraquat (grammoxone)+ Glyphosate (Round-up)	3.8	21.1
Paraquat/ Paraforce (grammoxone)	13.1	29.2
Paraquat (grammoxone) + Atrazine (AAtrex)	1.5	6.4
Paragon (Group FI)	6.1	4.2
Paragon (group FI) + Dragon (Paraquat Dichloride)	1.5	1.5
Paraquat (grammoxone)+ Glycosite + Primextra (Primextra Gold)	1.4	0.0
Primextra (Primextra Gold)	1.4	1.5
Primextra (Primextra Gold) + Dragon + Alachlor (Lasso)	1.5	0.0
Primextra (Primextra Gold) + Paragon (Paraquat Dichloride) + Fiscosate	1.5	0.0
Round-up (Round-up)	0.5	0.5
Total	**100.0**	**100.0**

Field survey: 2015

This was followed by mixture of paraforce and glyphosate, dragon, and mixture of paraforce and atrazine at 21.1%, 6.1% and 6.4% respectively, as represented in Table 4.2

4.2. Quantitative Determination of Phytochemicals in *Eucalyptus torelliana, Eucalyptus camudulensis* and *Leucaena leucocephala*

The phytochemical screening result showed the presence of total phenols, flavonoids, tannins, saponins, alkaloids and mimosine at varying amounts. Among the extracts, *Eucalyptus camaldulensis* had the highest quantity of total phenols (32.0±0.10), tannins (27.4±0.04), saponins (20.2±0.03) and significantly higher in Ec than in Et (21.8±0.08, 17.9±0.09, 14.2±0.06) and Ll (9.5±0.08, 8.6±0.19, and 6.3±0.14), respectively (Table 4.3*)*. The alkaloids and mimosine, however, were significantly higher in *Leucaena leucocephala* at 11.4±0.15 and 5.09±0.05 mg/g than in *Eucalyptus torelliana* (2.55±0.07 and 0.27±0.01 mg/g), respectively (Table 4.3).

4.3. Phytotoxic Effect of Extracts of *Eucalyptus torelliana* (Et), *Eucalyptus camudulensis* (Ec) and *Leucaena leucocephala* (Ll) on Seed Germination of Cowpea

The mean germination of cowpea values with the extract of Et as shown in Plates 4.1a, 4.1b and Table 4.4. The value varies from 8.3±0.3 to 9.7±0.4 in the first trial and ranged from 8.7±0.6 to 10.0±1.6 in second trials at days 3, 5 and 7 days after sowing (DAS), respectively. In the first trial, at day 7 there were no significant differences among the extracts of Et at 100, 75, 50 and 0%; except 25% that was significantly different from others. Although 50 and 0 % had the higher value of 9.7±0.3. While in the second trail, 5 and 7 DAS was not significantly different among the extracts of Et at 100, 75, 50, 25 and 0%. Although 0% had the higher value (10.0±1.6) with significant difference from other concentrations (100, 75, 50 and 25%) in day 3 (Plate 4.1a, 4.1b and Table 4.4).

Phytotoxic effect of *E.camaldulensis* (Ec) on cowpea seed germination in the first trial had no significant different among the extracts of Ec at 100, 50 and 0% concentration at 3 and 5 DAS. Although the higher value (10.0±0.5) was recorded at 100% of 5 DAS with significant difference from 75 and 25%. While in the second trial, 5 and 7 DAS, the concentration among the extracts of *E. camaldulensis* at 75, 50, 25

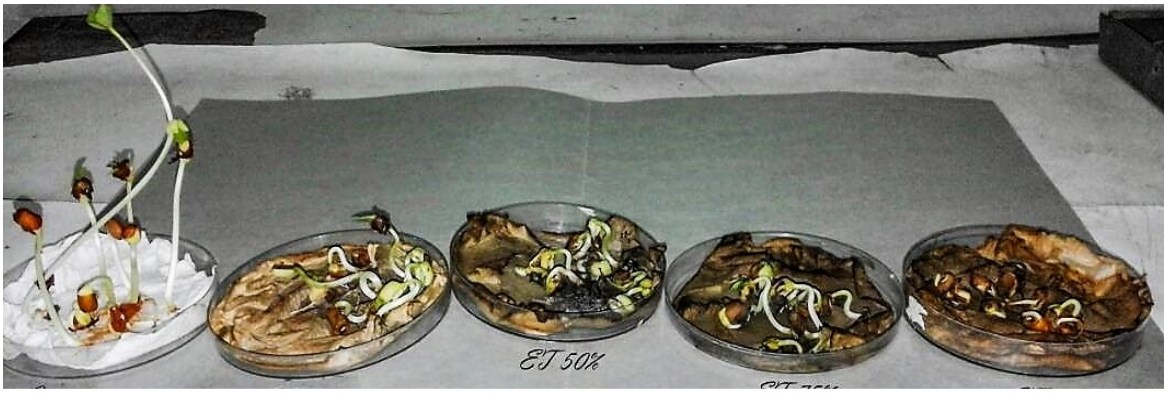
Table 4.3: Quantitative determination of the phytochemicals in the extracts of *Eucalyptus torelliana, E. camudulensis and L. leucocephala*

	Plant species		
Phytochemicals	*Eucalyptus torelliana* (mg/g)	*Eucalyptus camudulensis* (mg/g)	*Leucaena leucocephala* (mg/g)
Alkaloids	2.55±0.07[c]	4.83±0.04[b]	11.40±0.15[a]
Flavonoids	0.29±0.01[b]	1.42±0.01[a]	0.17±0.00[c]
Mimosine	0.27±0.01[b]	0.34\±0.01[b]	5.09±0.05[a]
Saponins	14.18±0.06[b]	20.15±0.03[a]	6.30±0.14[c]
Tannins	17.91±0.09[b]	27.40±0.04[a]	8.55±0.19[c]
Total phenols	21.78±0.08[b]	32.04±0.10[a]	9.47±0.08[c]

Means ± standard errors along a row having the same letter(s) as superscript are not significantly different at 5% probability

Control Et 25 % Conc. Et 50 % Conc. Et 75% Conc. Et 100%Conc.

Plate 4.1a: Phytotoxic effect of extracts of *Eucalyptus torelliana* on seed germination of cowpea in the first trial



Control Et 25 % Conc. Et 50 % Conc. Et 75% Conc. Et 100%Conc.

Et - *Eucalyptus torelliana*, control (0%) – distilled water

Plate 4.1b: Phytotoxic effect of extracts of *Eucalyptus torelliana* on seed germination of cowpea in the second trial

Control Ec 25 % Conc. Ec 50 % Conc. Ec 75% Conc. Ec 100% Conc

Ec - *Eucalyptus camaldulensis*, control – distilled water

Plate 4.2a: Phytotoxic effect of extracts of *Eucalyptus camaldulensis* on seed germination of cowpea in the first trial

Control Ec 25 % Conc. Ec 50 % Conc. Ec 75% Conc. Ec 100% Conc

Plate 4.2b: Phytotoxic effect of extracts of *Eucalyptus camaldulensis* on seed germination of cowpea in the second trial

Control Ll 25 % Conc. Ll 50 % Conc. Ll 75% Conc. Ll 100%Conc.

Ll - *Leucaena leucocephala;* control – distilled water

Plate 4.3a: Phytotoxic effect of extracts of *Leucaena leucocephala* on seed germination of cowpea first trial

Control Ll 25 % Conc. Ll 50 % Conc. Ll 75% Conc. Ll 100%Conc.

Ll - *Leucaena leucocephala;* control – distilled water

Plate 4.3b: Phytotoxic effect of extracts of *Leucaena leucocephala* on seed germination of cowpea second trial

Table 4.4: Phytotoxic effect of aqueous extracts of *Eucalyptus torelliana*, *Eucalyptus camudulensis* and *Leucaena leucocephala* on seed germination of cowpea

		Trial 1			**Trial 2**		
Trts	Conc (%)	3 DAS	5 DAS	7 DAS	3 DAS	5 DAS	7 DAS
Et	100	83.3±0.3^{ac}	90.0±0.3^{abc}	96.7±0.4^{a}	86.7±0.6^{bc}	93.3±1.0^{a}	93.3±0.6^{a}
	75	96.7±0.3^{a}	93.3±0.2^{ab}	96.7±0.1^{a}	96.7±0.2^{ab}	96.7±0.4^{a}	96.7±0.3^{a}
	50	96.7±0.3^{a}	96.7±1.0^{a}	96.7±0.3^{a}	93.3±0.3^{abc}	96.7±0.4^{a}	96.7±0.3^{a}
	25	90.0±0.6^{c}	90.0±1.0^{abc}	90.0±0.5^{abc}	93.3±0.3^{abc}	96.7±0.5^{a}	96.7±0.4^{a}
	Dw	96.7±0.3^{a}	96.7±0.3^{a}	96.7±0.3^{a}	100.0±1.6^{a}	100.0±1.6^{a}	100.0±1.6^{a}
Ec	100	96.7±0.3^{a}	100.0±0.5^{a}	93.3±0.3^{ab}	83.3±1.2^{c}	83.3±0.4^{b}	83.3±1.2^{b}
	75	93.3±0.1^{abc}	93.3±0.4^{ab}	93.3±0.2^{ab}	90.0±1.2^{abc}	93.3±1.0^{a}	93.3±0.8^{a}
	50	96.7±0.3^{a}	96.7±0.2^{a}	96.7±1.2^{a}	93.3±1.5^{abc}	100.0±1.2^{a}	100.0±0.8^{a}
	25	93.3±0.7^{abc}	93.3±0.4^{ab}	93.3±1.5^{ab}	100.0±1.2^{a}	100.0±0.8^{a}	100.0±0.4^{a}
	Dw	96.7±0.3^{a}	96.7±0.3^{a}	96.7±0.3^{a}	100.0±1.6^{a}	100.0±1.6^{a}	100.0±1.6^{a}
Ll	100	90.0±0.5^{abc}	93.3±0.3^{ab}	83.3±0.7^{bc}	100.0±0.4^{a}	100.0±1.2^{a}	100.0±0.2^{a}
	75	83.3±1.2^{ac}	83.3±0.6^{bc}	83.3±0.5^{bc}	96.7±0.8^{ab}	100.0±1.5^{a}	100.0±0.2^{a}
	50	80.0±0.5^{c}	80.0±0.4^{c}	80.0±0.3^{c}	90.0±1.0^{abc}	100.0±1.2^{a}	100.0±0.2^{a}
	25	96.7±0.3^{ab}	96.7±0.3^{a}	96.7±0.3^{a}	93.3±0.8^{abc}	100.0±1.2^{a}	100.0±0.4^{a}
	Dw	96.7±0.3^{ab}	96.7±0.3^{a}	96.7±0.3^{a}	100.0±1.6^{a}	100.0±1.6^{a}	100.0±1.6^{a}

Trts-Treatments, Conc.-Concentration, DAS-Days After Sowing, Et-*Eucalyptus torelliana*, Ec- *Eucalyptus camudulensis*, Ll - *Leucaena leucocephala;* Dw (0) – distilled water

Means ± standard errors within a column having the same letter(s) as superscript are not significantly different at 5% probability level using Duncan's Multiple Range Test (DMRT)

And 50% were significantly different from 100% (8.3±0.4) which was the least value of the seed germination (Plate 4.2a, 4.2b and Table 4.4).

In the first trial with the extracts of *L.leucocephala* (Ll), there were significant differences among the extracts of Ll at 100, 75, 50% with control (0%) at 3, 5 and 7 DAS. Although 25 and 100% had the higher seed germination value (9.7±0.3) with significant difference from other concentrations. In the second trial of cowpea seed germination, it was only significant at day 3 at 75%, 50% and 25% when compared with control and 100% (Plate 4.3a, 4.3b and Table 4.4).

4.4. Phytotoxic Effects of Aqueous Extracts of *Eucalyptus torelliana* (Et), *Eucalyptus camaldulensis* (Ec) and *Leucaena leucocephala* (Ll) Extracts on Seed Germination of Maize

The highest mean germination of maize with the extract of Et was 9.67±1.0 at 5 and 7 DAS at concentrations (100% and 50%) in the first trial with significant difference with the 0%, while the highest mean germination of 10.0±0.5 at 75% concentration in second trial was observed. There was significant difference at 3 DAS compared to the mean germination observed at 5 and 7 DAS in the first trial (Plate 4.4a and Table 4.5)

In second trial, the minimum mean germination of maize with the extract of Et was 8.0±0.3 at 3 DAS with 100% concentration. There were significant differences ($P<0.05$) in all the concentrations of 3 DAS compared with the mean germination observed in 100% concentration. (Plate 4.4b and Table 4.5).

The highest mean germination of maize with the extract of *E. camaldulensis* was 10.00±1.4 at 5 and 7 DAS of 75 % and 25 % concentrations in the first trial. (Plate 4.5a and Table 4.4a). There were significant differences among the different concentrations at 5 and 7 DAS compared with the control in the first trial (Table 4.5).

In the second trial (Plate 4.5b and Table 4.5) the least mean germination (7.33±0.3) observed for Ec was at 100% concentration and occurred at 3 DAS. Meanwhile, the same trend was observed at 5 and 7 DAS with all the concentrations. There were significant differences between 100% and 75% at 3, 5 and 7 DAS with the control (0%). Mean germination of maize was highest (10.00±0.8) with the extract of Ec at 25% of 7 DAS, with significant difference from other concentrations. Meanwhile, there were significant increment among all concentrations from 3 DAS to 7 DAS

Control Et 25 % Conc. Et 50 % Conc. Et 75% Conc. Et 100%Conc.

Et- ***Eucalyptus torelliana,*** control – distilled water

Plate 4.4a: Phytotoxic effect of extracts of *Eucalyptus torelliana* on seed germination of maize in the first trial

Control Et 25 % Conc. Et 50 % Conc. Et 75% Conc. Et 100%Conc.

ET - *Eucalyptus torelliana;* control – distilled water

Plate 4.4b: Phytotoxic effect of extracts of *Eucalyptus torelliana* on seed germination of maize in the second trial

Control **Ec 25 % Conc.** **Ec 50 % Conc.** **Ec 75% Conc.** **Ec 100% Conc**

Ec-*Eucalyptus camaldulensis,* control – distilled water

Plate 4.5a: Phytotoxic effect of extracts of *Eucalyptus camudulensis* on seed germination of maize in the first trial

Control **Ec 25 % Conc.** **Ec 50 % Conc.** **Ec 75% Conc.** **Ec 100%Conc.**

Ec- ***Eucalyptus camaldulensis,*** control – distilled water

Plate 4.5b: Phytotoxic effect of extracts of *Eucalyptus camaldulensis* on seed germination of maize in the second trial

Control **Ll 25 % Conc.** **Ll 50 % Conc.** **Ll 75% Conc.** **Ll 100%Conc.**

Ll- ***Leucaena leucocephala,*** control – distilled water

Plate 4.6a: Phytotoxic effect of extracts of *Leucaena leucocephala* on seed germination of maize in the first trial

Control **Ll 25 % Conc.** **Ll 50 % Conc.** **Ll 75% Conc.** **Ll 100% Conc.**

Ll- ***Leucaena leucocephala,*** control – distilled water

Plate 4.6b: Phytotoxic effect of extracts of *Leucaenia leucocephala* on seed germination of maize in the second trial

Table 4.5: Phytotoxic effect of aqueous extracts of *Eucalyptus torelliana, Eucalyptus camudulemensis* and *Leucaenia leucocephala* on germination of maize

	First trial			Second trial		
Trts.	Conc	3 DAS	5 DAS	7 DAS	3 DAS	5 DAS	7 DAS
Et	100	80.0±0.7^{ab}	96.7±1.0^{a}	96.7±1.4^{a}	80.0±0.3^{abc}	93.3±0.4^{ab}	93.3±0.4^{ab}
	75	73.3±0.2^{abc}	90.0±0.8^{a}	90.0±1.2^{a}	100.0±0.8^{a}	100.0±0.5^{a}	100.0±0.5^{a}
	50	90.0±0.3^{a}	96.7±0.6^{a}	96.7±0.4^{a}	93.3±0.5^{ab}	100.0±1.2^{a}	100.0±1.2^{a}
	25	76.7±0.5^{abc}	90.0±1.2^{a}	90.0±0.6^{a}	96.7±0.3^{a}	96.7±1.0^{ab}	96.7±1.0^{ab}
	Dw	70.0±0.6^{bc}	30.0±0.1^{b}	30.0±0.1^{b}	90.0±0.0^{ab}	96.7±0.3^{ab}	96.7±0.3^{ab}
Ec	100	73.3±0.2^{abc}	86.7±1.0^{a}	86.7±0.4^{a}	73.3±0.3^{c}	86.7±1.0^{b}	86.7±1.0^{b}
	75	60.0±0.2^{c}	100.±1.4^{a}	100.0±0.8^{a}	80.0±0.5^{bc}	86.70.8^{b}	86.7±8.67^{b}
	50	86.7±0.9^{ab}	96.7±0.8^{a}	96.7±0.4^{a}	93.3±0.6^{ab}	96.7±0.6^{ab}	96.7±0.6^{ab}
	25	90.0±1.0^{a}	100.0±1.4^{a}	100.0±0.5^{a}	86.7±0.8^{abc}	96.7±0.4^{ab}	100.0±0.8^{a}
	Dw	70.0±0.6^{bc}	30.0±0.1^{b}	30.0±0.1^{b}	90.0±0.0^{ab}	96.7±0.3^{ab}	96.7±0.3^{ab}
Ll	100	76.7±0.3^{abc}	93.3±0.9^{a}	93.3±1.0^{a}	86.7±1.2^{abc}	96.7±0.8^{ab}	96.7±0.6^{ab}
	75	86.7±0.5^{ab}	96.7±1.2^{a}	96.7±0.5^{a}	90.0±0.8^{ab}	93.3±0.6^{ab}	93.3±0.6^{ab}
	50	83.3±0.3^{ab}	90.0±0.6^{a}	90.0±0.7^{a}	96.7±0.6^{a}	96.7±0.3^{ab}	100.0±0.8^{a}
	25	90.0±0.4^{a}	96.7±0.8^{a}	96.7±0.7^{a}	96.7±1.0^{a}	100.0±1.0^{a}	100.0±0.9^{a}
	Dw	*70.0±0.6^{bc}	*30.0±0.1^{b}	*30.0±0.1^{b}	90.0±0.0^{ab}	96.7±0.3^{ab}	96.7±0.3^{ab}

Trts-Treatments, Conc.-Concentration, DAS-Days After Sowing, Et-*Eucalyptus torelliana*, Ec-*Eucalyptus camudulensis*, Ll - *Leucaena leucocephala;* Dw (0) – distilled water

Means ± standard errors within a column having the same letter(s) as superscript are not significantly different at 5% probability level using Duncan's Multiple Range Test (DMRT)

*Plate attacked by Rodents

Phytotoxic effect of *L. leucocephala* on maize germination in the first trial showed that the highest mean of 9.67±1.2 was observed at 5 and 7 DAS with 75% and 25%, which was not significantly different from the control (0%). While, the least mean 3.0±0.1 at 5 and 7 DAS was recorded at 0% with a significant difference from every other concentration (Table 4.5).

In the second trial, the highest mean germination (10.0±1.0) of maize was recorded at 5 and 7 DAS at 25 % concentration; and at 7 DAS at 50% concentration which were significantly different from the control. Thus, with *L. leucocephala* extracts, the lowest mean germination (8.67±1.2) was observed at 100% at 3 DAS which was significantly different from other concentrations. (Plate 4.6b and Table 4.5).

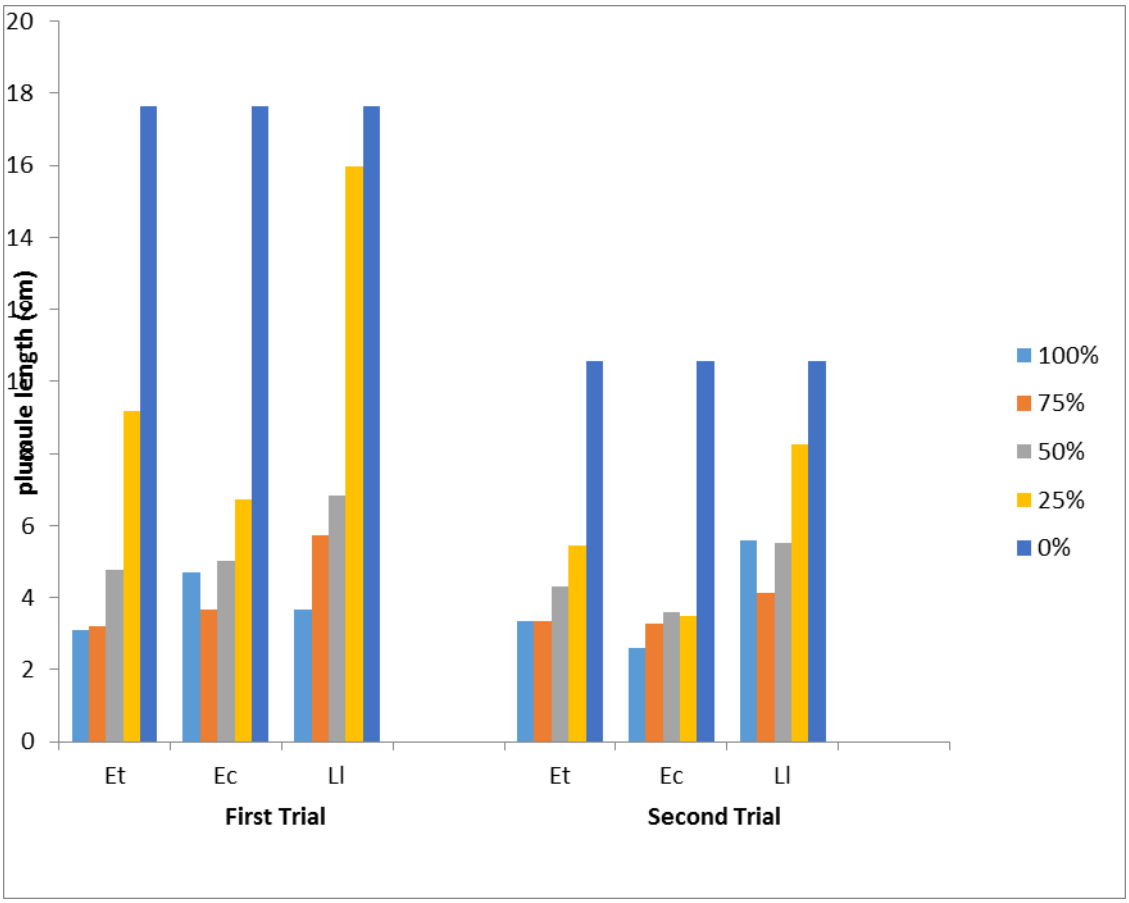
Generally, the lowest mean germination was 3.00±0.1 (control) for each of the extracts at 5 and 7 DAS, while 7.00±0.6 at 3 DAS. (Table 4.5).

4.5 Phytotoxic Effects of Extracts of *Eucalyptus torelliana* (Et), *Eucalyptus camaldulensis* (Ec) and *Leucaena leucocephala* (Ll) on Plumule and Radicle Length of Cowpea

In the first trial of Et, 0% had higher value (17.6±2.0 cm) of plumule length with a significant difference from other concentrations (100, 75, 50 and 25%). However, the least plumule length (3.09±0.4 cm) of cowpea was recorded at 100% with a significant difference from 50%, 25% and 0%. The same trend of result was observed in the second trial. The control had the higher plumule length (10.6±0.9 cm) which was significantly different from other concentrations. Although the least plumule length of cowpea (3.36±0.2 cm) was recorded at 100% and 75% (Plate 4.1a, 4.1b and Figure 4.2).

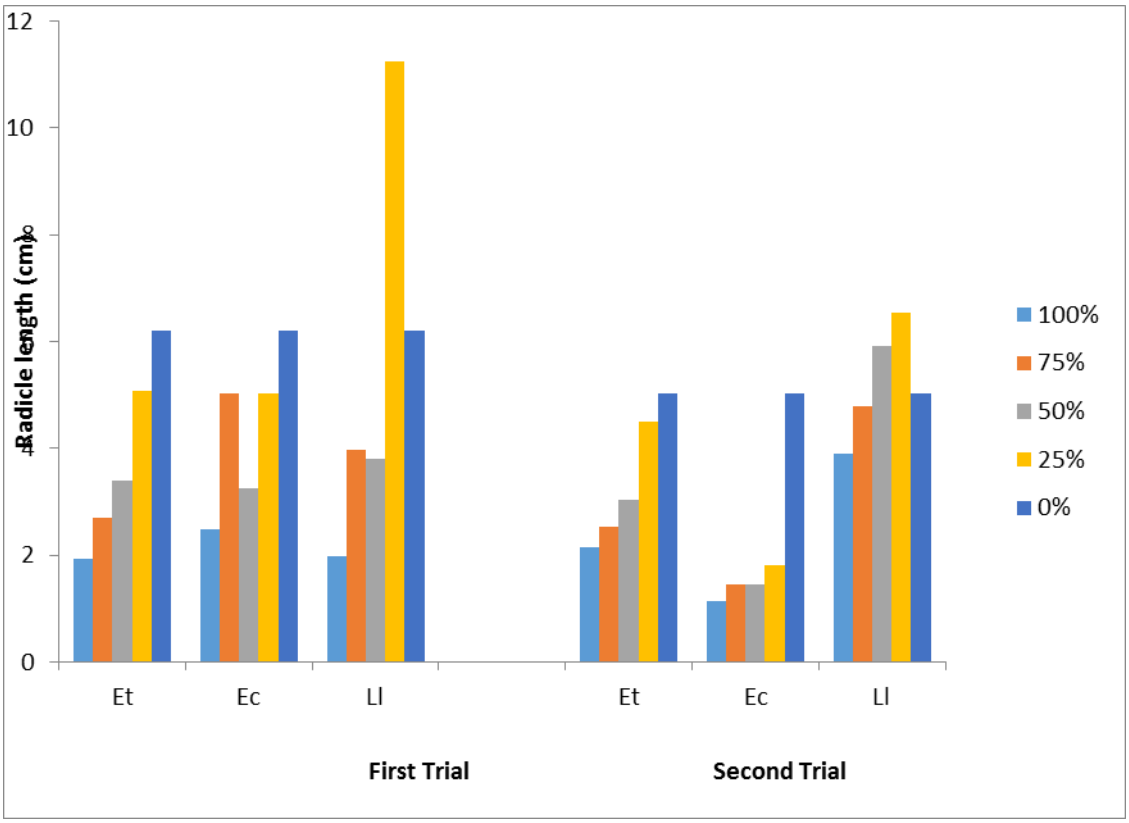
In the first trial of Ec, control recorded the higher plumule length (17.6±2.0 cm) with a significant difference from other concentrations. In Figure 4.2, the same trend of result was shown across other extracts and in both trials. In first trial of Ll where the value (15.96±0.7 cm) at 25% was not significantly different from the control.

The highest mean radicle length (6.21±0.4 cm) of cowpea was at 0% concentration, while the lowest (1.94±0.1cm) was at Et 100%. Among the plant extracts at all concentrations there were significant differences compared with the control in the first trial. It was observed that, the mean radicle length is inversely



Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, lL - *Leucaenia leucocephala;* control (0) – distilled water

Figure 4.2: Phytotoxic effect of extracts of *Eucalyptus torelliana*, *Eucalyptus camudulensis* and *Leucaena leucocephala* on Plumule length of cowpea



Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, lL - *Leucaenia leucocephala;* control (0) – distilled water

Figure 4.3: Phytotoxic effect of extracts of *Eucalyptus torelliana*, *Eucalyptus camudulensis* and *Leucaena leucocephala* on Radicle length of cowpea

proportional to the concentrations of each of the extract of Et, Ec and Ll in the first trial (Figure 4.3).

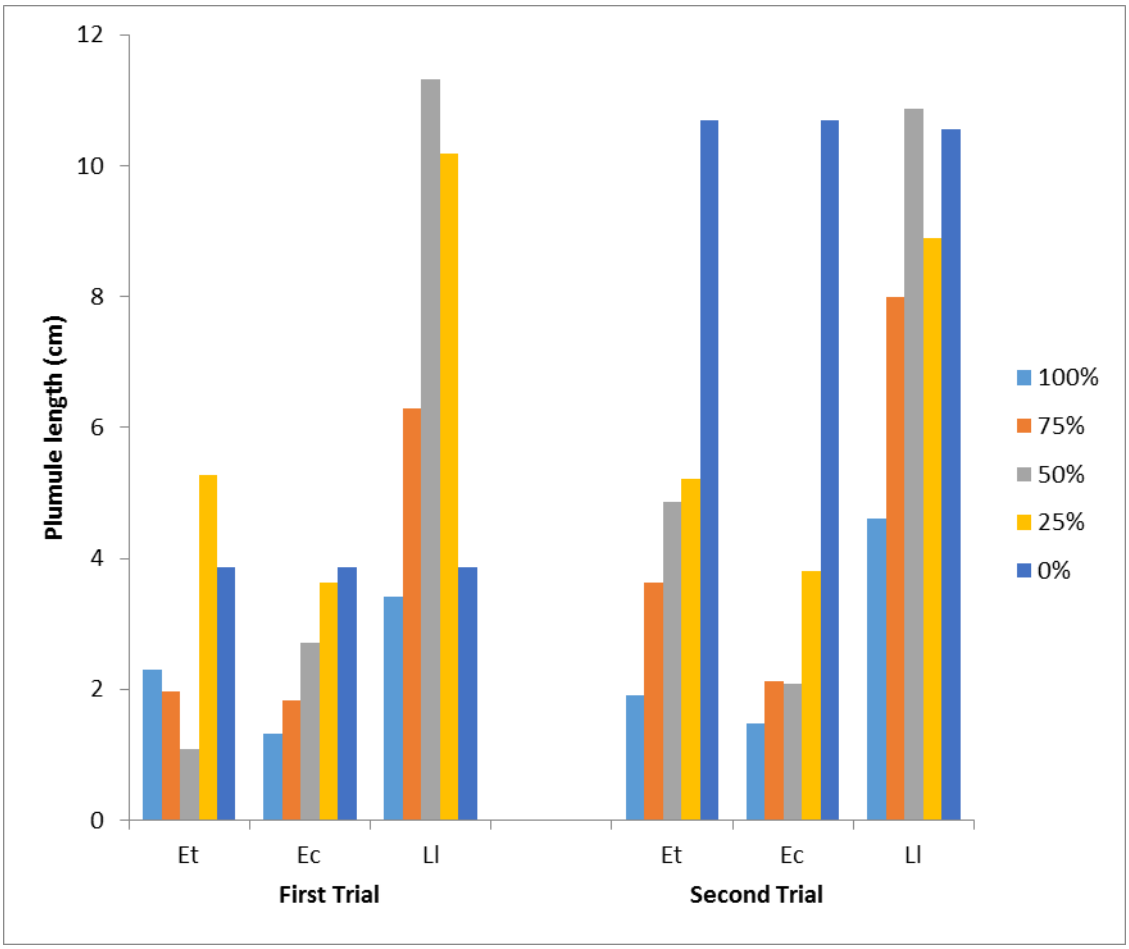
In the second trial, the highest mean radicle length obtained for cowpea was 5.03±0.2 cm at 0% concentration (control) for each of the extracts of *Eucalyptus torelliana*, *E. camudulensis* and *Leucaena leucocephala,* while the lowest mean radicle length of their extracts was 1.13±0.1cm at 100% Ec. There were no significant differences (P>0.05) in mean radicle length between 100% and 75% of *Eucalyptus torelliana*, 100%, at 75%, 50% and 25% with *Eucalyptus camudulensis*, while there were significant differences (P<0.05) among all concentrations with *Leucania leucocephala* (Figure 4.3). In comparison with control, there were significant differences in the mean radicle length at all concentrations of *Eucalyptus torelliana*, *E. camudulensis* and *L.leucocephala*. The higher the concentrations, the lower radicle length and vice versa (Figure 4.3).

4.6: Phytotoxic Effects of Extracts of *Eucalyptus torelliana, Eucalyptus camaldulensis* and *Leucaena leucocephala* on Plumule and Radicle Length of Maize

The mean plumule length of maize was significantly lower at 100%, 75% and 50% compared with the concentrations at 25% (5.27±0.8 cm) and 0% (3.86±1.0 cm) in the first trial With the lowest mean plumule at 1.09±0.1cm with a significant difference when compared with 25% and 0% as shown in Table 4.4b. In the second trial, it was observed from the extract of *E. torelliana* that, the highest mean plumule was 10.69±0.9 cm with a significant difference from every other concentration (Figure 4.4).

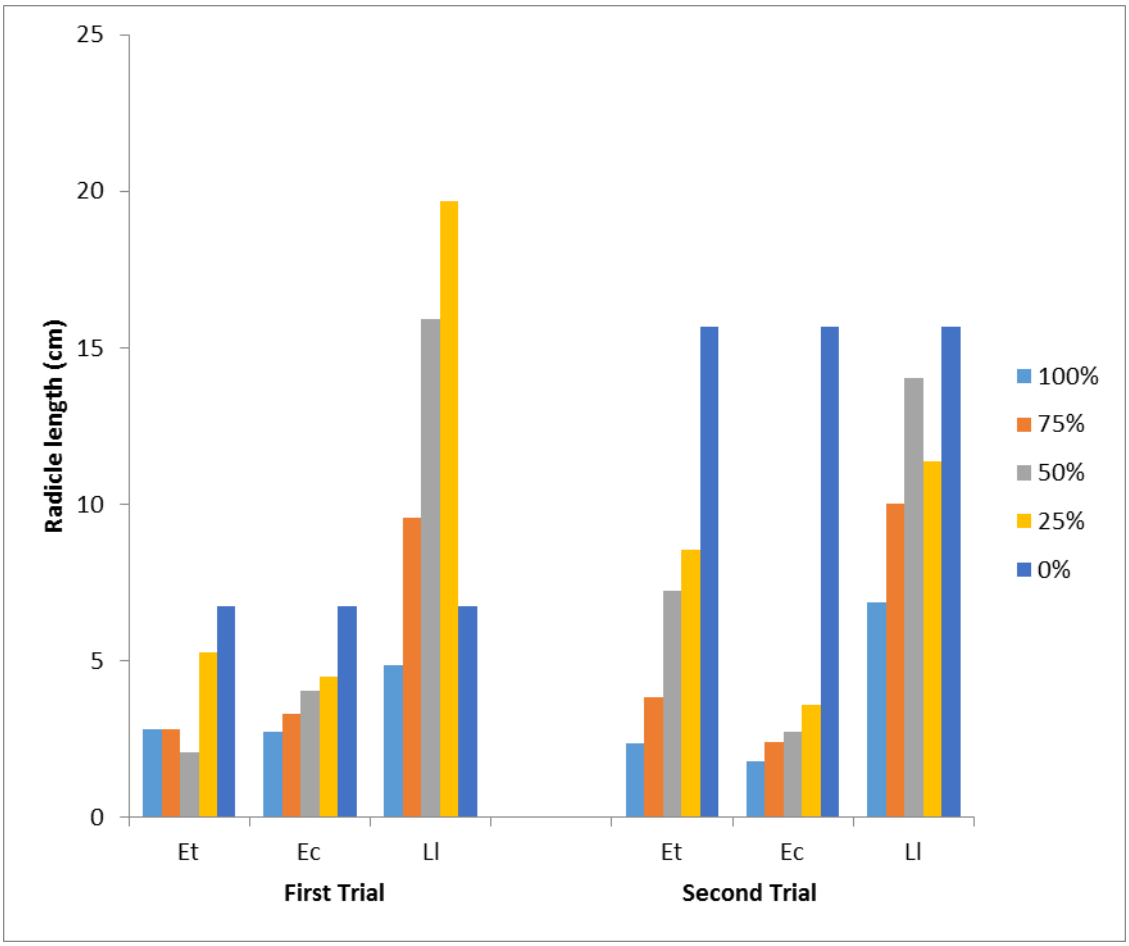
The mean plumule length in the first trial with *E. camaldulensis* was 3.63±1.0 at 0% followed with 3.63±0.3 at 25% with no significant difference from each other but significantly different when compared with 100%, 75% and 50% (Figure 4.4). In the second trial of *Eucalyptus camudulensis,* the highest mean was observed at 0% (10.69±0.9), which was significantly different from all other concentrations of *Eucalyptus camaldulensis*. Also, there were significant increases among all the concentrations and the control of extract as shown in Figure 4.4 and Plate 4.5b.

In the first trial, the highest mean plumule length of maize obtained in *Leucaena leucocephala* extracts pot was 11.31±0.6 cm at 50% concentration which was significantly higher when compared with other concentrations, while the lowest mean (3.42±0.3 cm) was at 100% concentration



Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaenia leucocephala;* control – distilled water

Figure 4.4: Phytotoxic effect of extracts of *Eucalyptus torelliana*, *Eucalyptus camudulensis* and *Leucaena leucocephala* on Plumule length of maize



Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaenia leucocephala;* control – distilled water

Figure 4.5: Phytotoxic effect of extracts of *Eucalyptus torelliana*, *Eucalyptus camudulensis* and *Leucaena leucocephala* on Radicle length of maize

In the second trial, the highest mean plumule length was 10.87±1.2 cm at 50% of *L. leucocephala* with significant difference with that of 100% (4.60±0.6 cm) and 75% (8.0±0.8 cm). Clearly, 4.60±0.6 cm and 8.0±0.8 cm at 100% and 75% were the lowest and significantly different from each other (Plate 4.6b and Figure 4.4).

From the result in Figure 4.5, the first trial shows that the highest mean radicle length of maize obtained for *Eucalyptus torelliana* were obtained from 25% (5.27±0.8 cm) and 0% (6.74± 2.0 cm) which were significantly different from the mean radicle lengths of 100%, 75%, 50% concentrations. The mean radicle length of maize increases inversely with concentrations (100%<75%<50%<25%<0%) in the second trial (Figure 4.5). However, the highest radical length with *Eucalyptus torelliana* was 15.67±0.7 cm at 0% with a significant difference from other concentrations. The lowest mean radicle length of cowpea treated with *Eucalyptus torelliana* was 2.8±0.1 cm at 100% concentration, with significant difference when compared to 25% (5.28±0.4 cm) and 0% (6.74±2.0 cm) concentrations (Plate 4.4a and Figure 4.5). In the second trial, the highest

mean radicle length (15.67±0.7 cm) was obtained at the control of *E. torelliana*, while the lowest mean radicle length for maize obtained was 2.38±0.2 cm at 100% concentration of *E. torelliana* (Figure 4.5), with significant difference from each other.

From Figure 4.5, the highest mean radical length in the first trial with *E. camaldulensis* was 6.74±2.0 at 0% followed with 4.50±1.2 at 25% with no significant difference from each other but with significant difference when compared with 100%, 75% and 50% (Plate 4.5a and Figure 4.5). In the second trial of *E.amudulensis*, 1.77±0.1 cm at 100% was the lowest mean radical length, which was significantly different from 3.57±0.3 cm and 15.67±0.7 cm at 25% and 100% concentrations respectively (Plate 4.5b and Figure 4.5).

The highest mean radicle length in *Leucaena leucocephala* in the first trail, was observed to be 19.70±0.9 cm at 25% concentration. It showed that, there were significant differences when compared with 100%, 75%, 50% and 0% (Plate 4.6a and Table 4.4b). In the second trial, the highest mean radicle length was observed at 0% (15.67±0.7 cm) followed by 14.03±1.4 cm at 50% with significant difference from each other. While the least mean radical length 6.86±0.7 cm at 100% (Plate 4.6b and Figure 4.5).

4.7: Phytotoxic effects of extracts of *Eucalyptus torelliana, Eucalyptus camaldulensis* and *Leucaena leucocephala* on plant height of cowpea

The highest mean plant length of cowpea of 42.1±4.1 was observed with the paraquat at 9 WAS in the first trial and 15.4±1.8 in the second trial. There were significant differences among the extracts compared with the control at 9 WAS in the first trial (Table 4.6).

The highest mean plant heights (41.7±3.8 and 43. 4±4.4cm) were observed from 25% of *E. torelliana* at 9 WAS in both 1st and 2nd trials, respectively. The mean plant height at 100%, 75% had significant differences compared with 25% at 9 WAS, of both 1st and 2nd trials as shown in Table 4.6. In second trial, the highest mean cowpea plant height treated with Et extract was 43.4±4.4 cm at 9 WAS and the lowest mean plant-height was 11.9±1.5 cm at 5 WAS. There was significant increase in plant height from 100% to 25% at 7 and 9 WAS with decrease at 0% (the control), while there was increase from 100% to 50% and 100% to 75%. There were significant difference in 100% when compared with other concentrations at 7 WAS (Table 4.6).

Based on the extract of *E.camaldulensis* applied, the highest mean plant height of cowpea obtained were 53.1±6.2cm at 50% of 7 WAS and 46.3±3.8cm at 100% of 9 WAS in the 1st and 2nd trials respectively, while the minimum mean plant height was 6.5±1.0 cm at 0% of 3 WAS and 15.6±4.3 cm at 100% of 3 WAS in the 1st and 2nd trials respectively (Table 4.6). There were significant difference with 0% at 3 WAS with other concentrations of *E. camaldulensis* in the first trial as shown in Table 4.6.

The highest mean plant height obtained with the treatment of *L. leucocephala* extract on cowpea were 39.6±2.8 cm at 0% and 43.0±4.0 cm at 50% in 9 WAS in the 1st and 2nd trials respectively, while the lowest mean plant height were 6.5±1.0 cm at 0% in 3 WAS and 15.4±2.3 cm at 50 % in the first and second trials, respectively. In the 1st trial, there were significant differences in the mean plant height at 100%, 75%, 50% and 25% when compared with 0% at 3 WAS, while at 9 WAS it was significantly higher than mean plant height at 75%, 25% and 0% when compared with the highest 39.6±2.8 cm. In the 2nd trial, there were no significant differences at the mean plant height of Ll at 3 and 5 WAS at all concentrations, while at 9 WAS, there were significant differences in the mean plant height at 100%, with that of 75% and 25% (Table 4.6).

Table 4.6: Phytotoxic effect of aqueous extracts of *Eucalyptus torelliana, Eucalyptus camudulensis* and *Leucaena leucocephala* on plant height of cowpea

		First trial				Second trial			
Trts	Conc(%)	3 WAS	5 WAS	7 WAS	9 WAS	11 WAS	3 WAS	5 WAS	7 WAS
CM		13.4±1.2^{abc}	22.5±2.5^{ab}	34.8±4.0^{abc}	42.1±4.1^{bc}	14.3±2.1^{ab}	7.8±0.8^{c}	10.0±1.4^{cd}	15.4±1.8^{de}
Et	100	9.73±0.8^{d}	13.3±2.2^{abc}	12.7±1.8^{c}	18.2±2.0^{cd}	12.1±2.0^{ab}	11.9±1.5^{bc}	16.8±3.1^{bc}	25.8±2.8^{abcd}
	75	14.3±1.7^{abc}	23.1±2.8^{ab}	31.9±3.5^{abc}	35.4±2.8^{cd}	15.9±1.4^{a}	19.2±2.0^{ab}	31.7±3.2^{a}	34.8±4.2^{abcd}
	50	14.3±1.0^{abc}	19.0±2.4^{abc}	32.9±4.0^{abc}	37.7±4.6^{bcd}	17.2±2.4^{a}	18.1±1.9^{ab}	31.2±4.2^{a}	40.3±5.1^{abc}
	25	12.3±0.8^{abc}	18.6±1.8^{abc}	35.0±4.3^{abc}	41.6±3.8^{bcd}	16.4±1.8^{a}	25.0±2.7^{a}	34.7±3.2^{a}	43.4±4.4^{abc}
	Dw(0)	6.50±1.0^{cd}	16.7±1.8^{abc}	26.4±4.2^{abc}	38.1±4.2^{bcd}	15.6±1.0^{a}	20.6±3.2^{ab}	30.9±3.8^{a}	41.7±4.5^{abc}
Ec	100	10.3±2.9^{abcd}	15.3±1.4^{abc}	20.5±2.8^{bc}	48.5±3.2^{c}	15.6±4.3^{a}	25.6±3.0^{a}	36.0±4.2^{a}	46.3±3.8^{a}
	75	14.0±1.8^{abc}	26.2±2.4^{a}	49.1±4.5^{ab}	44.6±5.2^{ab}	16.8±2.4^{a}	19.4±2.0^{ab}	32.2±3.2^{a}	44.2±5.0^{abc}
	50	16.0±2.0^{a}	26.7±2.2^{a}	53.1±6.2^{a}	40.4±4.2^{a}	16.4±2.5^{a}	17.1±1.9^{ab}	27.5±2.8^{ab}	35.2±4.1^{abcd}
	25	15.0±2.3^{ab}	23.3±2.5^{ab}	33.7±3.6^{abc}	36.7±3.2^{abc}	17.1±1.8^{a}	20.3±1.5^{ab}	29.3±3.8^{ab}	20.6±3.6^{bcde}
	Dw(0)	6.50±1.0^{cd}	16.7±1.8^{abc}	26.4±4.2^{abc}	38.1±4.2^{bcd}	15.6±1.0^{a}	20.6±3.2^{ab}	30.9±3.8a	41.7±4.5^{abc}
Ll	100	14.0±2.0^{abc}	15.6±1.0^{abc}	34.9±4.2^{abc}	39.6±2.8^{a}	15.6±1.4^{a}	20.8±2.1^{ab}	29.8±4.3^{ab}	41.1±3.2^{abc}
	75	7.60±0.8^{bcd}	16.8±1.2^{abc}	28.4±3.8^{abc}	37.7±2.2^{cd}	16.8±1.8^{a}	19.7±1.9^{ab}	25.2±4.0^{ab}	37.7±3.5^{abcd}
	50	11.4±1.0^{abc}	18.8±1.2^{abc}	35.0±4.1^{abc}	39.1±3.2^{a}	15.4±2.3^{a}	21.5±2.5^{ab}	29.5±3.8^{ab}	43.0±4.0^{abc}
	25	13.6±1.3^{abc}	20.2±1.8^{abc}	36.2±3.2^{abc}	37.0±2.4^{cd}	17.1±2.3^{a}	19.8±2.0^{ab}	31.7±4.6^{a}	37.7±2.8^{abcd}
	Dw(0)	6.50±1.0^{cd}	16.7±1.8^{abc}	26.4±4.2^{abc}	38.1±4.2^{bcd}	15.6±1.0^{a}	20.6±3.2^{ab}	30.9±3.8^{a}	41.7±4.5^{abc}

Trts-Treatments, Conc.-Concentration,WAS –Weeks After Sowing, CM – Paraquat, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll – *Leucaena leucocephala;* Dw (0) – distilled water, Means ±standard errors within a column having the same letter(s) are not significantly different at 5% probability level using Duncan's Multiple Range Test (DMRT)

4.8: Phytotoxic Effects of Extracts of *Eucalyptus torelliana*, *Eucalyptus camaldulensis* and *Leucaena leucocephala* on Stem diameter of cowpea

The maximum mean stem diameter of cowpea with chemical used (paraquat) was 7.0±0.9 cm at 9 WAS and 2.8±0.2 cm at 9 WAS of the 1st and 2nd trials respectively, while the lowest mean stem diameter was 3.68±0.2 cm at 3 WAS in the first trial and 1.5±0.1 cm at 7 WAS in the second trial (Table 4.5b). The mean stem diameter at 3 WAS was significantly different from other weeks after sowing in the first trial. In the second trial, cowpea treated with paraquat showed also significant difference at 3 WAS from 5, 7 and 9 WAS. (Table 4.7).

Based on the extract of *Eucalyptus torelliana* applied, the highest mean stem diameter of cowpea was 7.3±1.2 cm at 75% at 9 WAS and 8.0±1.0 cm at 25% at 9 WAS of the 1st and 2nd trials respectively, while the lowest mean stem diameter was 2.4±0.2 cm at 0% at 3 WAS in the first trial and mean stem diameter of 2.9±0.3 cm at 0% at 3 WAS in the second trial (Table 4.5b). There were no significant differences in the mean stem diameter at all concentrations in 7 and 9 WAS while at 3 WAS there were no significant differences between 100% and 25% in the first trial (Table 4.7)

In the second trial, the highest mean stem diameter was 8.0±1.0 cm at 25% at 9 WAS which was significantly different from all the concentrations of other weeks. However, there were no significant differences in all concentrations at 3 WAS but at 5 WAS, only the stem diameter at 25% was significantly different compared with others. At 9 WAS, it was revealed that there were significant differences at the mean stem diameter at 100% and 25% in the 2nd trial as shown in Table 4.7.

It was found from the extract of *E. camaldulensis* applied that the highest mean stem diameter of cowpea was 7.5±1.0 cm at 25% at 9 WAS and 9.5±0.9 cm at 100% at 9 WAS in the first and second trials respectively, while the lowest mean stem diameter was 2.3±0.4 cm at 100% in 3 WAS in the first trial and 2.6±0.2 cm at 25% at 3 WAS in the second trial. There were significant differences in the mean stem diameter (2.3±0.4 cm) with all concentrations of *Eucalyptus camaldulensis* extracts and the control observed at 3 WAS in the first trial (Table 4.7).

In the second trial, there were significant differences with the hightest mean stem diameter (9.5±0.9 cm) at 100% concentration of 9 WAS wth other concentrations of extracts of *Eucalyptus camaldulensis* in 9 WAS in the 2nd trial (Table 4.7).

Table 4.7: Effects of extracts of *Eucalyptus torelliana, Eucalyptus camudulensis* and *Leucaena leucocephala* on stem diameter of cowpea

		First trial				Second trial			
Trts	Conc.(%)	3 WAS	5 WAS	7 WAS	9 WAS	3 WAS	5 WAS	7 WAS	9 WAS
CM		3.68±0.2^{abc}	5.72±0.7^{ab}	6.58±0.4^{a}	6.97±0.9^{a}	2.86±0.2^{ab}	2.73±0.3^{c}	1.50±0.1^{de}	2.77±0.2^{fg}
Et	100	3.06±0.4^{abc}	3.00±0.3^{b}	3.61±0.3^{a}	2.49±0.1^{a}	2.97±0.3^{ab}	3.04±0.5^{bc}	3.14±0.2^{cde}	4.62±0.4^{def}
	75	4.06±0.5^{a}	5.54±0.4^{ab}	7.05±0.6^{a}	7.33±1.2^{a}	3.07±0.5^{ab}	4.85±0.5^{abc}	5.62±0.8^{abc}	6.35±0.6^{abcde}
	50	3.94±0.4^{ab}	5.42±0.8^{ab}	6.35±0.5^{a}	6.54±1.0^{a}	3.43±0.4^{ab}	4.90±0.8^{abc}	6.99±0.5^{ab}	7.81±0.8^{abcde}
	25	3.64±0.4^{abc}	5.7±0.8^{ab}	6.31±0.7^{a}	6.82±0.9^{a}	3.35±0.4^{ab}	5.25±0.9^{ab}	6.74±0.4^{ab}	8.01±1.0^{abcd}
	0	2.42±0.2^{bc}	4.17±0.6^{ab}	5.06±0.5^{a}	5.07±1.0^{a}	2.91±0.3^{ab}	4.35±0.5^{abc}	5.84±0.4^{abc}	6.32±0.6^{abcde}
Ec	100	2.27±0.4^{c}	3.18±0.4^{b}	3.95±0.4^{a}	4.43±0.3^{a}	3.68±0.3^{a}	6.07±1.2^{a}	7.85±0.7^{a}	9.47±0.9^{a}
	75	3.73±0.5^{abc}	5.69±0.6^{ab}	5.93±0.6^{a}	6.55±0.6^{a}	3.29±0.2^{ab}	5.14±1.0^{ab}	6.81±0.7^{ab}	8.32±1.0^{abc}
	50	3.89±0.3^{abc}	6.36±0.3^{a}	7.44±0.9^{a}	7.34±0.9^{a}	3.47±0.4^{ab}	5.25±0.7^{ab}	5.77±0.7^{abc}	5.96±0.3^{bcde}
	25	4.07±0.6^{a}	6.43±0.8^{a}	7.29±1.0^{a}	7.49±1.0^{a}	2.58±0.2^{bc}	5.27±0.5^{ab}	5.79±0.4^{abc}	7.10±0.9^{abcde}
	0	2.42±0.2^{bc}	4.17±0.6^{ab}	5.06±0.5^{a}	5.07±1.0^{a}	2.91±0.3^{ab}	4.35±0.5^{abc}	5.84±0.4^{abc}	6.32±0.6^{abcde}
Ll	100	3.41±0.4^{abc}	5.31±0.8^{ab}	5.59±0.8^{a}	6.64±0.8^{a}	3.20±0.2^{ab}	4.35±0.5^{abc}	6.83±0.6^{ab}	6.37±0.4^{abcde}
	75	3.43±0.3^{abc}	4.39±0.6^{ab}	5.47±0.6^{a}	6.29±1.0^{a}	3.47±0.3^{ab}	4.69±0.6^{abc}	6.18±0.4^{abc}	5.57±0.4^{cdef}
	50	3.21±0.3^{abc}	4.97±0.5^{ab}	5.01±0.6^{a}	6.28±0.7^{a}	3.49±0.4^{ab}	5.21±0.4^{ab}	6.51±0.5^{abc}	6.44±0.9^{abcde}
	25	3.52±0.3^{abc}	5.63±0.6^{ab}	6.03±0.8^{a}	6.54±0.5^{a}	2.93±0.2^{ab}	4.69±0.5^{abc}	5.98±0.5^{abc}	6.14±0.4^{abcde}
	0	2.42±0.2^{bc}	4.17±0.6^{ab}	5.06±0.5^{a}	5.07±1.0^{a}	2.90±0.3^{ab}	4.35±0.5^{abc}	5.84±0.4^{abc}	6.32±0.6^{abcde}

Trts-Treatments, Conc.-Concentration,WAS –Weeks After Sowing, CM – Paraquat, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll – *Leucaena leucocephala;* Dw (0) – distilled water, Means ±standard errors within a column having the same letter(s) are not significantly different at 5% probability level using Duncan's Multiple Range Test (DMRT)

The extract of *Leucaena leucocephala* on cowpea had highest mean stem diameter of 6.6±0.8 cm at 100% at 9 WAS and 6.8±0.6 cm at 100% at 7 WAS of the 1st and 2nd trials respectively, while the least mean stem diameter was 2.4±0.2 cm at 0% (control) at 3 WAS in the first trial and 2.9±0.3cm at 0% (control) at 3 WAS in the second trial. At 3 WAS, the mean stem diameter were not significantly different from each other but with a significant decrease with the control in the first trial (Table 4.7).

In the second trial, there was no significant difference in the mean stem diameter at all concentrations in 3 WAS. But there were significant difference with 100% concentration when compared with 75%, 50%, 25% and 0% concentrations at 7 WAS of the second trial (Table 4.7).

4.9: Phytotoxic Effects of Extracts of *Eucalyptus torelliana, Eucalyptus camaldulensis* and *Leucaena leucocephala* on Number of Leaves of Cowpea

The highest mean number of leaves of cowpea with chemical used (paraquat) was 32.3±5.2 at 5 WAS and 27.3±2.5 at 9 WAS of the 1st and 2nd trials respectively, while the lowest mean number of leaves was 2.0±0.1 at 9 WAS in the first trial and 6.0±0.9 at 3 WAS, respectively in the second trial. There were significant differences with the highest mean number of leaves (32.3±5.2) at 5 WAS when compared with 3, 7, and 9 WAS in the first trial (Table 4.8).

Based on the extract of *Eucalyptus torelliana* applied to the cowpea plant, the highest mean number of leaves of cowpea was 30.0±3.24 at 75% at 5 WAS and 36.3±4.1 at 50% in 9 WAS of the first and second trials respectively. However, the lowest mean number of leaves was 3.00±0.5 at 50% at 5 and 9 WAS in the first trial and mean number of leaves was 6.3±2.0 at 50% at 3 WAS in the second trial. In the first trial, there was a significant difference in the mean number of leaves at 100% compared with other concentrations at 3, 5, 7 and 9 WAS. In the second trial, there were significant differences with the highest mean number of leaves at 50% at 9 WAS compared with the control (Table 4.8).

The highest mean number of leaves of cowpea with *Eucalyptus camaldulensis* extract was 36.7±4.8 at 50% at 7 WAS and 42.3±4.5 at 100 % at 9 WAS of the first and second trials respectively, which were significantly different from the control on both trials. The lowest mean number of leaves was 9.0±2.0 at 0% at 3 WAS in the first trial, with significant difference only with 100% and 75% concentrations.

Table 4.8: Effects of extracts of *Eucalyptus torelliana, Eucalyptus camudulensis* and *Leucaena leucocephala* on number of leaves of cowpea

		First Trial				**Second trial**			
Trt.	Conc.(%)	3 WAS	5 WAS	7 WAS	9 WAS	3 WAS	5 WAS	7 WAS	9 WAS
CM		12.0±1.0^{ab}	32.3±5.2^{a}	24.3±4.6^{ab}	2.00±0.1^{b}	6.00±0.9^{ab}	12.7±2.8^{ab}	27.3±2.5^{ab}	26.0±3.5^{ab}
Et	100	6.00±2.0^{b}	3.00±0.5^{c}	11.7±3.2^{bc}	3.00±0.3^{b}	8.00±1.0^{a}	15.1±3.2^{ab}	16.7±3.5^{ab}	19.3±2.0^{ab}
	75	11.1±1.7^{ab}	30.0±3.24.2^{a}	29.7±3.9^{ab}	9.33±1.0^{ab}	8.33±0.8^{a}	20.2±2.9^{a}	15.0±3.0^{ab}	34.0±3.8^{a}
	50	13.0±1.0^{ab}	25.3±3.8^{ab}	7.33±2.6^{c}	4.33±0.4^{ab}	6.33±2.0^{ab}	17.3±2.0^{ab}	29.0±2.8^{ab}	36.3±4.1^{a}
	25	12.0±1.0^{ab}	26.3±5.0^{ab}	23.0±4.3^{abc}	5.00±0.8^{ab}	8.67±2.5^{a}	22.3±3.2^{a}	22.3±2.2^{ab}	34.3±3.8^{a}
	Dw (0)	9.00±2.0^{ab}	18.3±3.8^{abc}	20.0±4.2^{abc}	4.10±0.8^{ab}	7.30±1.0^{a}	19.7±2.4^{a}	22.3±4.0^{ab}	27.7±3.2^{ab}
Ec	100	8.33±4.2^{ab}	16.0±2.8^{abc}	13.0±2.0^{bc}	3.67±0.5^{ab}	9.00±1.5^{a}	27.7±2.6^{a}	36.3±2.5^{a}	42.3±4.5^{b}
	75	13.0±1.0^{ab}	24.0±3.8^{ab}	26.3±3.2^{abc}	17.0±2.1^{a}	8.00±1.2^{a}	26.7±2.5^{a}	20.0±2.1^{ab}	28.3±2.8^{ab}
	50	13.7±0.3^{a}	29.0±4.0^{ab}	36.7±4.8^{a}	8.00±0.8^{ab}	7.00±0.8^{a}	19.3±1.9^{a}	23.3±3.1^{ab}	24.3±3.5^{ab}
	25	13.7±1.3^{a}	29.3±4.0^{ab}	29.0±3.5^{ab}	3.33±0.2^{ab}	8.00±0.5^{a}	23.3±3.8^{a}	36.7±4.8^{a}	39.3±4.1^{a}
	Dw (0)	9.00±2.0^{ab}	18.3±3.8^{abc}	20.0±4.2^{abc}	4.10±0.8^{ab}	7.30±1.0^{a}	19.7±2.9^{a}	22.3±4.0^{ab}	27.7±3.2^{ab}
Ll	100	8.67±3.5^{ab}	26.0±4.6^{ab}	24.3±3.5^{abc}	7.00±1.0^{ab}	8.33±1.2^{a}	19.0±2.5^{ab}	19.3±2.4^{ab}	29.0±3.1^{ab}
	75	10.1±1.2^{ab}	19.3±4.0^{abc}	20.0±2.8^{abc}	8.67±1.0^{ab}	8.67±1.2^{a}	25.7±3.1^{a}	24.3±3.2^{ab}	21.3±2.5^{ab}
	50	10.0±1.1^{ab}	23.3±4.6^{abc}	17.0±2.4^{abc}	3.33±0.2^{ab}	7.33±1.2^{a}	22.7±3.1^{a}	22.7±3.7^{ab}	16.3±2.1^{ab}
	25	13.0±0.9^{ab}	29.7±5.2^{a}	23.0±3.0^{abc}	4.00±0.3^{ab}	7.23±0.8^{a}	17.7±2.8^{ab}	18.7±2.5^{ab}	20.7±2.0^{ab}
	Dw (0)	9.00±2.0^{ab}	18.3±3.8^{abc}	20.0±4.2^{abc}	4.10±0.8^{ab}	7.30±1.0^{a}	19.7±2.1^{a}	22.3±4.0^{ab}	27.7±3.2^{ab}

Trts-Treatments, Conc.-Concentration,WAS –Weeks After Sowing, CM – Paraquat, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll – *Leucaena leucocephala;* Dw (0) – distilled water, Means ±standard errors within a column having the same letter(s) are not significantly different at 5% probability level using Duncan's Multiple Range Test (DMRT)

In the second trial, the lowest mean number of leaves was 7.00±0.8 at 50% at 3 WAS with no significant difference in the mean number of leaves at all concentretions at 3 WAS (Table 4.8).

Table 4.8, showed that the mean number of leaves of cowpea with *L. leucocephala* was 29.7±5.2 at 25% at 5 WAS and 29.0±3.1 at 100% at 9 WAS in the 1st and 2nd trials respectively. The lowest mean number of leaves was 4.0±.03 at 25% at 9 WAS in the first trial and was 7.2±0.8 at 25% at 3 WAS in the second trial. There were no significant differences at all concentrations compared with control at 3, 7 and 9 WAS, while there were significant differences at 100% and 25% compared with the control at 5 WAS in the second trial.

4.10. Effects of Aqueous Extracts of *Eucalyptus torelliana, Eucalyptus camaldulensis* and *Leucaena leucocephala* on Biomass of Cowpea

Results in Table 4.9 revealed that in the first trial, the total biomass of cowpea (0.37±0.2) treated with paraquat showed that there was a significant difference when compared with 0% concentration. The *E. torelliana* extract applied on cowpea showed that the highest total mean biomass was 3.22±0.6 at 75% in the first trial and 2.33±0.8 at 75% in the second trial. There were significant differences in the highest total mean weight with the control in the both trials.

Based on the extract of *E. camaldulensis* applied on the cowpea plant, the highest total mean biomass of cowpea was 1.3±0.3 at 0% which was followed by 1.30± at 50% in the first trial. They were not significantly different from each other but significantly different with that of 100%, 75% and 25% concentrations. In the 2nd trial, the same trend was witnessed as shown in Table 4.9.

Table 4.9 showed that the *L. leucocephala* extract applied on cowpea had the highest total mean biomass of cowpea as 1.49±0.4 at 25% in the first trial with significant difference only at 50% concentration. In the second trial, 1.67±0.6 was the highest total mean biomass with significant difference only at 50% concentration.

Table 4.9: Effects of aqueous extracts of *Eucalyptus torelliana, Eucalyptus camudulensis* and *Leucaena leucocephala* on biomass of cowpea

	First trial				Second trial		
Trts.	Conc.	Stem	Root	Total	Stem	Root	Total
CM		0.36 ± 0.1^{a}	0.21 ± 0.1^{ab}	0.37 ± 0.2^{a}	0.40 ± 0.1^{bc}	0.13 ± 0.1^{bc}	0.53 ± 0.2^{b}
Et	100	0.36 ± 0.1^{a}	0.10 ± 0.1^{a}	0.60 ± 0.2^{b}	0.47 ± 0.1^{bc}	0.10 ± 0.1^{c}	0.63 ± 0.2^{b}
	75	1.34 ± 0.3^{b}	0.45 ± 0.2^{ab}	3.22 ± 0.6^{c}	1.73 ± 0.4^{a}	0.6 ± 0.2^{a}	2.33 ± 0.8^{a}
	50	1.32 ± 0.4^{ab}	0.30 ± 0.1^{b}	1.20 ± 0.4^{a}	1.33 ± 0.4^{abc}	0.37 ± 0.1^{ab}	1.27 ± 0.4^{ab}
	25	0.51 ± 0.1^{a}	0.25 ± 0.1^{abc}	0.68 ± 0.3^{a}	0.57 ± 0.2^{bc}	0.20 ± 0.1^{bc}	0.77 ± 0.2^{ab}
	Dw (0)	1.27 ± 0.2^{abc}	0.33 ± 0.1^{bc}	1.38 ± 0.3^{ab}	1.33 ± 0.3^{abc}	0.23 ± 0.1^{bc}	1.37 ± 0.2^{ab}
Ec	100	0.40 ± 0.1^{a}	0.18 ± 0.1^{bc}	0.68 ± 0.4^{bc}	0.50 ± 0.1^{bc}	0.17 ± 0.1^{bc}	0.67 ± 0.1^{b}
	75	0.30 ± 0.2^{b}	0.24 ± 0.1^{c}	0.50 ± 0.2^{bc}	0.30 ± 0.1^{c}	0.10 ± 0.1^{c}	0.40 ± 0.1^{b}
	50	1.00 ± 0.3^{abc}	0.37 ± 0.1^{abc}	1.30 ± 0.3^{ab}	0.97 ± 0.2^{abc}	0.30 ± 0.1^{abc}	1.27 ± 0.5^{ab}
	25	0.48 ± 0.2^{a}	0.24 ± 0.1^{c}	0.63 ± 0.2^{bc}	0.57 ± 0.3^{bc}	0.10 ± 0.1^{c}	0.67 ± 0.2^{b}
	Dw (0)	1.27 ± 0.2^{abc}	0.33 ± 0.1^{bc}	1.38 ± 0.3^{ab}	1.33 ± 0.3^{abc}	0.23 ± 0.1^{bc}	1.37 ± 0.2^{ab}
Ll	100	1.00 ± 0.2^{abc}	0.47 ± 0.1^{cd}	1.47 ± 0.1^{ab}	1.30 ± 0.2^{abc}	0.4 ± 0.1^{abc}	1.67 ± 0.6^{ab}
	75	1.45 ± 0.4^{a}	0.54 ± 0.1^{bc}	1.47 ± 0.2^{ab}	1.47 ± 0.3^{ab}	0.47 ± 0.2^{ab}	1.53 ± 0.4^{ab}
	50	0.58 ± 0.2^{a}	0.17 ± 0.1^{c}	0.71 ± 0.1^{a}	0.43 ± 0.2^{bc}	0.17 ± 0.1^{bc}	0.63 ± 0.1^{b}
	25	1.38 ± 0.2^{abc}	0.47 ± 0.1^{cd}	1.49 ± 0.4^{ab}	1.43 ± 0.5^{abc}	0.43 ± 0.2^{abc}	1.53 ± 0.3^{ab}
	Dw (0)	1.27 ± 0.2^{abc}	0.33 ± 0.1^{bc}	1.38 ± 0.3^{ab}	1.33 ± 0.3^{abc}	0.23 ± 0.1^{bc}	1.37 ± 0.2^{ab}

Trts-Treatments, Conc.-Concentration, DAS-Days After Sowing, Et-*Eucalyptus torelliana*, Ec- *Eucalyptus camudulensis*, Ll - *Leucaena leucocephala;* Dw (0) – distilled water

Means ± standard errors within a column having the same letter(s) as superscript are not significantly different at 5% probability level using Duncan's Multiple Range Test (DMRT)

4.11. Effects of aqueous extracts of *Eucalyptus torelliana, Eucalyptus camaldulensis* and *Leucaena leucocephala* on Cowpea Yield

The mean yield with the extracts used on the cowpea showed that the extract of *Eucalyptus torelliana* ranged from 1.0±0.1 g at 0% to 3.1±0.2 g at 100% concentration in the first trial, while in the second trail, ranged from 1.0±0.1 g at 0% to 3.0±0.2 g at 100% concentration. Effect of E. *camaldulensis* extract on seed weight of cowpea ranged from 0.4±0.1 g at 25% to 1.0±0.1 g at 0% concentration in the first trial, then, from 0.4±0.1 g at 25% to 1.0±0.1 g at 0% concentration in the second trial. With the extract of L. *leucocephala*, the mean seed weight of cowpea ranged from 1.0±0.1 g (0%) to 3.8±0.4 g (50%) and 0.1±0.1 g at 25% to 4.2±0.5 g at 50 % concentration in first and second trials, respectively (Figure 4.6).

However, among the extracts used, *Leucaenia leucocephala* recorded the highest means yield of cowpea with 3.8±0.4 g in the first trial and 4.2±0.5 g in the second trial, both were significantly different from every other concentration of *Leucaenia leucocephala, Eucalyptus torelliana* and *Eucalyptus camaldulensis* as shown in Figure 4.6.

4. 12: Effects of extracts of *Eucalyptus torelliana, Eucalyptus camaldulensis* and *Leucaena leucocephala* on Weed Biomass of Cowpea

The phytotoxic effect from the extracts of *Eucalyptus torelliana* on the weed of cowpea showed that, mean biomass ranged from 6.8±0.6 g at 100% to 12.9±0.8 g at 50% concentrations in the first trial, while in the second trial, it ranged from 0.7±0.1 g at 100% to 2.9±0.1 g at 0% followed by 2.8±0.1 g at 75% concentrations with no significant difference from each other (Figure 4.6).

Effect of *E.camaldulensis* extract on weed biomass ranged from 12.0±0.8 g at 0% to 17.4±0.5 g at 100% concentration in the first trial and from 1.1±0.1 g at 75% to 2.9±0.1 g at 0% concentration in the second trial as shown in Figure 4.6.

Based on the extract of *L. leucocephala* applied, the mean weed biomass ranged from 9.4±0.9 g at 50% to 22.2±1.6 g at 100% and from 1.2±0.1 g at 50% concentration to 2.9±0.2 g at 0 % concentration in first and second trial, respectively. With the extracts of *L.*

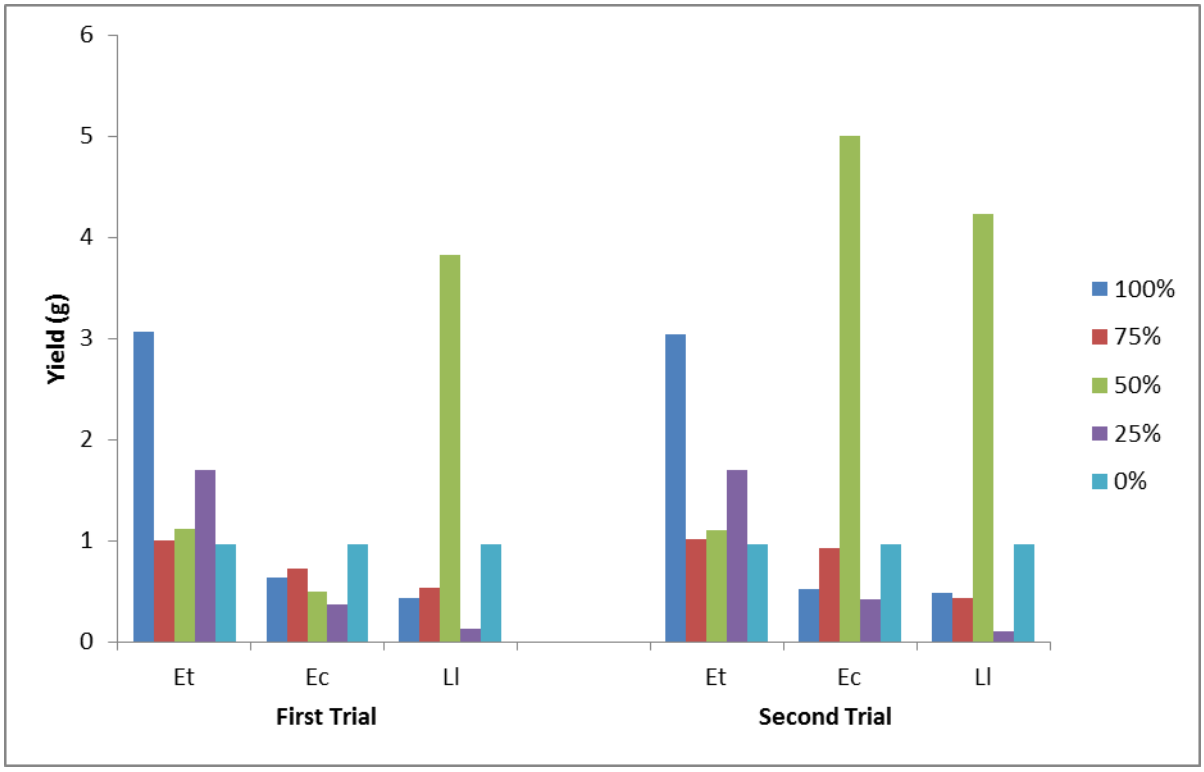


Figure 4.6: Effect of extracts of *Eucalyptus torelliana, Eucalyptus camudulemensis* and *Leucaena leucocephala* on cowpea yield

Trts-Treatments, CM – Paraquate, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaena leucocephala;* Dw (0) – distilled water

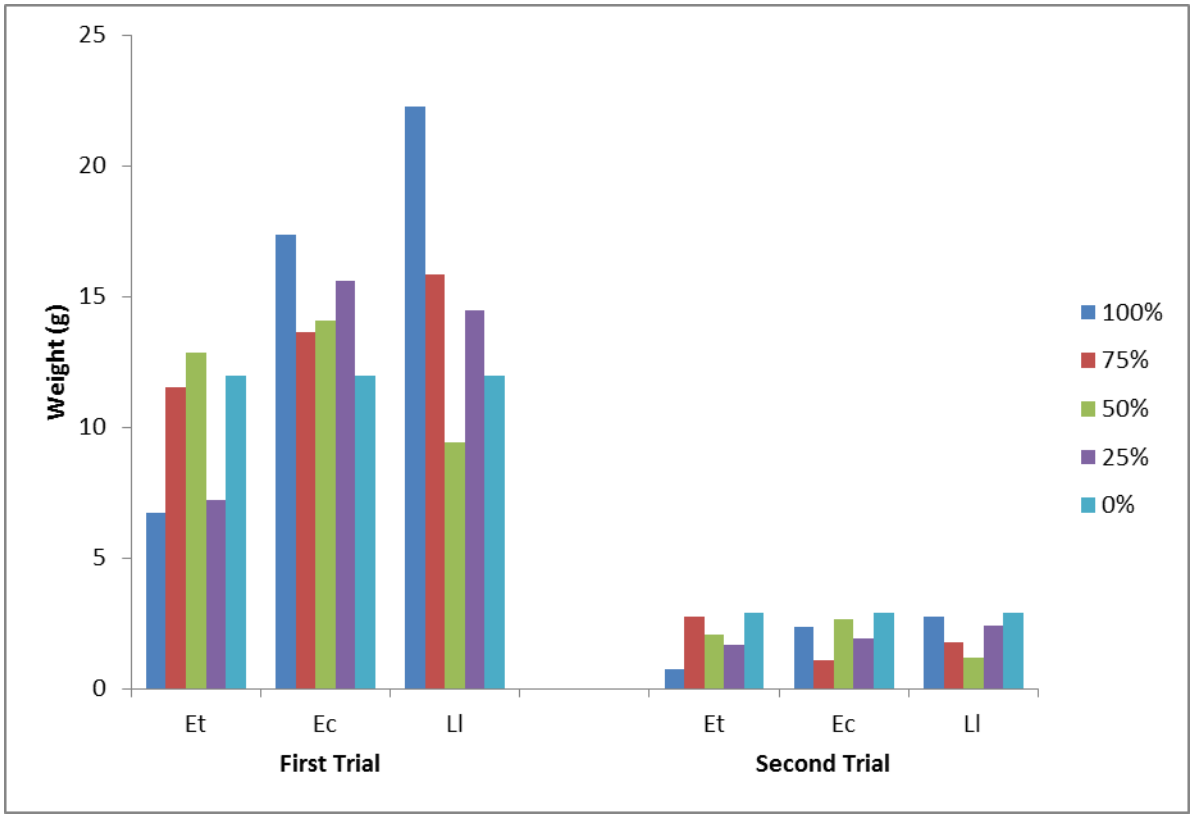


Figure 4.7: Phytotoxic effects of extracts on weed biomass of cowpea

Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaena leucocephala;* control (0) – distilled water

leucocephala, the highest mean weed weight was 22.24g and 2.77g at 100% for first and second trials, respectively. There was a significant difference at mean weed weight at 100% in the first trial when compared with other concentrations (75%, 50%, 25% and 0%) and other extracts.

4.13: Phytotoxic Effects of Extracts of *Eucalyptus torelliana, Eucalyptus camaldulensis* and *Leucaena leucocephala* on Plant Height of Maize

The highest mean plant height of maize in the pot treated with paraquat were 76.5±6.8 cm at 11 WAS and 96.0±6.4 cm at 9 WAS of the 1st and 2nd trials respectively. There were significant differences at the highest mean plant height of maize at 11 WAS and 9 WAS compared with control at 11 and 9 WAS for 1st and 2nd trials respectively as shown in Table 4.10.

The highest mean plant height of *Eucalyptus torelliana* observed was 127.9±7.4 cm at 75% at 11 WAS and 137.30±12.6 cm at 75% at 11 WAS of the first and second trials respectively, while the lowest mean in the first trial was 20.6±3.2 cm and 21.1±1.5 cm at 100% at 3 WAS of the 1st and 2nd trials, respectively. There were significant difference at the plant height only at 25% concentrations compared with 0%, 50%, 75% and 100% concentrations in the first trial. In the second trial, there were significant differences at all concentrations compared with the control at 3 WAS (Table 4.10).

Based on the extract of *Eucalyptus camaldulensis* applied, the highest mean plant height observed was 140.9±8.9 cm at 100% at 9 WAS and 151.47±14.3 cm at 100% at 9 WAS of the first and second trials, respectively. While the lowest mean in the first trial was 19.2±3.7 cm at 25% at 3 WAS and 21.4±2.5 cm at 50 % at 3 WAS at the 1st and 2nd trials, respectively. There were significant differences at the mean plant height at 100%, 75% and 50% concentrations compared with control (0%) at 9 WAS of the first trial. In the second trial, there were significant differences at 75 %, 50 % and 25 % concentrations compared with the control at 3 WAS while at 5 WAS, there were no significant differences at all concentrations (except at 25%) compared with the control (Table 4.10).

It was observed in Table 4.10, from the extract of *Leucaena leucocephala* applied that the highest mean plant height was 138.40±14.2 and 136.10±12.5 cm at 50% at 9 WAS

Table 4.10: Phytotoxic effect of extracts of *E. torelliana, E. camudulensis* and *Leucaena leucocephala* on Plant height of maize

		First trial (cm)					**Second trial (cm)**				
Trts	Conc	3 WAS	5 WAS	7 WAS	9 WAS	11 WAS	3 WAS	5 WAS	7 WAS	9 WAS	11 WAS
CM		20.58±0.9^{a}	43.08±10.9^{abc}	66.34±4.6^{a}	69.66±9.0^{cde}	76.50±6.8^{bc}	20.70±1.5^{abcde}	52.70±4.0^{ab}	76.70±5.8^{ab}	96.03±6.4^{abc}	92.70±7.2^{ab}
Et	100	20.62±1.9^{a}	58.52±3.4^{a}	85.70±5.3^{a}	115.92±12.1^{abc}	114.54±8.5^{ab}	21.07±1.5^{abcde}	60.20±5.6^{ab}	86.17±6.6^{a}	128.43±12.5^{ab}	126.77±10.4^{a}
	75	26.66±3.9^{a}	59.68±5.5^{a}	99.48±8.8^{a}	121.64±11.4^{ab}	127.86±7.4^{ab}	29.90±2.1^{a}	56.76±8.1^{ab}	113.80±12.2^{a}	125.33±10.0^{ab}	137.33±12.6^{a}
	50	24.98±4.1^{a}	59.16±5.6^{a}	88.04±9.1^{a}	110.40±10.0^{abc}	103.78±9.6^{ab}	25.37±2.0^{a}	63.53±4.8^{ab}	91.40±8.5^{a}	119.87±9.5^{ab}	119.0±10.2^{a}
	25	22.0±3.7^{a}	49.0±5.0^{ab}	81.90±6.2^{a}	85.94±6.8^{bcd}	111.4±10.1^{ab}	23.53±2.4^{a}	52.67±4.8^{ab}	74.17±6.5^{ab}	62.90±4.8^{bc}	100.33±6.8^{ab}
	Dw (0)	21.88±0.8^{a}	57.68±2.6^{a}	96.70±6.3^{a}	120.2±11.5^{ab}	113.66±15.1^{ab}	23.07±2.1^{abc}	38.17±4.6^{ab}	98.0±8.6^{a}	125.13±14.2^{ab}	113.30±12.5^{a}
Ec	100	24.0±3.2^{a}	60.80±3.1^{a}	95.40±4.5^{a}	140.92±8.9^{a}	123.40±9.8^{ab}	26.77±1.6^{a}	58.23±3.8^{ab}	93.50±8.5^{a}	151.47±14.3^{a}	129.67±14.8^{a}
	75	21.82±3.3^{a}	56.40±4.7^{a}	96.84±3.6^{a}	119.24±10.1^{ab}	126.94±10.2^{ab}	22.60±3.2^{abcd}	55.63±4.1^{ab}	100.90±9.5^{a}	121.20±10.5^{ab}	130.0±9.0^{a}
	50	21.04±1.5^{a}	55.30±4.1^{a}	92.90±6.2^{a}	120.68±9.5^{ab}	104.20±7.5^{ab}	21.37±2.5^{abcde}	59.47±2.9^{ab}	104.0±8.5^{a}	128.73±9.5^{ab}	106.0±7.5^{a}
	25	19.24±3.7^{a}	56.40±13^{a}	87.22±5.8^{a}	101.54±14.2^{abc}	107.70±8.8^{ab}	25.60±3.0^{a}	65.30±5.8a	109.03±6.5^{a}	135.73±12.0^{a}	140.50±12.3^{a}
	Dw (0)	21.88±0.8^{a}	57.68±2.6^{a}	96.70±6.3^{a}	120.20±11.5^{abc}	113.66±15.1^{ab}	23.07±2.1^{abc}	38.17±4.6^{ab}	98.0±8.6^{a}	125.13±14.2^{ab}	113.30±12.5^{a}
Ll	100	26.16±1.4^{a}	58.88±2.5^{a}	97.26±6.5^{a}	118.68±12.4^{ab}	117.60±9.4^{ab}	27.30±2.7^{a}	56.27±4.8^{ab}	94.10±5.8^{a}	110.03±14.2^{ab}	110.0±6.0^{a}
	75	27.02±2.0^{a}	61.18±5.6^{a}	92.92±6.2^{a}	127.66±12.5^{ab}	126.46±a7.5^{b}	27.30±3.0^{a}	52.83±5.2^{ab}	90.20±6.9^{a}	122.27±10.8^{ab}	121.0±6.5^{a}
	50	24.72±2.9^{a}	56.66±3.7^{a}	96.24±4.8^{a}	138.40±14.2^{a}	136.86±12.4^{a}	28.50±1.8^{a}	54.70±4.0^{ab}	97.63±4.5^{a}	136.10±12.5^{a}	132.77±8.5^{a}
	25	27.36±3.1^{a}	23.62±1.4bc	91.58±1.2^{a}	120.88±13.2^{ab}	121.64±12.1^{ab}	25.87±1.5^{a}	39.37±3.8^{ab}	92.67±8.6^{a}	108.27±10.5^{a}	115.40±12.0^{a}
	Dw (0)	21.88±0.8^{a}	57.68±2.6^{a}	96.70±6.3^{a}	120.20±11.5^{ab}	113.66±15.1^{ab}	23.07±1.3^{abc}	38.17±4.6^{ab}	98.0±8.6^{a}	125.13±14.2^{ab}	113.30±12.5^{a}

Trts-Treatment , WAS-Weeks After Sowing, CM – Paraquate, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaena leucocephala;* Dw(0%) – distilled water .

Means ± standard errors within a column followed by the same letter(s) are not significantly different at 5% probability level using Duncan's Multiple Range Test (DMRT)

in the 1st and 2nd trials, respectively. There were significant differences at 25% at 5 WAS, 50% at 9 WAS and 50% at 11 WAS compared with the control in the first trial. In the second trial, all concentrations were only significantly different from the control at 3 WAS but with no significant differences at all concentrations at 5, 7 and 11 WAS (Table 4.10).

4.14. Phytotoxic Effects of Extracts of *Eucalyptus torelliana, Eucalyptus camaldulensis* and *Leucaena leucocephala* on Stem Diameter of Maize

The highest mean stem diameter of maize treated with paraquat was 15.0±1.5 mm at 5 WAS and 19.2±1.8 mm at 5 WAS during the first and second trials respectively, while the lowest mean in the first trial was 5.28±0.8 mm and 5.25±0.4 mm at 3 WAS of the 1st and 2nd trials, respectively. There were significant differences at 11 WAS compared with the control. In the second trial with the plant treated with paraquat, there were no significant differences at stem diameter across 3, 5, 7, and 11 WAS (Table 4.11).

The highest mean stem diameter of extracts of *Eucalyptus torelliana* observed were 18.3±2.1 mm at 75% at 7 WAS and 19.6±3.1 mm at 75 % at 7 WAS during the 1st and 2nd trials, respectively. However, the lowest mean was 5.3±0.6 mm and 5.2±0.4 mm at 25% at 3 WAS during the first and second trials, respectively. There were significant differences only at 75% at 7 WAS compared with the control in the first trial (Table 4.11).

Based on the extracts of *Eucalyptus camaldulensis* applied, the highest mean stem diameter observed were 18.2±2.2 mm at 75% at 9 WAS and 18.7±1.5 mm at 0% at 5 WAS in the 1st and 2nd trials respectively, while the lowest mean in the first trial was 4.75±0.2 mm at 25% and 4.28±0.6 mm at 75% at 3 WAS of the second trial. In the second trial, there were significant differences at the mean stem diameter at 75% at 3 WAS compared with 100%, 75%, 50% concentrations and the control as shown in Table 4.11.

The extracts of *Leucaena leucocephala* applied showed that the highest mean stem diameter of maize was 18.2±2.4 mm at 100% of 7 WAS and 18.7±1.5 mm at 0% at 5 WAS of the 1st and 2nd trials respectively, while the lowest mean was 5.7±1.7 mm and 5.7±0.6 mm at 0% at 3 WAS of the 1st and 2nd trials, respectively. There were significant differences at the mean stem diameter of 75% concentration compared with

Table 4.11: Phytotoxic effect of extracts of *Eucalyptus torelliana, Eucalyptus camudulensis* and *Leucaena leucocephala* on stem diameter of maize

		First trial (mm)					**Second trial (mm)**				
Trts	Conc	3 WAS	5 WAS	7 WAS	9 WAS	11 WAS	3 WAS	5 WAS	7 WAS	9 WAS	11 WAS
CM	50	5.28±0.8^{ab}	14.95±1.5^{a}	12.53±1.4^{ab}	12.08±1.2^{a}	11.97±1.0^{b}	5.25±0.4^{abc}	19.23±1.8^{a}	15.96±1.4^{a}	14.98±1.0^{a}	15.04±1.3^{a}
	Dw(0)	5.73±1.7^{ab}	16.18±2.7^{a}	15.48±1.6^{ab}	15.28±2.0^{a}	14.97±1.2^{ab}	5.72±0.6^{ab}	18.67±1.5^{a}	15.58±1.6^{a}	15.54±1.8^{a}	15.61±2.0^{a}
Et	100	5.59±0.3^{ab}	17.05±1.5^{a}	17.14±2.4^{ab}	17.44±1.6^{a}	16.79±1.3^{ab}	6.21±0.5^{ab}	19.53±1.2^{a}	18.81±2.5^{a}	18.48±2.0^{a}	17.15±2.5^{a}
	75	6.67±0.6^{ab}	17.69±0.8^{a}	18.32±2.1a	15.72±0.8^{a}	16.13±1.5^{ab}	7.75±0.5^{a}	18.35±1.4^{a}	19.59±3.1^{a}	15.92±1.5^{a}	16.98±2.4^{a}
	50	5.85±0.9^{ab}	16.63±2.2^{a}	16.67±1.4^{ab}	14.87±1.2^{a}	15.71±1.2^{ab}	5.74±0.6^{ab}	18.70±1.8^{a}	18.58±2.8^{a}	16.95±2.1^{a}	16.93±2.3^{a}
	25	5.34±0.6^{ab}	14.68±2.1^{a}	14.78±1.7^{ab}	13.80±1.8^{a}	14.18±1.4^{ab}	5.15±0.4^{abc}	15.31±1.2^{a}	14.06±2.2^{a}	13.15±1.8^{a}	13.41±1.2^{a}
	Dw(0)	5.73±1.7^{ab}	16.18±2.7^{a}	15.48±1.6^{ab}	15.28±2.0^{a}	14.97±1.2^{ab}	5.72±0.6^{ab}	18.67±1.5^{a}	15.58±1.6^{a}	15.54±1.8^{a}	15.61±2.0^{a}
Ec	100	5.62±0.5^{ab}	17.41±2.1^{a}	17.04±1.6^{ab}	16.21±2.0^{a}	15.54±1.6^{ab}	6.24±0.4^{a}	17.81±2.1^{a}	17.21±1.5^{a}	17.83±1.5^{a}	16.58±2.0^{a}
	75	4.96±0.5^{ab}	17.68±2.8^{a}	11.71±2.1^{bc}	18.24±2.2^{a}	18.22±2.0^{a}	4.28±0.6^{bc}	17.74±1.4^{a}	14.58±1.2^{a}	18.49±1.8^{a}	18.37±3.1^{a}
	50	5.58±0.4^{ab}	16.06±1.4^{a}	17.76±2.1^{ab}	15.64±1.3^{a}	15.25±1.8^{ab}	6.07±0.5^{ab}	14.85±1.8^{a}	17.67±2.1^{a}	15.20±0.8^{a}	15.58±1.2^{a}
	25	4.75±0.2^{bc}	11.37±1.2^{ab}	13.69±1.2^{ab}	13.73±2.4^{a}	13.94±1.2^{ab}	6.32±0.9^{ab}	16.01±2.0^{a}	17.32±1.8^{a}	17.71±2.1^{a}	17.87±1.4^{a}
	Dw(0)	5.73±1.7^{ab}	16.18±2.7^{a}	15.49±1.6^{ab}	15.28±2.0^{a}	14.97±1.2^{ab}	5.72±0.6^{ab}	18.67±1.5^{a}	15.58±1.6^{a}	15.54±1.8^{a}	15.61±2.0^{a}
Ll	100	6.36±0.8^{ab}	17.32±1.4^{a}	18.18±2.4^{ab}	17.28±1.2^{a}	15.78±1.4^{ab}	6.67±0.6^{ab}	17.13±1.6^{a}	18.61±2.2^{a}	16.12±1.5^{a}	15.14±1.7^{a}
	75	7.17±0.5^{a}	15.49±1.8^{a}	16.99±1.2^{ab}	15.99±0.9^{a}	16.33±1.8^{ab}	7.78±0.9^{a}	14.49±1.8^{a}	17.61±2.5^{a}	15.43±1.4^{a}	16.14±1.6^{a}
	50	6.07±0.3^{ab}	15.57±2.4^{a}	16.29±1.8^{ab}	16.02±1.7^{a}	14.99±0.5^{ab}	6.31±0.3^{ab}	15.63±1.5^{a}	16.82±2.4^{a}	15.91±1.8^{a}	15.24±1.2^{a}
	25	6.49±0.9^{ab}	17.75±1.6^{a}	17.29±2.0^{ab}	16.32±1.6^{a}	17.88±0.8^{ab}	5.94±0.5^{ab}	17.04±1.2^{a}	16.22±2.1^{a}	15.26±0.8^{a}	17.61±1.8^{a}
	Dw(0)	5.73±1.7^{ab}	16.18±2.7^{a}	15.48±1.6^{ab}	15.28±2.0^{a}	14.97±1.2^{ab}	5.72±0.6^{ab}	18.67±1.5^{a}	15.58±1.6^{a}	15.54±1.8^{a}	15.61±2.0^{a}

Trts-Treatments, Conc.-Concentration,WAS –Weeks After Sowing, CM – Paraquat, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll – *Leucaena leucocephala;* Dw (0) – distilled water, Means ±standard errors within a column having the same letter(s) are not significantly different at 5% probability level using Duncan's Multiple Range Test (DMRT)

the control at 3 WAS in the first trial. The mean stem diameter were significantly difference only at 75% at 3 WAS compared with the control in second trial (Table 4.11).

4.15. Phytotoxic Effects of Extracts of *Eucalyptus torelliana, Eucalyptus camaldulensis* and *Leucaena leucocephala* on Number of Leaves of Maize

The highest mean number of leaves with chemical used, as illustrated in Table 4.12 was 8.2±0.5 and 10.7±1.0 at 9 WAS for the first and second trials, respectively. Conversely, the lowest mean in the first trial was 4.80±0.5 and 4.7±0.3at 100% at 3 WAS in the second trial. There were significant differences in comparison with control at 7, 9 and 11 WAS in the first trial. In the second trial, there were significant differences at 7 and 11 WAS when compared with 0% (control).

The extract of *Eucalyptus torelliana* applied on the maize pots showed that the highest mean number of leaves were 13.2±1.3 at 75 % at 7 WAS and 14.0±1.5 at 50% at 11 WAS for the first and second trials respectively, while the lowest mean in the first trial was 5.0±0.6 at 0% (control) at 3 WAS in both first and second trials. There was significant difference at 75% at 7 WAS compared with the 0% as illustrated in Table 4.11. In the second trial, there were significant differences in comparison with the control at 11 WAS and mean number of leaves at 50% at 11 WAS (Table 4.12).

Based on the extract of *E.camaldulensis* applied, the highest mean number of leaves observed was 12.8±1.5 at 50% at 9 WAS in the first trial and 13.0±1.0 at 50% and 0% at 9 WAS for the second trial. The lowest mean in the first trial was 4.4±0.2 at 50% and 25 % at 3 WAS, while 4.7±0.3 at 50% was the lowest in the second trial. In the first trial, there were significant differences at the mean number of leaves in 50% concentration at 9 WAS compared with that of 100% and 25% at 9 WAS. In the second trial, there were significant differences only at 25% (5.67±0.5) compared with the control (0%) at 3 WAS (Table 4.12).

As presented from Table 4.12, *L. leucocephala* extract had the highest mean number of leaves with 12.8±1.5 and 13.7±1.2 both at 75% at 11 WAS for the first and second trials respectively, while the lowest mean of 5.0±0.6 at 0% at 3 WAS for both first and second trials. In the first trial, there was significant difference at 50% only at 7 WAS compared with the control. In the second trial, there were significant differences at the mean number of leaves at 75% and 50% compared to other concentrations at 3 WAS and also 75% (13.67±1.2) at 11 WAS.

Table 4.12: Phytotoxic effect of *Eucalyptus torelliana, Eucalyptus camudulensis* and *Leucaena leucocephala* number of leaves of maize

		First trial (cm)					Second trial (cm)				
Trts	Conc	3 WAS	5 WAS	7 WAS	9 WAS	11 WAS	3 WAS	5 WAS	7 WAS	9 WAS	11 WAS
CM		4.80±0.5^{a}	7.0±0.5^{a}	7.60±0.4^{b}	8.20±0.5^{bd}	6.20b±0.5^{c}	4.67±0.3^{ab}	8.33±0.4^{a}	9.0±0.8^{b}	10.67±1.0^{a}	7.0±0.8^{bc}
Et	100	5.20±0.5^{a}	9.0±0.8^{a}	9.60±1.0^{ab}	11.80±1.2^{abc}	11.0±1.0^{a}	5.33±0.4^{ab}	9.67±1.0^{a}	9.33±1.0^{a}	11.0±1.0^{a}	11.0±1.0^{ab}
	75	5.60±0.5^{a}	9.20±0.6^{a}	13.20±1.3^{a}	11.80±1.2^{abc}	11.20±1.2^{a}	6.0±0.8^{a}	9.33±0.8^{a}	11.0±1.2^{a}	12.0±1.2^{a}	11.67±1.5^{ab}
	50	6.0±0.4^{a}	9.0±1.1^{a}	11.0±1.0^{ab}	12.60±0.5^{a}	12.80±1.8^{a}	6.0±1.0^{a}	10.33±1.2 ^{a}	11.33±1.2^{a}	13.33±1.2^{a}	14.0±1.5^{a}
	25	5.20±0.3^{a}	8.40±1.0^{a}	10.20±1.3^{ab}	11.80±1.3^{ab}	11.40±1.2^{a}	5.33±0.3^{ab}	8.67±0.8^{a}	10.0±1.2^{a}	11.33±1.0^{a}	11.0±1.2^{ab}
	Dw(0)	5.0±0.6^{a}	8.60±1.0^{a}	10.60±1.2^{ab}	12.60±1.0^{a}	11.60±1.5^{a}	5.0±0.5^{ab}	8.67±0.9^{a}	11.67±1.0^{a}	13.0±2.2^{a}	11.67±1.4^{ab}
Ec	100	5.2±0.2^{a}	9.40±1.2^{a}	9.80±1.4^{ab}	11.20±1.2^{abcd}	9.40±1.3^{ab}	5.33±0.5^{ab}	9.33±1.1^{a}	9.67±0.8^{a}	12.0±1.0^{a}	9.67±1.0^{ab}
	75	5.2±0.2^{a}	9.60±0.6^{a}	10.0±1.7^{ab}	12.20±1.5^{a}	11.0±1.0^{a}	5.33±0.5^{ab}	9.0±1.0^{a}	10.67±1.0^{a}	12.67±1.0^{a}	12.0±1.4^{ab}
	50	4.4±0.2^{a}	9.0±1.0^{a}	9.80±1.2^{ab}	12.80±1.5^{a}	11.0±1.0^{a}	4.67±0.3^{ab}	9.33±1.0^{a}	9.67±0.8^{a}	13.0±1.0^{a}	10.67±1.5^{ab}
	25	4.4±0.1^{a}	7.0±0.6^{a}	9.0±1.0^{b}	9.40±0.8^{abcd}	9.40±0.8^{ab}	5.67±0.5^{a}	9.0±0.7^{a}	11.67±1.2^{a}	12.33±1.3^{a}	12.33±1.8^{ab}
	Dw(0)	5.0±0.6^{a}	8.6±1.0^{a}	10.60±1.2^{ab}	12.60±1.0^{a}	11.60±1.5^{a}	5.0±0.5^{ab}	8.67±0.9^{a}	11.67±1.0^{a}	13.0±2.2^{a}	11.67±1.4^{ab}
Ll	100	6.0±0.6^{a}	8.80±1.0^{a}	9.80±1.0^{ab}	12.20±1.2^{a}	11.60±1.4^{a}	5.33±0.4^{ab}	8.33±0.6^{a}	9.33±0.5^{a}	11.67±1.2^{a}	11.0±1.0^{ab}
	75	5.60±0.8^{a}	9.0±1.0^{a}	10.0±1.0^{ab}	12.0±1.2^{a}	12.80±1.5^{a}	5.67±0.9^{a}	8.33±0.5^{a}	9.67±0.5^{a}	12.0±1.5^{a}	13.67±1.2^{a}
	50	5.60±0.7^{a}	8.60±0.7^{a}	9.40±0.8^{b}	12.40±1.0^{a}	12.20±2.0^{a}	5.67±0.8^{a}	8.67±0.7^{a}	9.33±0.5^{a}	12.0±1.2^{a}	11.67±1.1^{ab}
	25	5.60±0.5^{a}	9.0±0.8^{a}	10.0±1.2^{ab}	12.40±1.2^{a}	12.40±1.8^{a}	5.33±0.4^{ab}	9.0±0.8^{a}	9.67±0.9^{a}	12.33±1.2^{a}	12.33±1.4^{ab}
	Dw(0)	5.0±0.6^{a}	8.60±1.0^{a}	10.60±1.2^{ab}	12.60±1.0^{a}	11.60±1.5^{a}	5.0±0.5a^{b}	8.67±0.9^{a}	11.67±1.0^{a}	13.0±2.2^{a}	11.67±1.4^{ab}

Trts-Treatments, Conc.-Concentration,WAS –Weeks After Sowing, CM – Paraquat, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll – *Leucaena leucocephala;* Dw (0) – distilled water, Means ±standard errors within a column having the same letter(s) as superscript are not significantly different at 5% probability level using Duncan's Multiple Range Test (DMRT)

4.16. Phytotoxic effects of extracts of *Eucalyptus torelliana, Eucalyptus camaldulensis* and *Leucaena leucocephala* on Leaf Area of Maize

The highest mean leaf area of maize with paraquat used was observed to be 420.22±14.2 cm^3 at 9 WAS and 518.53±21.5 cm^3 at 9 WAS during the first and second trial respectively, while the lowest mean in the first trial was 65.7±8.4 cm^3 at 3 WAS and 65.3±5.8 cm^3 also at 3 WAS of the second trial. There were significant differences at the mean leaf area of maize compared with the control at 3, 5, 7 and 11 WAS on the first trial. In the second trial, there were significant differences at the mean leaf area compared with the control at 5 and 11 WAS (Table 4.13).

Based on extract of *Eucalyptus torelliana* applied, the highest mean leaf area of maize observed was 600.03±28.5 cm^3 at 0% and 634.98±31.5 cm^3 at 25% of 7 WAS in the first and second trials, respectively. However, the lowest mean in the first trial was 38.22±12.4 cm^3 and 33.88±4.0 cm^3 at 100% at 3 WAS of the first and second trials, respectively. There were significant differences at the mean leaf area of maize at 100% when compared with the control at 3, 5, 7 and 11 WAS in the first trial. In the second trial, the mean leaf area were significantly different from the control at 100% at 3 WAS, 100%, 50% and 25% at 5 WAS, 25% at 7 WAS while at 50% and 25% at 11 WAS (Table 4.13).

From table 4.13, the extract of *Eucalyptus camaldulensis* applied showed that the highest mean leaf area of maize observed was 600.03±28.5 cm^3 and 594.22±24.5 cm^3 at 0% (control) both at 7 WAS during the 1^{st} and 2^{nd} trials respectively. The lowest mean leaf area was 58.46±11.1 cm^3 at 50% and 60.33±12.5 cm^3 at 25% both also at 3 WAS during first and second trial, respectively. There were significant differences at 100% and 50% at 3 WAS, 25% at 5 WAS, 75%, 50% and 25% at 7 WAS, and 100% and 75% at 9 WAS compared with the control in the first trial. In the second trial, there were significant differences at the mean leaf area at 75%, 50% and 25% at 5 WAS when compared with the control in the second trial (Table 4.13).

In Table 4.13, it was observed that the extracts of *L. leucocephala* applied revealed that the highest mean leaf area of maize were 644.08±32.4 cm^3 at 25% at 7 WAS and 649.34±21.4 cm^3 at 25% at 9 WAS during the first and second trials respectively.

		First trial (cm^3)					Second trial (cm^3)				
Trts	Conc (%)	3 WAS	5 WAS	7 WAS	9 WAS	11 WAS	3 WAS	5 WAS	7 WAS	9 WAS	11 W
CM		65.70±8.4^{abc}	311.78±21.0^{ab}	285.79±22.4^{bcd}	420.22±14.2^{ab}	341.55±14.8^{ab}	65.30±5.8^{ab}	438.0±18.5^{ab}	431.02±21.5^{ab}	518.53±21.5^{ab}	400.
Et	100	38.22±12.4^{bc}	316.99±18.5^{ab}	415.27±24.5^{abcd}	430.40±9.8^{ab}	384.79±20.0^{ab}	33.88±4.0^{b}	359.0±20.5^{abc}	400.82±20.4^{ab}	496.64±21.4^{ab}	442.4
	75	73.33±22.7^{ab}	512.87±21.4^{a}	556.498±24.5^{ab}	460.56±10.5^{ab}	400.32±17.5^{a}	91.88±6.5^{ab}	597.87±23.2^{a}	597.29±28.6^{ab}	494.05±28.5^{ab}	432.8
	50	71.76±17.2^{ab}	293.64±22.2^{abc}	459.77±21.8^{abc}	427.26±1.8^{ab}	384.08±18.4^{ab}	76.45±4.8^{ab}	359.29±20.1^{abc}	592.57±25.5^{ab}	501.29±29.5^{ab}	418.6
	25	69.73±11.6^{ab}	408.95±32.1^{a}	487.48±19.6^{abc}	567.89±22.8^{a}	367.04±13.2^{ab}	63.94±4.3^{ab}	367.17±22.2^{abc}	634.98±31.5^{a}	597.47±25.5^{ab}	371.3
	0	72.05±5.2^{ab}	449.29±31.5^{a}	600.03±28.5^{a}	367.50±21.5^{ab}	423.80±21.2^{a}	71.97±8.5^{ab}	470.06±19.5^{a}	594.22±24.5^{ab}	298.14±21.1^{ab}	441.1
Ec	100	68.48±12.7^{abc}	469.75±22.8^{a}	598.97±32.2^{a}	520.43±28.5^{a}	419.48±16.4^{a}	78.92±15.5^{ab}	536.34±22.3^{a}	567.95±26.4^{ab}	508.22±30.2^{ab}	393.1
	75	78.95±9.9^{ab}	430.65±24.5^{a}	561.97±24.6^{ab}	543.49±25.6^{a}	480.04±14.5^{a}	83.02±18.2^{ab}	347.07±18.5^{abc}	560.35±22.1^{ab}	513.58±23.8^{ab}	444.7
	50	58.46±11.1^{abc}	388.75±15.8^{a}	444.15±21.2^{abcd}	408.92±21.4^{ab}	394.60±19.4^{a}	87.47±9.5^{ab}	463.49±14.5^{ab}	375.93±19.6^{ab}	330.29±19.5^{ab}	410.6
	25	80.17±12.4^{ab}	302.28±13.3^{ab}	442.76±24.2^{abcd}	375.37±18.2^{ab}	369.16±9.8^{a}	60.33±12.5^{ab}	352.35±13.2^{abc}	519.13±14.8^{ab}	523.42±25.4^{ab}	463.0
	0	72.05±5.2^{ab}	449.29±31.5^{a}	600.03±28.5^{a}	367.50±21.5^{ab}	423.80±21.2^{a}	71.97±8.5^{ab}	470.06±19.5^{a}	594.22±24.5^{ab}	298.14±21.1^{ab}	441.1
Ll	100	87.69±5.0^{a}	436.25±12.5^{a}	613.56±28.2^{a}	571.67±25.1^{a}	404.26±15.5^{a}	77.96±10.0^{ab}	380.58±12.2^{abc}	620.05±22.4^{ab}	568.87±23.5^{ab}	392.8
	75	78.95±4.6^{ab}	339.34±19.5^{ab}	480.24±22.6^{abc}	420.57±22.4^{ab}	274.61±10.5^{abc}	101.37±14.2^{a}	326.79±19.0^{abc}	462.73±21.6^{ab}	423.12±18.5^{ab}	227.3
	50	58.46±11.2^{abc}	375.06±21.4^{a}	548.52±19.5^{ab}	471.88±19.2^{a}	355.08±12.6^{ab}	69.45±9.5^{ab}	382.39±14.6^{abc}	607.39±31.0^{ab}	499.59±19.5^{ab}	369.7
	25	58.46±11.2^{abc}	373.51±18.4^{a}	644.08±32.4^{a}	610.90±30.2^{a}	410.59±15.4^{a}	82.75±9.0^{ab}	425.12±18.5^{ab}	639.01±28.5^{a}	649.34±21.4^{a}	422.2
	0	72.05±5.2^{ab}	449.29±31.5^{a}	600.03±28.5^{a}	367.50±21.5^{ab}	423.80±21.2^{a}	71.97±8.5^{ab}	470.06±19.5^{a}	594.22±24.5^{ab}	298.14±21.1^{ab}	441.1

Table 4.13: Phytotoxic effect of *Eucalyptus torelliana, Eucalyptus camudulensis* and *Leucaena leucocephala* on leaf-area of maize

Trts-Treatments, Conc.-Concentration,WAS –Weeks After Sowing, CM – Paraquat, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll – *Leucaena leucocephala;* Dw (0) – distilled water, Means ±standard errors within a column having the same letter(s) as superscript are not significantly different at 5% probability level using Duncan's Multiple Range Test (DMRT)

While the lowest mean leaf area was 58.46± cm^3 at 50% and 25% at 3 WAS in first trial and 69.45±9.5 cm^3 at 50% at 3 WAS of the second trial. There were significant differences at 100%, 50% and 25% at 3 WAS compared with the control in the first trial. In the second trial, there were significant differences at the mean leaf area at 25 % at other weeks when compared with the control except at 3 WAS.

4.17. Effects of Aqueous Extracts of *Eucalyptus torelliana, Eucalyptus camaldulensis* and *Leucaena leucocephala* on maize plant biomass

The mean weight of maize biomass with paraquat used was 24.95±2.6 g in the first trial and 27.61±1.8 g in the second trial, which showed that there was significant difference in the control during the both trials (Table 4.14).

Results from Table 4.6e shows that mean total weight of maize treated with the extract of *Eucalyptus torelliana* was 48.5±5.1 g at 0% which was followed by 44.0±5.0 g at 75% in the first trial. There were no significant differences from each other but there was from 50% and 25%. In the second trial, the mean total weight of maize with *Eucalyptus torelliana* extracts was 50.6±5.2 g at 75% concentration. There were significant differences at 75% compared with the control (0%), 100%, 50% and 25% as shown in Table 4.14.

Based on the extract of *Eucalyptus camaldulensis* applied, mean total weight in the first trial was 48.5±5.1 g at 0% which was followed by 47.5±2.9 g at 75% with no significant difference from each other, with significant difference only at 25%. In the second trial, the mean total weight of maize was 45.6±3.9 g at 0%, while the least was 35.3±3.2 g at 100%. There were significant differences only at 100% and 25% compared with 0% in the second trial as shown in Table 4.14.

Based on the extract of *Leucaena leucocephala* applied on maizes, the mean total weight was 48.5±5.1 g at 0% which was followed by 49.7±4.3 g at 25% with no significant difference from each other but significantly different with 100% and 75% concentration in the first trial. However, in the second trial, mean total weights were not significantly different from each other but there were significant difference with the control which had the highest total mean weight (45.6±3.9 g) of maize (Table 4.14).

Table 4.14: Phytotoxic effect of *Eucalyptus torelliana, Eucalyptus camudulemensis* and *Leucaena leucocephala* on biomass of maize

		First trial			Second trial		
Trt	Conc.	Stem	Root	Total	Stem	Root	Total
CM		18.2±2.4^{abc}	6.66±0.5^{bc}	24.95±2.6^{ab}	19.32±1.5^{abcde}	7.84±0.5^{ab}	27.61±1.8^{abc}
	Dw(0)	27.6±2.7^{a}	15.51±2.0^{abc}	48.53±5.1^{a}	32.37±4.1^{ab}	13.72±1.5^{ab}	45.63±3.9^{ab}
Et	100	26.4±2.1^{a}	11.57±0.8^{abc}	37.92±3.8^{a}	26.43±1.8^{abcd}	11.25±1.0^{ab}	37.64±4.0^{ab}
	75	30.7±2.9^{a}	22.18±1.9^{a}	44.01±5.0^{a}	31.03±2.6^{abcd}	18.42±2.0^{ab}	50.61±5.2a
	50	22.5±2.0^{a}	10.88±2.1^{abc}	34.65±4.2^{ab}	27.60±2.0^{abcd}	16.62±1.2^{ab}	46.33±4.1^{ab}
	25	15.4±1.2^{abc}	7.49±1.0^{bc}	22.82±2.4^{ab}	17.54±1.2^{abcde}	10.48±1.0^{ab}	27.99±3.5^{abc}
	Dw(0)	27.6±2.7^{a}	15.51±2.0^{abc}	48.53±5.1^{a}	32.37±4.1^{ab}	13.72±1.5^{ab}	45.63±3.9^{ab}
Ec	100	26.0±2.7^{a}	13.93±1.2^{abc}	39.81±3.2^{a}	27.33±2.0^{abcd}	8.17±0.4^{ab}	35.26±3.2^{abc}
	75	29.9±4.5^{a}	17.66±1.2^{ab}	47.52±2.9^{a}	23.45±1.4^{abcd}	19.65±1.2^{a}	43.0±3.6^{ab}
	50	26.2±2.5^{a}	12.41±1.0^{abc}	38.63±3.1^{a}	27.45±1.4^{abcd}	14.17±1.5^{ab}	41.93±3.9^{ab}
	25	21.5±1.8^{ab}	7.95±0.5^{abc}	28.75±4.2^{ab}	25.49±1.8^{abcd}	10.04±1.2^{ab}	35.06±3.0^{abc}
	Dw(0)	27.6±2.7^{a}	15.51±2.0^{abc}	48.53±5.1^{a}	32.37±4.1^{ab}	13.72±1.5^{ab}	45.63±3.9^{ab}
Ll	100	21.7±1.8^{a}	10.75±1.2^{abc}	32.51±3.0^{ab}	19.39±1.5^{abcde}	9.12±1.0^{ab}	28.68±3.0^{abc}
	75	16.1±1.5^{abc}	8.59±1.0^{abc}	25.37±4.8^{ab}	19.97±2.5^{abcde}	7.73±0.6^{ab}	29.25±2.5^{abc}
	50	24.8±2.0^{a}	10.48±0.8^{abc}	36.86±2.8^{a}	24.83±2.1^{abcd}	9.29±0.8^{ab}	36.06±2.8^{abc}
	25	25.4±2.2^{a}	15.35±1.9^{abc}	40.68±4.3^{a}	20.49±2.0^{abcde}	13.47±1.5^{ab}	33.85±4.8^{abc}
	Dw (0)	27.4±2.7^{a}	15.51±2.0^{abc}	48.53±5.1^{a}	32.37±4.1^{abc}	13.72±1.5^{abc}	45.63±3.9^{ab}

Trt.- Treatments, WAS-Wekks After Sowing, CM – Paraquate, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaena leucocephala;* Dw(0) – distilled water.

Means ± standard errors within a column having the same letter(s) as superscript are not significantly different at 5% probability level using Duncan's Multiple Range Test (DMRT)

4.18: Effects of Aqueous Extracts of *Eucalyptus torelliana, Eucalyptus camaldulensis* and *Leucaena leucocephala* on Maize Yield

In the first trial, the mean yield of maize with the effect of paraquat used on seed weight was 48.5±6.4 g and the 100-seed weight was 25.0±3.9 g as shown in Table 4.6f. There was significant difference with seed weight compared with the control (82.7±9.2 g) which had the highest mean weight. In the second trial, highest mean seed weight was 86.9±11.0 g, while the chemical treatment yielded 55.6±5.4 g and the 100-seed weight was 36.5±3.2 g having significant difference with the control (Figure 4.8).

It was revealed from the extract *Eucalyptus torelliana* applied that the higher 100-seed weight was 44.0±4.5 g in the first trial. There were significant difference compared with the control in the first trials of maize. In the second trial, the higher 100-seed weight was 70.4±10.0 at 0% which was followed by 51.2±4.8 at 75% concentration. There were significant differences compared with the control at all concentrations in the second trial (Figure 4.8).

Also, with *Eucalyptus camaldulensis,* the higher mean 100-seed weight were 47.52±5.2 g at 75% in the first trial. There was significant difference in the mean seed weight only at 25% compared to the control in the first trial. In the second trial, the higher mean 100-seed weight of maize was 70.37±10.0 g followed by 68.43±8.5 g at 100%. There were no significant differences at 100% compared with the 0%, but there were significant differences at 75%, 50% and 25% in the second trial compared with the control as illustrated in Figure 4.8.

From Figure 4.8, *Leucaena leucocephala* extract applied showed that the higher mean 100-seed weight was 41.33±5.5 g at 0% which was followed by 40.68±4.8 g at 25% in the first trial, although there were no significant differences in all concentrations compared with the control of maize seed weight in the first trial. In the second trial, the higher mean 100-seed weight was 70.37±10.0 g at 0%. There was no significant difference in all concentrations compared with control in the first trial, while there was in the second trial.

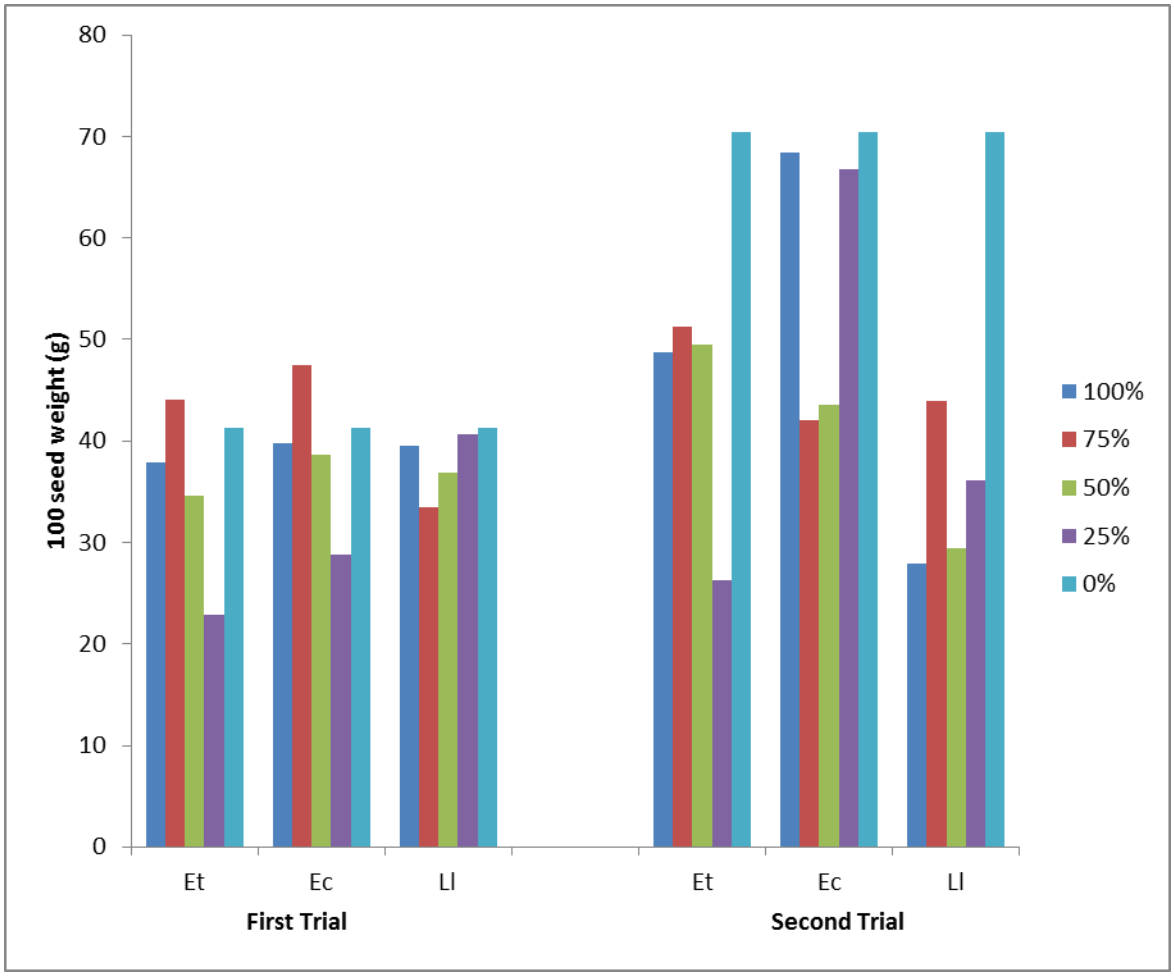


Figure 4.8: Phytotoxic effect of *Eucalyptus torelliana*, *Eucalyptus camudulemensis*and *Leucaena leucocephala* on yield (seed) of maize

Trt. – Treatment, WAS- Weeks After Sowing, CM – Paraquate, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaenia leucocephala;* control (0) – distilled water.

4.19: Effects of Extracts of *Eucalyptus torelliana, Eucalyptus camaldulensis* and *Leucaenia leucocephala* on Weed Biomass in Maize Pots

The mean weed dry weight of the paraquat used on maize was 4.9±0.2 g in the first trial and and 3.6±0.2 in second trial. There was significant difference at the mean weed weight in concentrations compared with the control in the first and second trials (Figure 4.9).

Based on the extract of *Eucalyptus torelliana* applied, the highest mean weed dry weight of the weed were 32.8±2.5 g at 100% in the first trial and 32.1±4.0 g at 0% in the second trial. There were significant differences at 100% and 75% in the first trial, then 50% and 25% at the second trial compared with the control of maize as illustrated in Figure 4.9.

The extract of *Eucalyptus camaldulensis* applied showed that 43.6±3.5 g at 50% in the first trial and 32.1±4.0 g at 0% in second trial were the highest mean dry weight. There were significant differences at 75% and 25% compared with the control in the first trial, while there were significant differences at all concentrations in the second trial when compared with the control (Figure 4.9).

Effects of *Leucaena leucocephala* extract on weed dry weight had higher value of 25.97±1.8 g at 25% concentration with no significant differences with other concentrations, compared with the control at the first trial. In the second trial, the higher weed biomass was 32.12±4.0 g. There were significant differences at 100%, 50% and 25% concentrations compared with the control in the second trial (Figure 4.9).

4.20. Effects of *Eucalyptus camaldulensis, Eucalyptus torelliana, Leucaena leucocephala* and Paraquat on Weeds composition and their relative Importance Value (RIV) at Three Weeks After Sowing Cowpea

Eucalyptus camaldulensis

There were 14 weed species belonging to eight families enumerated on all the pots sampled at three weeks after sowing in the first trial. The highest relative importance values obtained (52.3, 37.0, 32.2 and 22.5) were for *Mitracarpus vilosus* at 100%, 75%, 25% and50%, respectively. *Larpotea austeans* had the lowest relative importance value of 4.2 at 50%, as shown in Table 4.15.

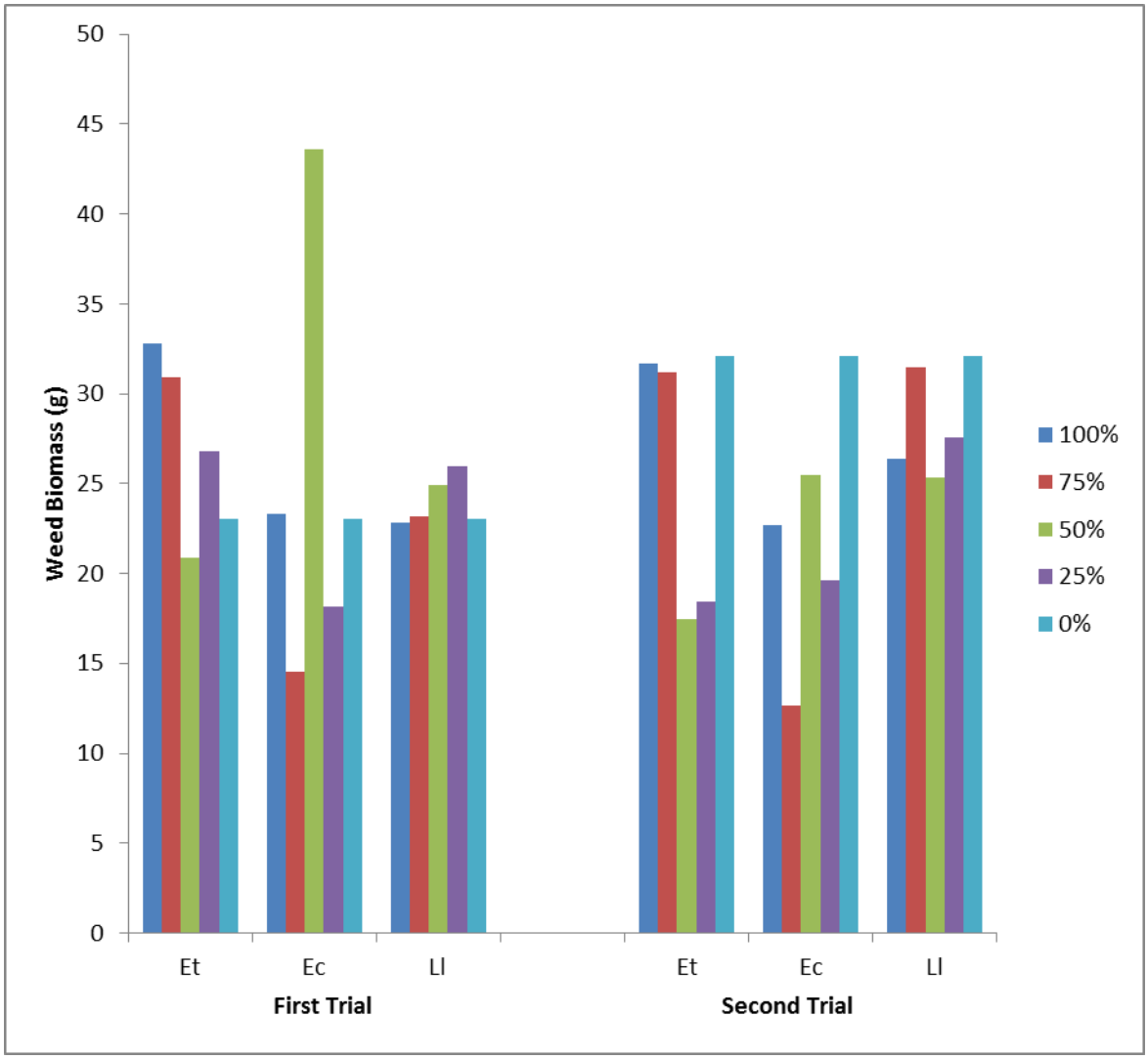


Figure 4.9: Phytotoxic effect of *Eucalyptus torelliana*, *Eucalyptus camudulensis* and *Leucaena leucocephala* on weed biomass of maize

Trt. – Treatment, WAS- Weeks After Sowing, CM – Paraquate, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaenia leucocephala;* control (0) – distilled water.

In the second trial, a total of seven weed species belonging to six families were enumerated on all the pots sampled at three weeks after sowing. *Cyperus esculentus* dominated with the highest relative importance values of 52.1, 44. 4, 41.1, 37.0 at 100%, 75%, 50%, and 25% respectively, while the lowest relative importance value of 3.7 at 50% for both *Ageratum conyzoides* and *Aspillia africana* was obtained as shown in (Table 4.15).

Eucalyptus torelliana

A total of 15 weed species belonging to nine families were enumerated on all the pots sampled at three weeks after sowing in the first trial. The relative importance values obtained as highest among all the species encountered, *Oldenlandia lancifolia* had the highest RIV (37.4) at 75% followed with 38.2, 35.7, 35.4 at 50%, 0% and 75%, respectively for *Mitracarpus vilosus* in the first trial. The lowest RIV was 4.5 at 100% for both *Cyperus rotundus* and *Larpotea austeans* (Table 4.15).

In the second trial, there were eight weed species belonging to seven families, were enumerated in all the pots sampled at three weeks after planting. The relative importance values obtained were highest for *Cyperus esculentus at* 41.2, 40.4, 39.8, 39.1 and 32.2 at 25%, 100%, 50%, 75%, and 0% respectively, while the lowest relative importance value obtained was 4.3 at 25% for *Larpotea austeans* as shown in Table 4.15.

Leucaena leucocephala

There were 14 weed species belonging to eight families were enumerated in all the pots sampled at three weeks after sowing in the first trial. The relative importance values obtained as highest among all the species encountered were 43.0, 42.9, 35.7 and 29.9 at 25%, 50%, 0% and 100% respectively for *Mitracarpus vilosus*, but relative importance values of 29.1 at 100% was the same for both *Mitracapus vilosus* and *Mariscus alternifolius*. The lowest relative importance values was 4.2 at 25% for *Amaranthus spinosus, Oldenlandia lancifolia* and *Synedrella nodiflora* in the first trial (Table 4.15).

In the second trial, a total of nine weed species belonging to seven families were enumerated in all the pots treated with *Leucaena leucocephala*. The relative importance values obtained was highest for *Cyperus esculentus at* 34.8, 30.3, 30.1 and 23.8 at 100%,

Table 4.15: Species composition and Relative Importance Value (RIV) of Weeds at 3 Weeks After Sowing

Trt	Species		First trial						Second trial					
		Family	CM	10%	75%	50%	25%	0%	CM	100%	75%	50%	25%	0%
Ec	*Ageratum conyzoides* Linn.	Asteraceae	-	-	-	-	-	-	-	-	-	3.74	12.31	-
	Alternanthera brasilliana (L.) Kuntze	Amaranthaceae	-	-	-	-	-	-	-	-	4.72	4.14	-	3.76
	Amaranthus spinosus Linn.	Amaranthaceae	9.33	11.45	5.66	18.77	13.40	10.71	-	-	-	-	-	-
	Aspilia africana (Pers.) C.D. Adams	Asteraceae	-	-	-	-	-	-	-	-	-	3.74	-	8.38
	Cyperus rotundus Linn.	Cyperaceae	8.67	7.02	5.66	-	-	-	-	-	-	-	-	-
	Cyperus esculentus L.	Cyperaceae	-	-	-	-	-	-	-	52.08	44.37	41.05	37.50	32.22
	Larpotea austeans (Linn.) chew	Urticaceae	-	-	5.65	4.21	-	-	-	-	-	7.47	-	-
	Mariscus alternifolius Vahl	Cyperaceae	8.67	16.63	14.55	21.56	24.16	20.48	-	-	-	-	-	-
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	5.00	52.27	36.98	22.47	32.22	35.71	-	-	-	-	-	-
	Oldenlandia lancifolia (Schumach.)DC.	Rubiaceae	12.00	19.34	24.75	11.05	20.93	11.91	-	-	-	-	-	-
	Oldenlandia corymbosa Linn	Rubiaceae	-	-	-	-	-	-	10.0	13.83	16.03	23.71	20.27	26.67
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae		-	-	-	-	-	-	26.33	18.54	14.03	14.02	15.13
	Syndedralla nodiflora (Linn.)Gaertn.	Compositae	14.00	4.43	6.77	9.30	9.29	14.05	-	-	-	-	-	-
	Talinum fruticosum	Talinaceae	-	8.87	-	12.63	-	8.90	-	7.77	16.35	4.14	15.91	9.23

	(L) Juss												
Trt	Species		First trial						Second trial					
		Family	CM	10%	75%	50%	25%	0%	CM	100%	75%	50%	25%	0%
Et	*Ageratum conyzoides* L.	Asteraceae	-	-	-	-	-	-	-	6.82	14.93	-	18.04	-
	Alternanthera brasilliana (L.) Kuntze	Amaranthaceae	-	-	-	-	-	-	-	-	6.94	8.87	-	-
	Amaranthus spinosus Linn.	Amaranthaceae	9.33	9.97	9.95	7.49	5.43	10.71	-	-	-	-	-	-
	Aspilia africana (Pers.) C.D. Adams	Asteraceae	-	-	-	-	-	-	-	5.49	5.97	8.87	-	-
	Cyperus rotundus Linn.	Cyperaceae	8.6	4.52	17.36	-	-	-	-	-	-	-	-	-
	Cyperus esculentus L.	Cyperaceae	-	-	-	-	-	-	-	40.38	39.05	39.78	41.21	32.22
	Larpotea austeans (Linn.) chew	Urticaceae	-	4.52	-	5.53	4.64	-	-	5.05	5.97	-	4.25	-
	Mariscus alternifolius Vahl	Cyperaceae	8.67	13.01	-	22.82	26.62	20.48	-	-	-	-	-	-
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	5.0	27.70	35.42	38.15	34.55	35.71	-	-	-	-	-	-
	Oldenlandia lancifolia (Schumach.)DC.	Rubiaceae	12.00	25.81	37.27	7.49	14.84	11.91	-	-	-	-	-	-
	Oldenlandia corymbosa Linn.	Rubiaceae		-	-	-	-	-	10.0	25.33	9.85	19.46	18.67	26.67
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	-	-	-	-	-	-	16.93	13.33	11.22	9.32	15.13
	Setaria barbata (Lam.) Kunth	Poaceae	-	-	-	-	4.64	-	-	-	-	-	-	-
	Syndedralla nodiflora (Linn.)Gaertn.	Compositae	14.0	14.49	-	6.51	9.28	14.05	-	-	-	-	-	-

	Talinum fruticosum (L) Juss	Talinaceae	-	-	-	12.03	-	8.90	-	-	3.96	11.81	8.51	9.23
Ll	*Ageratum conyzoides* Linn.	Asteraceae	-	-	-	-	-	-	-	-	-	5.51	8.28	-
	Alternanthera brasilliana (L.) Kuntze	Amaranthaceae	-	-	-	-	-	-	-	3.26	4.03	3.70	6.92	-
	Amaranthus spinosus Linn.	Amaranthaceae	9.33	15.09	15.54	13.60	4.17	10.71	-	3.26	-	-	-	-
	Aspilia Africana (Pers.) C.D. Adams	Asteraceae	-	-	-	-	-	-	-	-	9.44	3.70	-	8.38
	Cyperus esculentus L.	Cyperaceae	-	-	-	-	-	-	-	34.78	23.80	30.29	30.10	32.22
	Cyperus rotundus Linn.	Cyperaceae	8.67	4.55	-	16.23	16.85	-	-	-	-	-	-	-
	Larpotea austeans (Linn.) chew	Urticaceae	-	-	-	5.25	-	-	-	6.52	-	-	6.92	-
	Mariscus alternifolius Vahl	Cyperaceae	8.67	29.09	7.69	-	22.46	20.48	-	-	-	-	-	-
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	5.0	29.09	27.69	42.99	42.94	35.71	-	-	-	-	-	-
	Oldenlandia corymbosa Linn.	Rubiaceae	-	-	-	-	-	-	10.0.	12.29	23.56	27.75	26.70	26.67
	Oldenlandia lancifolia (Schumach.) DC.	Rubiaceae	12.0	4.55	23.54	13.60	4.17	11.91	-	-	-	-	-	-
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	-	-	-	-	-	-	12.18	6.78	9.57	7.26	15.13
	Syndedralla nodiflora (Linn.) Gaertn	Compositae	14.0	6.55	13.54	-	4.17	14.05	-	-	-	-	-	-
	Talinum fruticosum (L) Juss	Talinaceae	-	6.55	-	-	-	8.90	-	11.22	14.94	9.57	10.71	9.23

CM – Paraquat, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaenia leucocephala;* Dw (0) – distilled water

50%, 25% and 75% respectively, while the lowest relative importance value obtained was 3.3 at 100% for *Alternanthera brasiliana* and *Amaranthus spinosus* as shown in Table 4.15.

Paraquat

There were six weed species belonging to four families enumerated in all the pots sampled at three weeks after sowing in the first trial. The relative importance values of 14.0 for *Syndedralla nodiflora* was highest among all the species encountered in the first trial. The lowest lowest relative importance value was 5.0 for *Mitracarpus vilosus* in the first trial as shown in Table 4.15.

In the second trial, there was only one weed specie enumerated in all the pots sampled at three weeks after sowing with relative importance values of 10.0 (Table 4.15).

4.21: Effects of *Eucalyptus camaldulensis, Eucalyptus torelliana, Leucaena leucocephala* and Paraquat on Weeds composition and their Relative Importance Value (RIV) at Five Weeks After Sowing of Cowpea

Eucalyptus camaldulensis

In Table 4.16, there were nine weed species belonging to seven families enumerated in all the pots sampled at five weeks after sowing in the first trial. The relative importance values obtained as highest among all the species encountered were 39.9 for *Mitracarpus vilosus* at 75% which was followed by 33.7 at 100% for *Mariscus alternifolius* in the first trial. The lowest relative importance value was 3.7 at 50% for *Synedrella nodiflora* in the first trial.

In the second trial, there were 12 weed species belonging to nine families enumerated in all the pots sampled at three weeks after sowing. The relative importance values obtained as highest were 54.1, 44.7, 35.6, 35.5, 30.8 and in 100%, 75%, 0%, 25%, and 50% respectively for *Mariscus alternifolius.* The lowest relative importance value obtained was 4.3 at 50% for *Aspillia africana*. (Table 4.16).

Eucalyptus torelliana

There were 10 weed species belonging to eight species enumerated in all the pots sampled at five weeks after sowing in the first trial. The relative importance values obtained

Table 4.16: Species composition and Relative Importance Value (RIV) of weeds in cowpea at 5 Weeeks After Sowing

Trt	Species	Family	First trial						Second trial					
			CM	100%	75%	50%	25%	0%	CM	100%	75%	50%	25%	0%
Ec	*Ageratum conyzoides* Linn.	Asteraceae	-	-	-	-	-	-	-	-	6.78	5.60	-	-
	Alternanthera brasilliana (L.) Kuntze	Amaranthaceae	-	-	-	-	-	-	3.86	-	-	4.25	-	9.59
	Amaranthus spinosus Linn.	Amaranthaceae	-	-	-	-	-	-	3.86	-	-	-	-	-
	Aspilia africana (Pers.) C.D. Adams	Asteraceae	-	-	-	-	-	-	-	-	-	4.92	8.00	6.15
	Bidens pilosa L. (Asteraceae)	Asteraceae	4.77	5.07	4.85	7.95	3.97	17.13	-	-	-	-	-	7.09
	Cyperus esculentus L.	Cyperaceae	-	4.71	-	-	-	-	-	-	-	-	-	-
	Digitaria horizontalis		-	-	-	-	-	-	-	5.781	-	-	-	-
	Larpotea austeans (Linn.) chew	Urticaceae	-	4.07	11.07	-	8.00	11.73	-	-	-	-	-	4.56
	Mariscus alternifolius Vahl	Cyperaceae	-	33.72	14.44	25.48	26.03	19.15	-	54.06	44.72	30.79	35.50	33.55
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	-	32.72	39.90	23.21	31.15	21.78	-	-	-	-	-	-
	Oldenlandia corymbosa Linn	Rubiaceae	-	-	-	-	-	-	-	-	14.09	17.09	11.65	6.72
	Oldenlandia lancifolia (Schumach.)DC.	Rubiaceae	-	20.72	15.18	11.34	13.08	2.63	-	-	-	-	-	-
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	-	-	-	-	19.01	-	5.78	18.43	13.42	11.65	11.72
	Shrankia leptocarpa DC.	Fabaceae	-	-	-	-	-	-	-	21.25	9.21	8.49	13.55	16.14
	Syndedralla nodiflora	Compositae	-	-	-	3.97	7.95	8.04	-	-	-	-	-	-

	(Linn.)Gaertn.													
	Talinum fruticosum (L) Juss	Talinaceae	-	8.14	-	7.95	-	12.59	-	-	6.78	11.20	19.65	14.14
Et	*Alternanthera brasilliana (L.) Kuntze*	Amaranthaceae	-	-	-	-	-	-	3.86	-	-	-	-	9.59
	Amaranthus spinosus Linn.	Amaranthaceae	-	-	-	-	-	-	3.86	-	-	-	-	-
	Aspilia africana (Pers.) C.D. Adams	Asteraceae	-	-	-	-	-	-	-	-	-	-	-	6.15
	Bidens pilosa L. (Asteraceae)	Asteraceae	-	-	-	-	-	17.13	-	-	-	-	-	7.09
	Digitaria horizontalis Willd.	Poaceae	-	-	-	-	-	-	-	-	11.22	8.25	4.06	-
	Larpotea austeans (Linn.) chew	Urticaceae	-	-	-	-	-	11.73	-	-	-	-	-	4.56
	Mariscus alternifolius Vahl	Cyperaceae	-	24.36	25.00	26.35	41.75	19.15	-	45.83	46.15	46.84	42.27	33.55
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	-	30.04	29.17	26.21	21.63	21.78	-	-	-	-	-	-
	Oldenlandia corymbosa Linn.	Rubiaceae	-	-	-	-	-	-	-	7.50	7.05	4.91	7.46	6.72
	Oldenlandia lancifolia	Rubiaceae	-	11.69	22.92	20.80	18.14	2.63	-	-	-	-	-	-
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	-	-	-	-	19.01	-	11.67	6.09	3.86	6.00	11.72
	Shrankia leptocarpa DC.	Fabaceae	-	-	-	-	-	-	-	12.33	12.18	13.68	8.60	16.14
	Syndedralla nodiflora (Linn.)Gaertn.	Compositae	-	14.13	10.42	9.54	-	8.04	-	-	-	-	-	-
	Talinum fruticosum (L) Juss	Talinaceae	-	-	-	-	-	12.59	-	-	-	-	-	14.14

Ll	*Alternanthera brasilliana (L.) Kuntze*	Amaranthaceae	-	-	-	-	-	-	3.86	-	3.75	9.59	-	9.59
	Ageratum conyzoides Linn.	Asteraceae	-	4.36	-	-	4.55	-	-	16.28	22.51	14.86	16.35	-
	Amaranthus spinosus Linn.	Amaranthaceae	-	-	-	-	-	-	3.86	3.22	-	-	3.47	-
	Aspilia Africana (Pers.) C.D. Adams	Asteraceae	-	-	-	-	-	-	-	-	-	6.15	7.61	6.15
	Bidens pilosa L. (Asteraceae)	Asteraceae	4.77	-	5.88	8.04	5.01	17.13	-	-	-	-	-	7.09
	Cyperus rotundus Linn.	Cyperaceae	-	7.16	4.55	-	8.33	-	-	-	-	-	-	-
	Cyperus esculentus L.	Cyperaceae	-	-	-	-	-	-	-	-	-	-	3.09	-
	Digitaria horizontalis		-	-	-	-	-	-	-	3.22	8.98	-	11.03	-
	Larpotea austeans (Linn.) chew	Urticaceae	-	-	5.88	5.26	4.08	11.73	-	-	-	-	7.61	4.56
	Mariscus alternifolius Vahl	Cyperaceae	-	29.96	39.64	75.05	26.50	19.15	-	36.84	33.15	39.13	31.83	33.55
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	-	40.63	40.40	37.94	40.13	21.78	-	43.25	42.36	39.46	42.86	-
	Oldenlandia corymbosa Linn.	Rubiaceae	-	-	-	-	-	-	-	15.35	7.96	15.40	19.37	6.72
	Oldenlandia lancifolia	Rubiaceae	-	16.64	8.71	11.01	4.55	2.63	-	12.41	8.46	9.22	4.55	-
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	-	4.55	-	-	19.01	-	9.06	8.52	-	8.65	11.72
	Shrankia leptocarpa DC.	Fabaceae	-	-	-	-	-	-	-	3.66	3.80	5.80	1.98	16.14
	Syndedralla nodiflora (Linn.)Gaertn.	Compositae	-	8.83	23.64	12.50	16.33	8.04	-	-	4.25	2.46	-	-
	Talinum fruticosum (L) Juss	Talinaceae	-	-	4.55	-	-	12.54	-	10.97	8.52	9.06	9.84	14.14

CM – Paraquat, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaena leucocephala;* Dw (0) – distilled water

as highest among all the species encountered were 41.8 at 25% for *Mariscus alternifolius* followed by 30.0, 29.2 and 26.2 at 100%, 75% and 50% respectively for *Mitracarpus vilosus* in the first trial. The lowest RIV was 8.0 at 0% for *Syndedralla nodiflora* in the first trial (Table 4.16).

In the second trial, there were 11 weed species belonging from nine families enumerated in all the pots sampled at five weeks after sowing. The relative importance values obtained as highest were 46.8, 46.2, 45.8, 42.3 and 33.55 at 50%, 75%, 100%, 25% and 0% respectively, for *Mariscus alternifolius,* while the lowest relative importance value obtained was 3.76 at 50% for *Phyllantus amarus* (Table 4.16).

Leucaena leucocephala

There were 11 weed species belonging from eight families enumerated in all the pots sampled at five weeks after sowing in the first trial. The relative importance values obtained as highest among all the species encountered were 40.63, 40.4 and 40.13 at 100%, 75% and 25% for *Mitracarpus vilosus,* followed with 39.6 at 75% for *Mariscus alternifolius* in the first trial. The lowest relative importance value (RIV) was 4.6 at 75% for *Cyperus rotundus*, *Phyllantus amarus and Talinum fruticosum* in the first trial (Table 4.16).

In the second trial, there were 16 weed species from nine families enumerated in all the pots sampled at five weeks after sowing the cowpea. The relative importance values obtained as highest were 43.3, 42.9, 42.4, 39.5 in 100%, 25%, 75% and 50% respectively, for *Mitracarpus vilosus.* The lowest relative importance value obtained was 2.0 at 25% for *Shrankia leptocarpa* (Table 4.16).

Paraquat

One weed specie was encounted in all the pots sampled at five weeks after sowing in the first trial with the relative importance values of 4.77 in the first trial. In the second trial, there were 2 weed species belonging to *Amaranthaceae* family were enumerated in all the pots sampled at five weeks after sowing, with relative importance values 3.86 (Table 4.16).

4.22. Effects of *Eucalyptus camaldulensis, Eucalyptus torelliana, Leucaena leucocephala* and Paraquat on Weeds composition and their Relative Importance Value (RIV) at Seven Weeks After Sowing Cowpea

Eucalyptus camaldulensis

There were 20 weed species from 11 families enumerated in all the pots sampled at seven weeks after sowing in the first trial. *Ageratum conyzoides* had the highest relative importance values, among all the species encountered, of 37.5, 36.3, 32.9, 28.6, and at 100%, 50%, 25%, and 0% respectively, in the first trial. The lowest RIV was 4.8 at 25% for *Syndedralla nodiflora* in the first trial (Table 4.17).

In the second trial, 13 weed species belonging to 11 families were enumerated in all the pots sampled at seven weeks after sowing. The relative importance values obtained as highest were 42.6 at 100% for *Cyperus esculentus,* followed by 39.3 at 75% for *Mimosa pudica,* while the lowest relative importance value obtained was 3.3 at 50% for *Alternanthera brasilliana* and *Tithonia diversifolia* (Table 4.17).

Eucalyptus torelliana

A total of 14 weed species belonging to nine families were enumerated in all the pots sampled at seven weeks after sowing in the first trial. The relative importance values obtained as highest among all the species encountered was 35.5 at 100% for *Mariscus alternifolius* and 33.9 at 0% for *Oldenlandia lancifolia* in the first trial. The lowest RIV was 6.3 at 75% for *Oldenladia lancifolia and Axonopus compressus* in the first trial (Table 4.17).

In the second trial, there were six weed species from six families enumerated in all the pots sampled at seven weeks after sowing. The relative importance values obtained as the highest were 32.7, 28.9, 26.7, 26.2 and 24.7 at 25%, 100%, 50%, 0% and 75%, respectively for *Cyperus esculentus.* The lowest relative importance value obtained was 3.5 at 100% and 25% for *Alternanthera brasilliana* (Table 4.17).

Leucaena leucocephala

There were six weed species enumerated from six families in all the pots sampled at seven weeks after sowing in the first trial. The relative importance values obtained as the highest among all the species encountered were 54.6 at 100% and 40.4 at 25% for *Amaranthus*

Table 4.17: Species composition and Relative Importance Value of weeds in cowpea at 7 Weeeks After Sowing cowpea

Trt	Species	Family	First trial						Second trial					
			CM	100%	75%	50%	25%	0%	CM	100%	75%	50%	25%	0%
Ec	*Ageratum conyzoides* Linn.	Asteraceae	-	37.53	28.63	36.32	32.90	28.57	-	9.08	5.82	5.30	9.92	2.98
	Alternanthera brasilliana (L.)	Amaranthaceae	-	-	-	-	-	-	-	-	4.50	3.30	-	5.95
	Amaranthus spinosus	Amaranthaceae	-	-	14.31	-	10.09	21.43	-	-	-	-	-	2.98
	Aspilia africana (Pers.) C.D. Adams	Asteraceae	-	-	-	-	-	-	-	-	4.50	7.26	-	11.91
	Axonopus compresus (Sw.) P. Beauv.	Poaceae	-	5.10	-	-	-	-	-	-	-	-	-	-
	Cyperus esculentus L.	Cyperaceae	-	-	-	-	-	-	-	42.55	13.06	28.56	-	26.19
	Cyperus rotundus		-	-	-	-	-	-	-	-	-	-	21.43	-
	Larpotea austeans (Linn.) chew	Urticaceae	-	-	13.51	-	5.48	7.14	-	-	-	-	-	-
	Mariscus alternifolius Vahl	Cyperaceae	26.78	11.87	12.35	-	24.13	-	-	-	10.43	-	-	-
	Mimosa pudica L.	Fabaceae	-	-	-	-	-	-	-	23.16	29.30	9.90	8.73	36.67
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	-	10.76	10.02	7.34	-	6.67	-	-	-	-	-	-
	Oldenlandia corymbosa Linn.	Rubiaceae	-	-	-	-	-	-	-	-	9.77	19.90	25.00	63.33
	Oldenlandia lancifolia (Schumach.)DC.	Rubiaceae	-	34.75	5.01	27.19	-	33.93	-	-	-	-	-	-
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	-	-	-	-	-	-	25.20	18.12	15.23	15.87	8.93
	Shrankia leptocarpa DC.	Fabaceae	-	-	-	-	-	-	-	-	4.50	-	-	-
	Syndedralla nodiflora (Linn.)Gaertn.	Compositae	-	-	11.18	20.04	4.83	14.29	-	-	-	-	-	-

	Talinum fruticosum (L) Juss	Talinaceae	-	-	5.01	9.13	10.31	7.14	-	-	-	3.97	14.68	3.57
	Tithonia diversifolia (Hemsl.) A. Gray.	Asteraceae	-	-	-	-	-	-	7.14	-	-	3.30	4.37	-
Et	*Alternanthera brasilliana* (L.)	Amaranthaceae	-	-	-	-	-	-	-	3.52	9.16	-	3.52	5.95
	Axonopus compresus (Sw.) P. Beauv.	Poaceae	-	-	-	6.28	-	-	-	-	-	-	-	-
	Cyperus esculentus L.	Cyperaceae	-	-	-	-	-	-	-	28.94	24.73	26.68	32.66	26.19
	Mariscus alternifolius Vahl	Cyperaceae	26.78	35.50	23.62	21.54	22.41	-	-	-	-	-	-	-
	Mimosa pudica L.	Fabaceae	-	-	-	-	-	-	-	12.27	13.74	13.82	4.69	36.67
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	-	-	-	-	-	6.67	-	-	-	-	-	
	Oldenlandia corymbosa Linn.	Rubiaceae	-	-	-	-	-	-	-	22.04	11.62	15.88	19.29	63.33
	Oldenlandia lancifolia (Schumach.)DC.	Rubiaceae	-	-	-	6.28	6.99	33.93	-	-	-	-	-	-
	Phyllantus amarus	Phyllanthaceae	-	-	-	-	-	-	-	9.91	13.742	11.60	8.21	8.93
	Syndedralla nodiflora (Linn.)Gaertn.	Compositae	-	11.67	7.12	-	6.98	14.29	-	-	-	-	-	-
	Talinum fruticosum (L) Juss	Talinaceae	-	-	7.01	12.56	-	7.14	-	-	5.40	5.08	10.57	3.57
Ll	*Ageratum conyzoides* Linn.	Asteraceae	-	-	-	-	-	28.57	-	14.97	30.69	20.13	9.50	2.98
	Alternanthera brasilliana (L.)	Amaranthaceae	-	-	-	-	-	-	-	-	-	3.66	-	5.95
	Amaranthus spinosus	Amaranthaceae	-	54.55	-	-	40.40	21.43	-	7.40	-	-	3.00	2.98
	Aspilia Africana (Pers.) C.D. Adams	Asteraceae	-	-	-	-	-	-	-	-	4.20	7.33	6.00	11.91
	Axonopus compresus (Sw.) P. Beauv.	Poaceae	-	15.15	-	-	18.02	-	-	-	-	-	-	-

Cyperus esculentus L.	Cyperaceae	-	-	-	-	-	-	-	25.49	4.14	28.73	29.00	26.19
Mariscus alternifolius Vahl	Cyperaceae	26.78	-	37.23	-	11.49	-	-	-	-	-	-	-
Mimosa pudica L.	Fabaceae	-	-	-	-	-	-	-	8.91	13.45	8.40	11.00	36.67
Oldenlandia corymbosa Linn.	Rubiaceae	-	-	-	-	-	-	-	18.67	25.52	15.39	19.50	63.33
Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	-	-	-	-	-	-	11.94	11.84	10.01	12.00	8.93
Syndedralla nodiflora (Linn.)Gaertn.	Compositae	-	15.15	31.39	9.32	11.49	14.29	-	-	-	-	-	
Talinum fruticosum (L) Juss	Talinaceae	-	13.15	10.32	-	9.32	7.14	-	8.913	10.115	6.351	6.50	3.57

Trt.- Treatment, CM – Paraquat, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaenia leucocephala;* control Dw(0) – distilled water, - Not available

spinosus in the first trial. The lowest relative importance (RIV) was 7.4 at 50% for *Talinum fruticosum* in the first trial (Table 4.17).

In the second trial, there were 9 weed species enumerated from seven families in all the pots sampled at seven weeks after sowing. The relative importance values obtained as the highest were 30.69 at 75% followed by 29.0 at 25% and 28.7 at 50% for *Cyperus esculentus.* The lowest relative importance value obtained was 3.0 at 25% for *Amaranthus spinosus* (Table 4.17).

Paraquat

Mariscus alternifolius was the only weed specie enumerated in all the pots sampled at seven weeks after sowing, with a relative importance values of 26.8 in the first trial. However, in the second trial, there were no weed species enumerated in all the pots sampled at seven weeks after sowing (Table 4.17).

4.23: Effects of *Eucalyptus camaldulensis, Eucalyptus torelliana, Leuceana leucocephala* and Paraquat on Weeds composition and their Relative Importance Value (RIV) at Nine Weeks After Planting of Cowpea

Eucalyptus camaldulensis

There were 10 weed species enumerated from nine families in all the pots sampled at nine weeks after sowing in the first trial. The relative importance values obtained as the highest among all the species encountered were 33.6, 30.1, 29.8 and 24.8 at 100% 75%, 50% and 25% respectively for *Talinum fruticosum* in the first trial. The lowest RIV were 3.4 at 25% for *Tithonia diversifolia* and *Larpotea austeans* in the first trial (Table 4.18).

In the second trial, there were 10 weed species enumerated from eight families in all the pots sampled at nine weeks after sowing. The relative importance values obtained as the highest were 38.6 at 100% for *Alternanthera brasilliana and Mariscus alternifolius,* followed with RIV of 30.1 at 75% for *Cyperus esculentus*. The lowest relative importance value obtained was 4.8 for at 75% for *Aspillia africana* (Table 4.18).

Eucalyptus torelliana

There were eight weed species belonging to six families enumerated in all the pots sampled at nine weeks after sowing in the first trial. The relative importance values obtained as highest among all the species encountered were 42.5, 34.2, 28.8 and 28.6 at

Table 4.18: Species composition and Relative Importance value of weeds in cowpea at 9 Weeeks after Sowing cowpea seed

Trt	Species	Family	First trial						Second trial					
			CM	100%	75%	50%	25%	0%	CM	100%	75%	50%	25%	0%
Ec	*Ageratum conyzoides* L.	Asteraceae	-	-	-	-	-	-	16.12	7.05	7.55	12.93	24.44	5.11
	Alternanthera brasilliana (L.) Kuntze	Amaranthaceae	-	23.57	21.64	22.29	21.75	-	-	38.64	-	-	-	7.22
	Amaranthus spinosus Linn.	Amaranthaceae	-	5.72	10.03	10.83	8.60	-	-	-	-	-	-	-
	Aspilia africana (Pers.) C.D. Adams	Asteraceae	-	-	-	-	-	-	10.17	-	4.77	-	-	9.72
	Cyperus esculentus L.	Cyperaceae	-	-	-	-	-	-	-	8.30	30.06	15.87	22.48	16.39
	Cyperus rotundus Linn.	Cyperaceae	5.60	7.14	11.91	4.38	14.70	10.27	-	-	-	-	-	-
	Larpotea austeans (Linn.) chew	Urticaceae	-	-	5.01	-	3.39	8.44	-	-	-	-	-	-
	Mariscus alternifolius Vahl	Cyperaceae	8.46	-	-	-	-	21.02	14.40	38.64	16.95	11.52	7.49	20.50
	Mimosa pudica L.	Fabaceae	-	-	-	-	-	-	-	-	7.55	-	-	-
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	5.60	28.5	-	-	-	6.90	-	-	-	-	-	-
	Oldenlandia corymbosa Linn.	Rubiaceae	-	-	-	-	-		16.12	8.30	9.40	21.50	14.99	87.50
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	-	-	-	-	4.20		22.39	18.02	10.81	13.03	9.72
	Shrankia leptocarpa DC.	Fabaceae	-	-	-	-	-	-	14.40	7.05	5.70	9.40	12.05	16.67
	Syndedralla nodiflora (Linn.)Gaertn.	Compositae	11.19	-	-	-	-	18.90	-	-	-	-	-	-

	Talinum fruticosum (L) Juss	Talinaceae	12.62	33.58	30.14	29.79	24.80	10.65	-	8.30	-	5.76	5.53	4.44
	Tithonia diversifolia (Hemsl.) A. Gray.	Asteraceae		4.29	8.138	13.13	3.40			-	-	-	-	-
Et	*Ageratum conyzoides* Linn.	Asteraceae	-	-	-	-	-	-	16.12	-	-	-	-	5.11
	Aspilia Africana (Pers.) C.D. Adams	Asteraceae	-	-	-	-	-	-	10.17	-	-	-	-	9.72
	Alternanthera brasilliana (L.) Kuntze	Amaranthaceae	-	-	-	-	-	-	-	-	5.83	7.59	-	7.22
	Cyperus esculentus L.	Cyperaceae	-	-	-	-	-	-	-	28.85	11.65	16.12	19.60	16.39
	Cyperus rotundus Linn.	Cyperaceae	5.60	-	-	-	-	-	10.27	-	-	-	-	-
	Larpotea austeans (Linn.) chew	Urticaceae	-	-	-	-	-	8.44	-	-	-	-	-	-
	Mariscus alternifolius Vahl	Cyperaceae	8.46	-	-	-	-	21.02	14.40	-	-	-	-	20.50
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	5.60	28.53	28.76	42.52	34.15	6.90	-	-	-	-	-	-
	Oldenlandia corymbosa Linn.	Rubiaceae	-	-	-	-	-	-	16.12	-	-	-	-	87.50
	Oldenlandia lancifolia (Schumach.)DC.	Rubiaceae	-	10.47	19.83	14.05	16.18	33.15	33.15	-	-	-	-	-
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	-	-	-	-	4.20	-	12.50	18.44	5.09	-	9.72
	Shrankia leptocarpa DC.	Fabaceae	-	-	-	-	-	-	14.40	-	-	-	-	16.67
	Syndedralla nodiflora (Linn.)Gaertn.	Compositae	11.19	-	-	-	-	18.90	-	-	-	-	-	-
	Talinum fruticosum (L) Juss	Talinaceae	12.62	-	-	-	-	10.65	-	-	-	-	-	4.44

Ll	*Ageratum conyzoides* L.	Asteraceae	-	-	-	-	-	-	16.12	11.68	16.67	19.90	13.66	5.11
	Alternanthera brasilliana (L.) Kuntze	Amaranthaceae	-	-	-	-	-			-	-	4.00	10.42	7.22
	Amaranthus spinosus Linn.	Amaranthaceae	-	13.21	10.51	-	6.19	-	-	-	-	-	4.05	-
	Aspilia africana (Pers.) C.D. Adams	Asteraceae	-	-	-	-	-	-	10.17	-	-	-	-	9.72
	Cyperus esculentus L.	Cyperaceae		-	4.30	-	-	-	-	19.56	12.22	18.15	20.49	-
	Cyperus rotundus Linn.	Cyperaceae	5.60	-	-	-	-	10.27	-	-	-	-	-	-
	Larpotea austeans (Linn.) chew	Urticaceae	-	-	-	10.47	3.13	8.44	-	-	-	-	-	-
	Mariscus alternifolius Vahl	Cyperaceae	8.46	27.31	18.21	26.79	27.57	21.02	14.40	6.86	26.67	11.51	14.58	20.50
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	5.60	29.23	28.27	19.64	41.51	6.90	-	-	-	-	-	-
	Oldenlandia corymbosa Linn.	Rubiaceae	-	-	-	-	-	-	16.12	-	4.44	26.04	17.36	87.50
	Oldenlandia lancifolia (Schumach.)DC.	Rubiaceae	-	11.03	21.54	53.58	19.37	6.90	-	-	-	-	-	-
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	-	-	-	-	4.20	-	14.46	12.22	4.88	4.98	9.72
	Shrankia leptocarpa DC.	Fabaceae	-	-	-	-	-	-	14.40	4.82	10.00	9.76	15.86	16.67
	Syndedralla nodiflora (Linn.)Gaertn.	Compositae	11.19	7.95	12.89	-	-	18.90	-	-	-	-	-	-
	Talinum fruticosum (L) Juss	Talinaceae	12.62	7.95	-	-	5.37	10.65	-	9.64	12.22	5.76	4.98	4.44

Trt. – Treatment, CM – Paraquat, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaenia leucocephala;* Dw (0) – distilled water, - Nil

50%, 25%, 75% and 100% respectively for *Mitracarpus villosus* in the first trial. The lowest RIV was 4.2 at 0% for *Phyllantus amarus* in the first trial (Table 4.18).

In the second trial, 11 weed species from seven families were enumerated in all the pots sampled at nine weeks after sowing. The relative importance values obtained as highest were 28.9 at 100% for *Cyperus esculentus* and 20.5 at 0% for *Mariscus alternifolius*. The lowest relative importance value obtained was 4.4 at 0% for *Talinum fruticosum* (Table 4.18).

Leuceana leucocephala

A total of 10 weed species from seven families enumerated in all the pots sampled at nine weeks after sowing in the first trial. The relative importance values obtained as the highest among all the species encountered were 53.6 at 50% for *Oldenlandia corymbosa* followed by 41.5, 29.2 and 28.3 at 25%, 100% and 75% respectively, for *Mitracarpus villosus* in the first trial. The lowest RIV was 3.1 at 25% for *Larpotea austeans* in the first trial (Table 4.18).

In the second trial, eight weed species from seven families were enumerated in all the pots sampled at nine weeks after sowing. The relative importance values obtained as the highest were 26.7 at 75% for *Mariscus alternifolius* and 26.0 at 50% for *Oldenlandia corymbosa*. The lowest relative importance value obtained was 4.0 for 50% for *Alternanthera brasilliana* (Table 4.18).

Paraquat

There were five weed species from four families enumerated in all the pots sampled at nine weeks after sowing in the first trial. The relative importance values obtained as the highest among all the species encountered were 12.6 for *Talinum fruticosum*. The lowest RIV was 5.6 for *Mitracarpus vilosus* in the first trial (Table 4.18).

In the second trial, five weed species from four families were enumerated in all the pots sampled at nine weeks after sowing. The relative importance value obtained as the highest was 16.1 for *Oldenlandia corymbosa* and *Ageratum conyzoides*. The lowest relative importance value obtained was 10.2 for *Aspilia africana* (Table 4.18).

4.24: Effects of *Eucalyptus camaldulensis, Eucalyptus torelliana, Leucaena leucocephala* and Paraquat on Weeds composition and their Relative Importance Value (RIV) at Three Weeks After Sowing Maize

Eucalyptus camaldulensis

There were 11 weed species belonging to 10 families enumerated in all the pots sampled at three weeks after sowing in the first trial. The relative importance values obtained as the highest were 48.7 at 25%, 46.2 at 0%, 44.1 at 75%, 40.3 at 50% and 38.0 at 100% concentrations for *Mariscus alternifolius*. The lowest relative importance value obtained was 2.01 for *Mitracarpus vilosus* at CM (Paraquat) followed by 2.9 at 50% for *Alternanthera brasiliana* (Table 4.19)

In the second trial, there were 12 weed species belonging to 10 families enumerated in all the pots sampled at three weeks after sowing. The relative importance values obtained as the highest were, for *Mariscus alternifolius* 60.5, 49.8, 44.9, 41.1 and 33.3 at 0%, 25%, 75%, 50%, and 100%, respectively, while the lowest relative importance value obtained was 4.7 at 75% for *Amaranthus spinosus* (Table 4.19).

Eucalyptus torelliana

In the first trial, a total of 11 weed species belonging to nine families were enumerated in all the pots sampled at three weeks after sowing. The relative importance values obtained as the highest among all the species encountered were 48.0, 46.8, 46.2, 45.9, and 44.1 at 50%, 75%, 0%, 100%, and 25% respectively, for *Mariscus alternifolius*. The lowest RIV was 2.72 at 100% for both *Peperomia pellucida* and *Amaranthus spinosus* (Table 4.19).

In the second trial, there were 10 weed species enumerated from eight families in all the pots sampled at three weeks after sowing. The relative importance values obtained as the highest were for *Mariscus alternifolius* at 60.5, 47.7, 45.5, 45.3 and 44.0 in 0%, 100%, 75%, 50%, and 25% respectively, while the lowest relative importance value obtained was 4.4 at 100% for *Alternanthera brasiliana* (Table 4.19).

Leucaena leucocephala

There were 12 weed species enumerated from 10 families in all the pots sampled at three weeks after sowing in the first trial. The relative importance values obtained as the

Table 4.19: Species composition and relative importance value of weeds in maize at Three Weeks After Sowing Maize Seed

Trt	Species	Family	First Trial						Second trial					
			CM	100%	75%	50%	25%	0%	CM	100%	75%	50%	25%	0%
Ec	*Ageratum conyzoides* L.	Asteraceae	-	-	-	-	-	7.82	-	-	-	-	-	10.93
	Alternanthera brasilliana (L.) Kuntze	Amaranthaceae	-	4.48	-	2.91	9.28	-	-	5.83	5.70	-	5.15	13.48
	Amaranthus spinosus Linn.	Amaranthaceae	-	-	5.95	-	-	-	-	-	4.77	-	-	-
	Digitaria horizontalis wild	Poaceae	-	4.48	9.52	8.73	3.41	9.62	-	5.83	-	-	-	-
	Larpotea austeans (Linn.) chew	Urticaceae	-	-	-	6.19	-	-	-	-	15.24	17.46	5.15	22.93
	Mariscus alternifolius Vahl	Cyperaceae	5.21	37.99	44.05	40.28	48.70	46.23	8.71	33.33	44.87	41.14	49.78	60.54
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	2.01	17.14	-	-	-	33.16	-	-	-	-	-	-
	Oldenlandia corymbosa Linn.	Rubiaceae	-	-	4.76	5.85	13.15	17.04	-	-	5.70	9.67	5.75	8.21
	Peperomia pellucida (L.) Kunth	Piperaceae	-	-	2.98	-	-	5.18	3.23	-	7.55	6.58	9.97	10.52
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	10.78	13.7	13.11	3.09	10.21	-	16.67	-	-	-	17.30
	Shrankia leptocarpa DC.	Fabaceae	-	8.96	8.33	5.45	3.73	15.00	2.00	13.33	-	5.16	6.35	12.73
	Talinum fruticosum (L)	Talinaceae	3.22	16.17	10.7	17.49	15.23	19.53	-	11.67	11.40	15.49	12.10	10.93
Et	*Ageratum conyzoides* Linn.	Asteraceae						7.82						
	Alternanthera brasilliana (L.) Kuntze	Amaranthaceae	-	3.40	3.10	3.40	5.22	-	-	4.40	-	-	-	13.48
	Amaranthus spinosus	Amaranthaceae	-	2.72	-	-	-	-	-	18.21	13.69	5.82	14.04	-

	Linn.													
	Digitarial horizontalis wild	Poaceae	-	5.78	5.48	3.40	8.17	9.62	-	-	-	-	4.58	-
	Mariscus alternifolius Vahl	Cyperaceae	5.21	45.92	46.80	48.04	44.13	46.23	8.71	47.65	45.54	45.33	44.04	22.93
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	2.01	-	-	-	-	33.16	-	-	-	-	-	60.54
	Oldenlandia corymbosa Linn.	Rubiaceae	-	-	5.98	6.65	11.30	17.04	-	-	-	15.56	17.69	-
	Peperomia pellucida (L.) Kunth	Piperaceae	-	2.72	2.74	-	-	5.18	3.23	-	16.21	-	9.19	8.21
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	10.20	12.76	16.86	12.47	10.21	-	-	-	-	-	10.52
	Shrankia leptocarpa DC.	Fabaceae	-	12.93	8.58	8.20	3.29	15.00	2.00	14.87	4.51	14.20	-	17.30
	Talinum fruticosum (L)	Talinaceae	3.22	16.33	14.60	13.45	15.42	19.53	-	39.39	4.67	9.02	46.50	12.73
Ll	*Ageratum conyzoides* Linn.	Asteraceae	-	-	2.680	-	-	7.82	-	4.91	3.32	9.29	10.80	10.93
	Alternanthera brasilliana (L.) Kuntze	Amaranthaceae	-	10.070	6.19	26.67	26.95	-	-	-	-	-	12.47	13.48
	Amaranthus spinosus Linn.	Amaranthaceae	-	2.30	-	-	8.49	-	-	-	18.79	18.62	16.99	-
	Digitaria horizontalis wild	Poaceae	-	9.81	10.44	8.84	9.78	9.62	-	-	-	3.91	11.61	-
	Larpotea austeans (Linn.) chew	Urticaceae	-	-	2.340	2.16	2.30	-	-	12.88	11.79	8.51	11.61	-
	Mariscus alternifolius Vahl	Cyperaceae	5.21	40.73	45.83	47.25	47.38	46.23	8.71	-	48.17	46.05	38.00	22.93
	Mimosa pudica L.	Fabaceae		-	-	-	-	-	-	-	-	4.73	0	-
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	2.01	-	-	-	-	33.16	-	-	-	-	-	60.54
	Oldenlandia	Rubiaceae	-	10.26	15.18	13.70	9.12	17.04	-	18.68	-	15.48	26.14	-

corymbosa Linn.													
Peperomia pellucida (L.) Kunth	Piperaceae	-	-	4.680	-	-	5.18	3.23	22.81	24.09	15.02	38.71	10.52
Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	16.59	11.74	22.04	11.01	10.21	-	12.81	5.49	15.71	22.38	17.30
Shrankia leptocarpa DC.	Fabaceae	3.22	7.77	4.68	6.97	4.60	15.00	2.00	16.25	-	38.10	21.59	12.73
Talinum fruticosum (L)	Talinaceae	-	16.63	18.38	15.11	20.39	19.53	-	23.485	5.06	4.29	4.30	10.93

CM – Paraquate, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaenia leucocephala;* control (0) – distilled water

highest among all the species encountered were 47.4 at 25%, 47.3 at 50%, and 40.7 at 100% for *Mariscus alternifolius* in the first trial. The lowest RIV was 2.0 for *Mitracarpus vilosus* and 2.2 at 50% for *Larpotea aestuans* in the first trial (Table 4.19)

In the second trial, 13 weed species belonging to 10 families were enumerated in all the pots sampled at three weeks after sowing. The relative importance values obtained as the highest were for 60.5 at 0% for *Mitracarpus vilosus,* 48.2 at 75% and 46.1 at 50% for *Mariscus alternifolius* while, the lowest relative importance value obtained was 2.0 at CM (Paraquat) for *Shrankia leptocarpa* as shown in Table 4.19.

Paraquat

There were three weed species belonging to three families enumerated in all the pots sampled at three weeks after sowing in the first trial. The relative importance values obtained as the highest among all the species encountered was 5.2 for *Mariscus alternifolius*. The lowest RIV of 2.0 for *mitracarpus vilosus* (Table 4.19).

In the second trial, there were three weed species enumerated from three families in all the pots sampled at three weeks after sowing. The relative importance value obtained as the highest was 8.7 for *maricus alternifolius,* while the lowest relative importance value obtained was 2.00 for *shrankia leptocarpa* as shown in Table 4.19.

4.25. Effects of *Eucalyptus camaldulensis, Eucalyptus torelliana, Leucaena leucocephala* and Paraquat on Weeds Composition and their Relative Importance Value (RIV) at Five Weeks After Sowing for Maize

Eucalyptus camaldulensis

There were 14 weed species enumerated from nine families in all the pots sampled at five weeks after sowing in the first trial. The relative importance values obtained as the highest were, for *Mariscus alternifolius,* 57.1, 50.7 and 45.9 at 0%, 25% and 75% respectively, while the lowest relative importance value obtained was 1.1 for *Aspilia africana.* (Table 4.20)

In the second trial, there were 14 weed species enumerated from nine families in all the pots sampled at five weeks after sowing. The relative importance values obtained as the highest were for Cyperus *esculentus* with 44.9 at 75% and 40.3 at 50%. The lowest

Table 4.20: Species composition and relative importance value of weeds in maize at 5 Weeeks after Sowing

Trt	Species	Family	First Trial						Second Trial					
			CM	**100%**	**75%**	**50%**	**25%**	**0%**	**CM**	**100%**	**75%**	**50%**	**25%**	**0%**
Ec	*Ageratum conyzoides* Linn.	Asteraceae	-	2.51	7.12	17.89	15.26	20.34	-	-	4.77	-	-	7.77
	Amaranthus spinosus Linn.	Amaranthaceae	-	2.51	4.78	2.15	-	5.50		5.83	-	-	-	23.42
	Aspilia africana (Pers.) C.D. Adams	Asteraceae	1.12	5.44	2.39	5.19	5.92	12.02	-	5.83	5.70	-	-	-
	Brachiaria falcifera (Trin.) Stapf	Poaceae	-	-	2.39	-	-	-	-	-	5.70	9.15	10.30	6.89
	Cyperus esculentus L.	Cyperaceae	10.23	39.23	35.78	29.20	36.36	42.31	8.45	33.33	44.87	40.32	30.25	40.13
	Digitaria horizontalis wild	Poaceae	-	-	-	-	-	-	-	-	15.24	16.64	17.42	-
	Mariscus alternifolius Vahl	Cyperaceae	6.71	37.95	45.92	38.22	50.67	57.12	6.80	-	4.77	-	-	62.91
	Mimosa pudica L.	Fabaceae	-	5.01	12.36	7.04	8.87	-	-	16.67	-	-	-	-
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	2.22	-	-	-	-	40.66	-	-	-	-	-	70.54
	Oldenlandia corymbosa Linn.	Rubiaceae	-	17.66	8.52	22.65	21.76	-		11.67	11.40	14.66	16.56	-
	Peperomia pellucida (L.) Kunth	Piperaceae	-		3.03	-	-	6.78	1.23	-	-	-	-	9.23
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	15.93	16.63	8.23	3.64	9.98	-	13.33	-	4.89	3.86	10.23
	Shrankia leptocarpa DC.	Fabaceae	3.52	-	-	-	-	15.21	2.30	-	7.55	10.15	13.11	17.34
	Talinum fruticosum	Talinaceae	3.03	11.72	10.03	7.64	8.19	16.72	-	13.33	-	-	-	13.41
Et	*Ageratum conyzoides* Linn.	Asteraceae	-	21.68	14.96	8.44	9.88	20.34	-	-	-	-	4.85	7.77
	Amaranthus spinosus Linn.	Amaranthaceae	-	2.17	-	-	-	5.50	-	-	16.21	-	9.19	23.42
	Aspilia africana (Pers.) C.D. Adams	Asteraceae	1.12	2.81	4.33	5.50	8.54	12.02	-	-	-	-	-	-
	Brachiaria falcifera (Trin.) Stapf	Poaceae	-	-	-	-	-	-	-	-	-	11.56	17.69	6.89
	Cyperus esculentus L.	Cyperaceae	10.23	20.21	27.41	41.32	35.37	42.31	8.45	47.65	45.54	45.33	44.04	40.13

	Digitaria horizontalis wild	Poaceae	-	-	-	-	3.516	-	-	4.402	4.513	-	-	-
	Mariscus alternifolius Vahl	Cyperaceae	6.71	-	-	-	-	57.12	6.80	-	-	-	-	62.91
	Mimosa pudica L.	Fabaceae	-	5.30	6.49	3.49	2.85	-	-	-	-	-	-	-
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	2.22	-	-	-	-	40.66	-	-	-	-	-	70.54
	Oldenlandia corymbosa Linn.	Rubiaceae	-	21.36	23.32	14.86	22.12	-	-	18.21	13.69	5.82	14.04	-
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	8.74	13.32	10.45	6.697	9.98	-	14.87	4.51	14.10	-	10.23
	Shrankia leptocarpa DC.	Fabaceae	3.52	4.34	0	0	0	15.21	2.30	10.47	15.54	23.20	10.19	17.34
	Talinum fruticosum (L) Juss	Talinaceae	3.03	13.40	10.53	15.95	11.05	16.72	-	4.40	0	0	0	13.41
Ll	*Ageratum conyzoides* Linn.	Asteraceae	-	11.76	10.46	13.74	20.35	20.34	-	23.49	18.79	18.62	17.21	7.77
	Amaranthus spinosus Linn.	Amaranthaceae	-	2.07	-	-	2.41	5.50	-	-	-	19.89	22.98	23.42
	Aspilia africana (Pers.) C.D. Adams	Asteraceae	1.12	8.98	7.79	7.04	3.08	12.02	-	10.00	-	-	-	-
	Brachiaria falcifera (Trin.) Stapf	Poaceae	-	-	-	-	2.41	-	-	-	15.48	10.80	10.80	6.89
	Cyperus esculentus L.	Cyperaceae	10.23	-	-	-	-	42.31	8.45	-	38.10	21.59	20.63	40.13
	Digitaria horizontalis wild	Poaceae	-	-	-	4.47	2.75	-	-	-	9.70	8.27	6.95	-
	Mariscus alternifolius Vahl	Cyperaceae	6.71	11.40	8.38	12.47	6.82	57.12	6.80	39.39	48.17	46.05	43.09	62.91
	Mimosa pudica L.	Fabaceae	-	-	63.33	14.55	14.60	-	-	-	15.48	10.80	9.35	-
	Mitracarpus vilosus (Sw) DC.	Rubiaceae	2.22	-	-	-	-	40.66	-	-	-	-	-	70.54
	Oldenlandia corymbosa Linn.	Rubiaceae	-	46.92	25.42	27.45	20.35	-	-	41.56	19.74	13.45	11.61	-
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	13.98	-	15.43	8.246	9.98	-	16.25	4.67	4.60	3.87	10.23
	Shrankia leptocarpa DC.	Fabaceae	3.52	30.51	34.11	16.23	24.56	15.21	2.30	12.12	12.18	9.02	8.05	17.34
	Talinum fruticosum (L) Juss	Talinaceae	3.03	7.60	11.57	12.78	14.39	16.72	-	12.12	5.06	4.29	11.02	13.41

CM – Paraquat, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaenia leucocephala;* Dw (0) – distilled water

relative importance value obtained was 1.8 with CM (Paraquat) for *Mariscus alternifolius* (Table 4.20)

Eucalyptus torelliana

There were 14 weed species belonging to 10 families enumerated in all the pots sampled at five weeks after sowing in the first trial. The relative importance values obtained as highest among all the species encountered were 57.1 at 0% for *Mariscus alternifolius,* followed by 43.3 at 50% for *Cyperus esculentus* in the first trial. The lowest relative importance value obtained was 1.1 for *Aspilia africana* with paraquat (Table 4.20).

In the second trial, a total of 11 weed species beleonging to 10 families were enumerated in all the pots sampled at five weeks after sowing. The relative importance values obtained as the highest were for *Cyperus esculentus* at 47.7, 45.5, 45.3 and 44.0 in 100%, 75%, 50%, and 25% respectively, while the lowest relative importance value obtained was was 1.8 with CM (Paraquat) for *Mariscus alternifolius* (Table 4.20)

Leucaena leucocephala

In Table 4.20, a total of 14 weed species belong to nine families were enumerated in all the pots sampled at five weeks after sowing in the first trial. The relative importance values obtained as the highest among all the species encountered were 6.33 (*Mimosa pudica)* at 75% and 57.1 at 0% for *Mariscus alternifolius* in the first trial, while *Aspilia africana* had the lowest relative importance value of 1.1 at paraquat .

In the second trial, there were 14 weed species enumerated from nine families in all the pots sampled at five weeks after sowing. The relative importance values obtained as the highest were for 48.2 at 75% and 46.1 at 50% for *Mariscus alternifolius*, while the lowest relative importance value obtained was 1.8 at paraquat for *Mariscus alternifolius* as shown in Table 4.20.

Paraquat

There were six weed species enumerated from five families in all the pots sampled at five weeks after sowing in the first trial. The highest relative importance values

obtained was 10 .2 for *Cyperus esculentus.* The lowest RIV was 1.1 for *Aspilia africana* in the first trial (Table 4.20).

In the second trial, there were four weed species enumerated from three families in all the pots sampled at five weeks after sowing. The relative importance value obtained as the highest value was 8.45 for *Cyperus esculentus,* while the lowest relative importance value obtained was 1.8 at paraquat for *Mariscus alternifolius* as illustrated in Table 4.20.

4.26 Effects of *Eucalyptus camaldulensis, Eucalyptus torelliana, Leucaena leucocephala* and Paraquat on Weeds Composition and their Relative Importance Value at Seven Weeks After Sowing Maize

Eucalyptus camaldulensis

There were 11 weed species enumerated from nine families in all the pots sampled at seven weeks after sowing in the first trial. The relative importance values obtained as the highest were for *Cyperus esculentus* at 46.7, 41.2 and 40.0 in 100%, 25% and 75%, respectively. The lowest relative importance value obtained was 2.2 at paraquat for *Shrankia leptocarpa* (Table 4.21)

In the second trial, there were 10 weed species enumerated from 10 families in all the pots sampled at seven weeks after sowing in the second trial. The relative importance value obtained as the highest were for *Cyperus esculentus* at 39.6 at 100% and 39.6 at 25%, while the lowest relative importance value obtained was 3.6 at 75% for both *Amaranthus spinosus* and *Aspilia africana* (Table 4.21).

Eucalyptus torelliana

A total of 10 weed species belonging to nine families were enumerated in all the pots sampled at seven weeks after sowing in the first trial. The relative importance value obtained as the highest among all the species encountered were 41.1 at 50% for *Cyperus esculentus* and 39.3 at 0% for *Oldenlandia corymbosa* in the first trial. The lowest RIV was 2.2 for *Shrankia leptocarpa* (Table 4.21).

In the second trial, nine weed species belonging to eight families were enumerated in all the pots sampled at seven weeks after sowing. The relative importance values obtained as the highest were for *Cyperus esculentus* at 40.4, 39.1, 39.0 and 35.5 in 25%,

Table 4.21: Species composition and relative importance value of weeds at 7 Weeks after Sowing

Trt	Species		First trial						Second trial					
		Family	CM	100%	75%	50%	25%	0%	CM	100%	75%	50%	25%	0%
Ec	*Ageratum conyzoides* Linn.	Asteraceae	-	3.69	3.46	12.93	9.69	13.31	-	5.45	-	11.12	7.27	15.45
	Amaranthus spinosus Linn.	Amaranthaceae	-	2.82	2.49	2.46	-	11.56	-	-	3.56	-	4.09	-
	Aspilia africana (Pers.) C.D. Adams	Asteraceae	-	2.82	5.63	3.02	8.28	8.20	-	-	3.56	5.28	7.97	3.53
	Cyperus esculentus L.	Cyperaceae	-	46.69	40.04	34.60	41.17	31.30	27.93	39.56	36.85	33.44	39.64	100.0
	Larpotea austeans (Linn.) chew	Urticaceae	-	2.82	-	3.02	2.95	4.33	9.90	4.04	-	8.23	6.93	6.72
	Mimosa pudica L.	Fabaceae	-	-	-	-	-	13.41	-	-	-	-	-	-
	Oldenlandia corymbosa Linn.	Rubiaceae	16.45	6.94	15.18	26.12	23.44	79.28	16.61	10.19	21.54	27.19	27.01	82.74
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	14.31	13.18	6.33	2.67	7.59	-	16.34	14.33	4.14	3.13	4.41
	Pteridium aquilinum Linn.	Dennstaedtiaceae	-	3.25	-	-	2.95	4.74	-	8.78	-	-	2.82	3.85
	Shrankia leptocarpa DC.	Fabaceae	2.24	-	5.31	-	-	20.71	-	-	7.15	-	6.98	-
	Talinum fruticosum (L) Juss	Talinaceae	-	16.69	14.72	11.52	8.85	11.90	-	15.63	12.98	10.55	8.62	9.07
Et	*Ageratum conyzoides* Linn.	Asteraceae	-	18.32	15.15	6.57	12.27	13.31	-	13.89	14.04	10.91	15.22	15.45
	Amaranthus spinosus Linn.	Amaranthaceae	-	2.17	0	2.56	0	11.56	-	0	0	0	0	-
	Aspilia africana (P ers.) C.D. Adams	Asteraceae	-	2.42	0	5.12	5.06	8.20	-	0	0	4.20	0	3.53
	Cyperus esculentus L.	Cyperaceae	-	29.83	36.32	41.13	33.49	31.30	27.93	31.11	39.05	35.47	40.44	100.0
	Larpotea austeans (Linn.) chew	Urticaceae	-	4.84	0	2.85	2.41	4.33	9.90	5.28	0	0	4.47	6.72
	Oldenladia corymbosa Linn.	Rubiaceae	16.45	15.22	23.42	13.51	25.84	79.28	16.61	20.56	18.80	29.76	8.08	82.74
	Phyllantus amarus	Phyllanthaceae	-	14.09	10.57	8.84	6.49	7.59	-	12.22	12.57	4.92	10.30	4.41

	Schumach. & Thonn.												
	Pteridium aquilinum Linn.	Dennstaedtiaceae	-	2.17	2.53	3.14	0	4.74	-	9.44	3.70	0	0	3.85
	Shrankia leptocarpa DC.	Fabaceae	2.24	0	2.309	0	3.13	20.71	-	0	3.70	0	5.37	-
	Talinum fruticosum (L) Juss	Talinaceae	-	10.93	9.69	16.28	11.32	11.90	-	7.51	8.14	14.75	16.12	9.07
Ll	*Ageratum conyzoides* Linn.	Asteraceae	-	15.80	9.64	3.95	8.78	13.31	-	13.82	13.08	13.11	0	15.45
	Amaranthus spinosus Linn.	Amaranthaceae	-	2.41	0	4.91	0	11.56	-	0	0	0	3.42	-
	Aspilia Africana (Pers.) C.D. Adams	Asteraceae	-	8.52	0	4.93	4.82	8.20	-	10.17	3.741	0	8.28	3.53
	Cyperus esculentus L.	Cyperaceae	-	28.36	36.12	29.79	29.95	31.30	27.93	26.68	34.83	31.22	38.37	100.0
	Larpotea austeans (Linn.) chew	Urticaceae	-	4.39	7.49	0	2.73	4.33	9.90	7.39	7.48	0	4.33	6.72
	Mimosa pudica L.	Fabaceae	-	0	26.67	0	11.14	13.41	-	-	-	-	-	-
	Oldenlandia corymbosa Linn.	Rubiaceae	16.45	32.17	26.63	21.66	26.49	79.28	16.61	26.16	32.62	25.10	24.65	82.74
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	8.20	11.04	15.37	5.76	7.59	-	11.16	4.83	13.41	13.87	4.41
	Pteridium aquilinum Linn.	Dennstaedtiaceae	-	2.73	2.18	0	4.50	4.74	-	3.61	0	0	4.02	3.85
	Shrankia leptocarpa DC.	Fabaceae	2.24	1.93	4.75	0	0	20.71	-	0	0	0	0	-
	Talinum fruticosum (L) Juss	Talinaceae	-	9.05	11.23	10.63	13.34	11.90	-	7.39	3.741	14.08 5	8.66	9.07

CM – Paraquate, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaenia leucocephala;* control (0) – distilled water

75%, 0% and 50% respectively, while the lowest relative importance value obtained was 3.7 at 75% for *Pteridium aquilinium* and *Shrankia leptocarpa* (Table 4.21).***Leucaena leucocephala***

A total of 11 weed species belonging to nine families were enumerated in all the pots sampled at seven weeks after sowing in the first trial. The relative importance values obtained as the highest among all the species encountered were 39.3 and 32.2 at 0% and 100% respectively, for *Oldenlandia corymbosa,* in the first trial. The lowest RIV was 2.2 for *Shrankia leptocarpa* as shown in Table 4.21.

In the second trial, there were nine weed species enumerated from eight families in all the pots sampled at seven weeks after sowing in the second trial. The relative importance values obtained as the highest among all the species encountered were 39.0 at 0%, 38.4 at 25% and 34.8 at 75% for *Cyperus esculentus* in the second trial. The lowest RIV was 3.4 at 25% for *Shrankia leptocarpa* in the second trial. For the control, a total of eight species were enumerated in all the pots sampled. *Cyperus esculentus* had the highest RIV at 27.9 but the lowest RIV was 3.5 for *Amaranthus spinosus* (Table 4.21).

Paraquat

There were two weed species enumerated from two families in all the pots sampled at seven weeks after sowing in the first trial. The highest relative importance value obtained was 16.5 for *Oldenlandia corymbosa,* while the lowest RIV was 2.2 for *Shrankia leptocarpa* (Table 4.21).

In the second trial, there were three weed species enumerated from three families in all the pots sampled at seven weeks after sowing. The relative importance values obtained as the highest was 27.6 for *Cyperus esculentus,* while the lowest RIV was 9.9 for *Larpotea austeans* (Table 4.21).

4.27. Effects of *Eucalyptus camaldulensis, Eucalyptus torelliana, Leucaena leucocephala* and Paraquat on Weeds Composition and their relative Importance Value at 9 weeks after Sowing Maize

Eucalyptus camaldulensis

In the first trial, a total of 10 weed species belonging to seven families were enumerated in all the pots sampled at nine weeks after sowing. The relative importance values obtained as the highest among all the species encountered was 53.8 at 0% for *Oldenladia corymbosa*. Paraquat had the lowest RIV of 1.10 for *Amaranthus spinosus* as shown in Table 4.22.

In the second trial, there were nine weed species enumerated from seven family in all the pots sampled at nine weeks after planting. The relative importance values obtained as the highest were, 49.4 for *Oldenlandia corymbosa* at 0%. The lowest relative importance value obtained was 2.3 at 25% for *Oldenlandia corymbosa* as shown in Table 4.22.

Eucalyptus torelliana

There were nine weed species enumerated from six families in all the pots sampled at nine weeks after planting in the first trial. The relative importance values obtained as the highest among all the species encountered were 53.8 and 38.3 for *Oldenlandia corymbosa* and *Mariscus alternifolius* respectively, in the first trial. The lowest relative importance value was 1.10 at 100% for *Amaranthus spinosus* (Table 4.22).

In the second trial, there were nine weed species belonging to seven families enumerated in all the pots sampled at nine weeks after planting. The relative importance values obtained as the highest weas 49.4 for *Oldenladia corymbosa* at 0%, while the lowest relative importance value obtained was 2.2 at 100% for *Aspillia africana* (Table 4.22).

Leucaena leucocephala

There were 10 weed species enumerated from seven families in all the pots sampled at nine weeks after planting in the first trial. The relative importance value obtained as the highest among all the species encountered was 53.83 at 0% for *Oldenlandia corymbosa* in the first trial.

Table 4.22: Species composition and Relative Importance Value of weeds in maize at 9 Weeks After Sowing

Trt	Species	Family	First trial						Second trial					
			CM	100%	75%	50%	25%	0%	CM	100%	75%	50%	25%	0%
Ec	*Ageratum conyzoides* Linn.	Asteraceae	-	13.23	4.17	19.193	5.573	17.59	-	5.41	22.91	8.71	6.97	19.38
	Amaranthus spinosus Linn.	Amaranthaceae	-	3.32	5.35	3.298	-	-	-	3.56	4.93	-	-	-
	Aspilia africana (Pers.) C.D. Adams	Asteraceae	-	-	6.84	3.298	6.734	3.24	-	4.79	4.93	-	4.27	4.79
	Cyperus esculentus L.	Cyperaceae	3.80	29.59	17.52	4.632	15.983	13.72	3.11	22.41	7.26	17.42	11.05	23.03
	Mariscus alternifolius Vahl	Cyperaceae	9.40	27.96	20.20	35.158	18.924	38.31	6.83	13.29	28.59	20.55	12.65	37.78
	Mimosa pudica L.	Fabaceae	-	-	-	-	-	7.38	-	-	-	-	-	-
	Oldenlandia corymbosa Linn.	Rubiaceae	2.07	-	17.22	12.596	3.379	53.83	-	22.41	10.67	21.59	2.28	49.44
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	13.77	12.02	3.965	4.102	6.85	-	15.61	-	16.38	7.64	11.06
	Shrankia leptocarpa DC.	Fabaceae	6.24	3.32	6.35	3.965	10.836	17.86	5.75	3.56	6.12	-	8.78	12.78
	Talinum fruticosum (L) Juss	Talinaceae	-	8.81	10.02	13.895	7.469	14.84	-	8.97	14.51	15.41	4.93	12.05
Et	*Ageratum conyzoides* Linn.	Asteraceae	-	13.90	18.94	16.28	4.96	17.59	-	13.09	13.49	17.77	-	19.38
	Amaranthus spinosus Linn.	Amaranthaceae	-	-	-	-	-	-	-	-	8.94	-	-	-
	Aspilia africana (Pers.) C.D. Adams	Asteraceae	-	2.67	-	-	7.46	3.24	-	2.18	-	-	12.75	4.79
	Cyperus esculentus L.	Cyperaceae	3.80	17.16	24.22	24.66	16.52	13.72	3.11	20.83	21.37	23.83	7.11	23.03
	Mariscus alternifolius Vahl	Cyperaceae	9.40	15.07	19.67	14.26	24.75	38.31	6.83	15.15	15.76	7.94	33.09	37.78
	Mimosa pudica L.	Fabaceae	-	-	-	-	-	7.38	-	-	-	-	-	-

	Oldenlandia corymbosa Linn.	Rubiaceae	2.07	1.23	11.28	19.96	13.20	53.83	-	14.42	16.90	25.71	10.05	49.44
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	15.39	12.94	9.05	7.46	6.85	-	17.52	5.61	7.94	-	11.06
	Shrankia leptocarpa DC.	Fabaceae	6.24	10.37	3.83	3.85	8.28	17.86	5.75	13.32	4.47	-	14.22	12.78
	Talinum fruticosum (L) Juss	Talinaceae	-	14.22	9.11	14.93	17.38	14.84	-	15.67	13.49	16.83	22.80	12.05
Ll	*Ageratum conyzoides* Linn.	Asteraceae	-	13.93	7.87	9.13	5.73	17.59	-	8.17	20.91	8.24	9.72	19.38
	Amaranthus spinosus Linn.	Amaranthaceae	-	5.37	-	6.29	-	-	-	-	-	-	1.95	-
	Aspilia africana (Pers.) C.D. Adams	Asteraceae	-	-	-	3.298	6.734	3.24	-	1.02	-	-	-	4.79
	Cyperus esculentus L.	Cyperaceae	3.80	8.25	7.29	18.14	19.39	13.72	3.11	7.55	11.21	18.54	18.40	23.03
	Mariscus alternifolius Vahl	Cyperaceae	9.40	28.73	11.32	8.14	20.65	38.31	6.83	31.64	9.55	20.21	19.47	37.78
	Mimosa pudica L.	Fabaceae	-	-	-	-	-	7.38	-	-	-	-	-	-
	Oldenlandia corymbosa Linn.	Rubiaceae	2.07	10.84	7.29	20.36	5.02	53.83	-	7.55	-	15.42	-	49.44
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	4.45	15.35	7.68	9.99	6.85	-	-	15.76	11.53	16.27	11.06
	Shrankia leptocarpa DC.	Fabaceae	6.24	-	-	-	-	17.86	5.75	-	-	-	-	12.78
	Talinum fruticosum (L) Juss	Talinaceae	-	12.05	28.84	14.81	13.74	14.84	-	14.09	26.97	10.42	16.27	12.05

CM – Paraquat, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaenia leucocephala;* Dw(0) – distilled water

The lowest RIV was 1.10 at paraquat for *Amaranthus spinosus* in the first trial (Table 4.22).

In the second trial, there were nine weed species enumerated from seven families in all the pots sampled at nine weeks after planting. The relative importance value obtained as the highest among all the species encountered was 49.44 at 0% for *Oldenlandia corymbosa,* while the lowest RIV was 1.02 at 100% for *Aspillia africana* in the second trial (Table 4.22)

4.28. Effects of *Eucalyptus camaldulensis, Eucalyptus torelliana, Leucaena leucocephala* and Paraquat on Weeds Composition and their Relative Importance Value (RIV) at Eleven Weeks After Planting for Maize

Eucalyptus camaldulensis

A total of nine weed species belonging to six families were enumerated in all the pots sampled at eleven weeks after sowing. The relative importance values obtained as the highest among all the species encountered was 38.3 at 0% for *Mariscus alternifolius,* while the lowest RIV of 2.66 for *Amaranthus spinosus* was recorded with paraquat (Table 4.23).

In the second trial, there were eight weed species enumerated from six families in all the pots sampled at eleven weeks after planting. The relative importance value obtained as the highest were, 45.4 for *Oldenlandia corymbosa* at 0%. Also, *Oldenlandia corymbosa* had the lowest relative importance value obtained of 1.11 with paraquat (Table 4.23).

Eucalyptus torelliana

In Table 4.23, there were 9 weed species enumerated from 6 family in all the pots sampled at eleven weeks after planting in the first trial. The relative importance values was 45.4 for *Oldenlandia corymbosa* at 0%. Also *Oldenlandia corymbosa* had the lowest relative importance value obtained (1.11) with paraquat as shown in Table 4.23.

Eucalyptus torelliana

In Table 4.23, there were nine weed species enumerated from six families in all the pots sampled at eleven weeks after planting in the first trial. The relative importance value

Table 4.23: Species composition and relative importance value of weeds in maize at 11 Weeks After Sowing

Trt	Species	Family	First trial						Second trial					
			CM	100%	75%	50%	25%	0%	CM	100%	75%	50%	25%	0%
Ec	*Ageratum conyzoides* Linn.	Asteraceae	-	10.23	4.17	15.193	5.00	15.91	-	4.31	12.91	7.61	4.85	11.20
	Aspilia Africana (Pers.) C.D. Adams	Asteraceae	-	-	-	2.81	3.30	2.24	-	2.79	4.93	-	4.27	4.00
	Cyperus esculentus L.	Cyperaceae	3.00	20.59	13.20	4.62	12.08	10.20	1.11	22.41	7.26	15.42	9.05	17.33
	Mariscus alternifolius Vahl	Cyperaceae	2.66	17.68	26.08	26.158	16.87	38.31	-	13.29	28.59	20.55	12.65	39.82
	Mimosa pudica L.	Fabaceae	-	-	-	-	-	5.38	3.39	-	-	-	-	-
	Oldenlandia corymbosa Linn.	Rubiaceae	-	-	17.22	12.596	3.379	36.34	-	22.41	10.67	21.59	2.28	45.44
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	13.77	12.02	3.965	4.102	4.55	-	15.61	-	16.38	7.64	5.08
	Shrankia leptocarpa DC.	Fabaceae	6.40	3.32	6.35	3.965	10.836	17.82	-	3.56	6.12	-	8.78	7.90
	Talinum fruticosum (L) Juss	Talinaceae	-	8.81	10.02	13.895	7.469	14.84	-	8.97	14.51	15.41	4.93	12.05
Et	*Ageratum conyzoides* Linn.	Asteraceae	-	13.90	18.94	16.28	4.96	15.91	-	13.09	13.49	17.77	-	11.20
	Aspilia africana (Pers.) C.D. Adams	Asteraceae	-	2.67	-	-	7.46	2.24	-	2.18	-	-	12.75	4.00
	Cyperus esculentus L.	Cyperaceae	3.00	17.16	24.22	24.66	16.52	10.20	1.11	20.83	21.37	23.83	7.11	17.33
	Mariscus alternifolius Vahl	Cyperaceae	2.66	15.07	19.67	14.26	24.75	38.31	-	15.15	15.76	7.94	33.09	39.82
	Mimosa pudica L.	Fabaceae	-	-	-	-	-	5.38	3.39	-	-	-	-	-
	Oldenlandia corymbosa Linn.	Rubiaceae	-	1.23	11.28	19.96	13.20	36.34	-	14.42	16.90	25.71	10.05	45.44
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	15.39	12.94	9.05	7.46	4.55	-	17.52	5.61	7.94	-	5.08

	Shrankia leptocarpa DC.	Fabaceae	6.40	10.37	3.83	3.85	8.28	17.82	-	13.32	4.47	-	14.22	7.90
	Talinum fruticosum (L) Juss	Talinaceae	-	14.22	9.11	14.93	17.38	14.84	-	15.67	13.49	16.83	22.80	12.05
Ll	*Ageratum conyzoides* Linn.	Asteraceae	-	12.90	7.87	9.13	5.73	15.91	-	8.17	20.91	8.24	9.72	11.20
	Aspilia africana (Pers.) C.D. Adams	Asteraceae	-	-	-	3.298	6.734	2.24	-	1.00	-	-	-	4.00
	Cyperus esculentus L.	Cyperaceae	3.00	8.00	7.29	18.14	19.39	10.20	1.11	7.55	11.21	18.54	18.40	17.33
	Mariscus alternifolius Vahl	Cyperaceae	2.66	23.30	11.32	8.14	20.65	38.31	-	31.64	9.55	20.21	19.47	39.82
	Mimosa pudica L.	Fabaceae	-	-	-	-	-	5.38	3.39	-	-	-	-	-
	Oldenlandia corymbosa Linn.	Rubiaceae	-	10.08	7.29	20.36	5.02	36.34	-	7.55	-	15.42	-	45.44
	Phyllantus amarus Schumach. & Thonn.	Phyllanthaceae	-	2.51	15.35	7.68	9.99	4.55	-	-	15.76	11.53	16.27	5.08
	Shrankia leptocarpa DC.	Fabaceae	6.40	-	-	-	-	17.82		-	-	-	-	7.90
	Talinum fruticosum (L) Juss	Talinaceae	-	12.05	28.04	13.81	12.74	14.00	-	12.09	20.70	8.27	16.00	12.05

Trt.- Treatment, CM – Paraquat, Et - *Eucalyptus torelliana,* Ec - *Eucalyptus camudulensis,* Ll - *Leucaenia leucocephala,* Dw (0) – distilled water

obtained as the highest among all the species encountered was 38.3 for *Mariscus alternifolius* in the first trial. The lowest RIV was 1.23 at 100% for *Oldenlandia corymbosa.*

In the second trial, there were eight weed species belonging to six families enumerated in all the pots sampled at eleven weeks after planting. The relative importance values obtained as the highest were 45.4 for *Oldenlandia corymbosa* at 0%, while *Cyperus esculentus* had the lowest relative importance value of 1.1 with Paraquat (Table 4.23).

Leucaena leucocephala

There were nine weed species enumerated from six families in all the pots sampled at eleven weeks after planting in the first trial. The relative importance values obtained as the highest among all the species encountered was 38.3 at 0% for *Mariscus alternifolius* in the first trial. The lowest RIV of 2.51 at 100% for *Amaranthus spinosus* was observed in the first trial (Table 4.23).

In the second trial, there were eight weed species enumerated from six families in all the pots sampled at eleven weeks after planting. The relative importance values obtained as the highest among all the species encountered was 45.44 at 0% for *Oldenlandia corymbosa,* while the lowest RIV was 1.00 at 100% for *Aspillia africana* in the second trial as shown in Table 4.23.

Paraquat

There were three weed species enumerated from two families in all the pots sampled at eleven weeks after sowing in the first trial. The highest relative importance value obtained was 6.4 for *Shrankia leptocarpa,* while the lowest RIV was 2.7 for *Mariscus alternifolius* as shown in Table 4.23.

In the second trial, there were two weed species enumerated from two families in all the pots sampled at eleven weeks after sowing. The relative importance values obtained as the highest was 3.4 for *mimosa pudica,* while the lowest RIV was 1.1 for Cyperus *austeatus* (Table 4.23).

4.29: Physicochemical Properties of Soil in Pre-planting, and Post-harvest of Maize and Cowpea

The pH of pre-planting soil (6.8) was neutral compared to pH values of the post-harvest soil for both maize and cowpea which ranged between 6.0 (moderately acidic) to 6.5 (slightly acidic) for the soil treated with Paraquat, *Eucalyptus torelliana*, *Eucalyptus camaldulensis* and *Leucaenia leucocephala* (Table 4.24).

The total organic carbon 2.5% was the highest in pre-planting soil. The total organic carbon of post-harvest soil on maize was high for *Eucalyptus camaldulensis* and *Eucalyptus torelliana* but the control had the highest total organic carbon (1.8%) in post-harvest soil on cowpea. The total nitrogen of 0.23% in pre-planting soil was higher than post-harvest soil on maize and cowpea. Meanwhile the total nitrogen was higher with *Eucalyptus camaldulensis* and *Eucalyptus torelliana* (0.2%) in post-harvest soil in maize but the control and paraquat had the highest total nitrogen (0.2%) in post-harvest soil on cowpea as shown in Table 4.24.

The highest available phosphorus (69.7 mg/kg) was higher with *Leucaenia leucocephala* in post-harvest maize followed by pre-planting (64.14) but *Eucalyptus camaldulensis* had the highest (38.9 mg/kg) among post-harvest soil on cowpea (Table 4. 24).

In Table 4.24, Calcium (Ca) content was the highest (2.9 cmol/kg) with the soil treated with paraquat in post-harvest soil in cowpea and followed by pre-planting soil (1.75 cmol/kg). The highest Ca of 1.6 cmol/kg in post-harvest soil of maize was observed about *Eucalyptus camaldulensis*.

The Magnesium (Mg), Sodium (Na) and Copper (Cu) contents of 0.2 cmol/kg, 0.2 cmol/kg and 0.9 cmol/kg, respectively in pre-planting soil were lower than that of the extracts (*Eucalyptus camaldulensis*, *Eucalyptus torelliana and Leucaenia leucocephala)* applied in post-harvest soil in both maize and cowpea pots.

The manganese (Mn) of 168 mg/kg in pre-planting soil was higher than the post harvest soil in both maize and cowpea. The highest Mn obtained in post-harvest soil in maize was 116 mg/kg in both *Eucalyptus torelliana* and control. The highest Mn 148

Parameters	Pre-planting	Post-harvest (Maize)				Post-harvest (Cowpea)			
		Ec	Et	Ll	CC	CM	Ec	Et	Ll	CC
Ph	6.8	6.3	6.2	6.0	6.2	6.2	6.1	6.5	6.5	6.3
Total organic carbon (%)	2.46	1.90	1.90	1.50	1.40	1.40	1.00	1.70	0.90	1.80
Total nitrogen (%)	0.23	0.20	0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.20
Available P. (mg/kg)	64.14	36.4	25.5	69.7	30.8	32.4	38.9	35	35.5	30.8
Exchangeable acid	0.4H+ Al3+	1.1H+ 5.3Al+	2.05H+ 7.25Al+	0.32H+ 4.02Al+	1.5H+ 4.25Al+	0.75H+ 3.75Al+	1.0H+ 3.0Al+	4.75H+ 10.0Al+	0.25H+ 4.0Al+	2.75H 1.5Al
Ca (Calcium) (cmol/kg)	1.75	1.6	0.5	1.5	0.4	0.2	0.1	1.6	1.1	1.5
Mg (Magnesium) (cmol/kg)	0.24	2.4	3.0	1.7	2.7	1.9	2.3	2.2	2.2	2.0
K (Potassium) (cmol/kg)	0.15	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Na (Sodium) (cmol/kg)	0.18	1.5	0.9	0.8	1.2	1.2	1.3	1.2	0.9	1
Mn (Manganese) (mg/kg)	168	76	116	52	116	56	116	40	148	124
Fe (Iron) (mg/kg)	143	34	56	24	60	42	48	32	350	52
Cu (Copper) (mg/kg)	0.94	5.6	11.9	5.5	12.4	4.9	8.7	5.3	5.7	9
Zn (Zinc) (mg/kg)	4.37	39.4	20.6	38.6	30.4	13.4	17.7	13.2	1.4	21.3
Sand (%)	85.2	83.3	82.4	83.3	84.4	82.4	84.4	83.3	86.4	83.3
Clay (%)	3.14	3.7	5.6	3.7	5.6	5.6	5.6	4.0	3.6	3.7
Silt (%)	11.6	12.7	12.2	13.2	10.1	12.0	10.1	12.7	10.0	13.0
Texturial class	LS	LS	LS	LS	LS	LS	LS	LS	LS	LS

Table 4.24: Physicochemical properties of soil in pre-planting, Post-harvest of maize and cowpea

CM – Paraquate, Et - *Eucalyptus torelliana*, Ec - *Eucalyptus camudulensis*, Ll - *Leucaenia leucocephala;* Dw (0) – distilled water, LS-Loamy sand

mg/kg in cowpea post-harvest soil was observed in the soil treated with *Leucaenia leucocephala* which was significantly higher than in every other treatment (Table 4.24).
In Table 4.24, Fe (Iron) content was the highest (350 mg/kg) in post-harvest soil in cowpea with L. *leucocephala* extract which was significantly higher with the pre- planting soil (143 mg/kg) and the control (46 mg/kg). In maize, the control had the highest Fe contents of 60 mg/kg in post-harvest soil, although it was lower than pre-planting soil (143 mg/kg).

The sandy soil which ranged between 82.4 – 86.3% had the highest percentage in pre-planting soil, post-harvest soil in maize and post-harvest soil in cowpea with the extracts of E. *camaldulensis*, E. *torelliana*, L. *leucocephala*, paraquat and control compared to that of clay and silt. However, the texturial class of the soil in all treatment was observed to be loamy sand (Table 4.24)

CHAPTER FIVE

5.0 DISCUSSION

The findings of this study revealed the efficacy of *Eucalyptus camudulensis, Eucalyptus torreliana* and *Leucaena leucocephala* as bio-herbicide on weeds (*Ageratum conyzoides, Alternanthera brasilliana, Amaranthus spinosus, Aspilia africana, Cyperus rotundus, Digitaria horizontalis, Larpotea austeans, Mariscus alternifolius, Mitracarpus vilosus, Oldelandia lancifolia, Oldenladia corymbosa, Peperomia pellucida, Phyllantus amarus, Syndedralla nodiflora* and *Talinum fruticosum*) associated with cowpea and maize in Oyo State. This report is in line with that of Saxena *et al.* (2016) and Adeniyi and Ayepola (2008) that reported about the presence of phytochemical in some plants that have inhibitory capacity. Phytotoxicity has been noted to be a component of many plant chemicals and variety of compounds contained in plants can be pesticides and/or allelopathic. Phytotoxicity of plant-based chemicals is eco-friendly compared to synthetic pesticides that have been proven to be detrimental to the agro ecosystem (Fayinminnu and Shiro, 2014).

The most striking observation that emerged from data in this present study on farmers' knowledge about the use of bio-herbicide at Ibarapa Central, Oyo West and Iseyin was that over 90% of farmers have no knowledge of bio-herbicide usage. This shows that the use of synthetic herbicide is high and may be dangerous to man and his environment which is in contrary to the recommendation from Fayinminnu and Shiro (2014), that the production and utilization of plant extracts as bio-pesticides should become a common practice for sustainable organic agriculture.

The findings from the field observation recorded from the areas, with respect to the most commonly used synthetic herbicide used in cowpea farms, shows that there were twelve commonly used herbicides in the areas and paraquat is the most commonly used herbicide. For maize farms, there were nine (9) commonly used herbicides as at the time

of the research. Paraquat was also the most commonly used synthetic herbicide in the field.

Chou (2010) reported that the overuse of synthetic agrochemicals often causes environmental hazards and change of soil physicochemical properties, resulting in decrease of crop productivity. This research also encourages more awareness as suggested by Fayinminnu and Shiro (2014) that the use of synthetic chemicals will be tightly regulated in the future due to the well-documented environmental risks which may lead to a growing demand for biological plant protection agents because sustainable food security cannot continue to rely on these agro-chemicals. The production and utilization of bio-pesticides should become a common practice.

The study provides evidence of phytochemicals in the extract of *Eucalyptus camaldulensis*, *Eucalytus torelliana* and *leucaena leucocephala* such as total phenols, flavonoids, tannins, saponins, alkaloids and mimosine, which shows that they have the tendency of inhibitory actions. The mimosine content found in *Leucaena leucocephala* was higher than that of *Eucalyptus camaldulensis* and *Eucalyptus torelliana*, which is in line with the report of Xuan *et al.* (2006) that mimosine has been found as an allelochemical in *Leucaena*, which may be useful for the development of bio-herbicides. This finding is consistent with the findings of Ayepola and Adeniyi, (2008) who reported the presence of tannins, saponins and cardiac glycosides and absence of anthraquinones and alkaloids in *Eucalytus camaldulensis*. Babayi *et al.* (2004) also found the presence of saponin, saponin glycosides, steroid, cardiac glycosides, tannins, volatile oils, phenols and balam gum in crude extracts of Eucalyptus species. This result agreed with the report of Adeniyi and Ayepola (2008) that there is presence of secondary metabolites (tannins, saponins and cardiac glycosides) in extracts of *Eucalyptus camaldulensis and E. torelliana.* Futhermore, Adeniyi and Ayepola (2008) reported that *Eucalyptus camaldulensis* and *E. torelliana* extracts inhibit all the isolates at 10 mg/ mL concentrations. The performance may be due to the presence of high concentrations of plant extracts. Quantitatively, this research showed that the *Eucalyptus* species used had higher total phenols, flavonoids, tannins and saponins than in *Leucaena leucocephala* leave extract. This is in line with Ayepola and Adeniyi (2008) reports that the antibacterial

activity of the leaf extracts of *Eucalyptus camaldulensis* can be attributed to the action of the phytochemical compounds it contains.

The phytochemicals found in the extracts used did not prevent the seed germination of the two test crops (cowpea and maize). The results of the seed germination on the test crops used in this study showed that there were no dormancy in cowpea and maize seeds, as they germinated readily under favourable conditions even though cowpea germination was faster than that of the maize which is in line with the of Harrison *et al*. (2006) that reported that cowpea seeds germinate readily, and establish quickly due to its large seed and its relative resistance to moisture stress at shoot emergence and early plant vigour.

The findings in this research showed that the mean plumule length of maize and cowpea increaseed with decreasing concentrations of the extracts of *Eucalyptus camaldulensis, Eucalytus torelliana and Leucaena leucocephala* in both first and second trials. This study also revealed that the three leave extracts used were inhibitory to the growth of the cowpea and maize seed, although that of *Leucaena leucocephala* was less phytotoxic than that of the *Eucalyptus* species used. There were no significant differences between the 25% extract of *Leucaena leucocephala* and the control on the first trial for cowpea, while in maize, there were no significant differences at 50% and 25% concentration of the *Leucaena leucocephala* extract for the control on the second trial. Similarly, El-Khawa and Shehata (2005) reported the phytotoxic effect of leaf extracts of Eucalyptus and Acacia on seed germination of maize and kidney-bean. Javaid *et al*. (2006) also reported that aqueous shoot extracts of sorghum were highly phytotoxic and suppressed germinating Parthenium at high and low concentrations of shoot extract. In a similar report, Uremis *et al*.(2005) found out that water extracts of different Brassica spp. were phytotoxic on germination and growth of cutleaf ground-cherry weed (*Physalis angulata* L.).

It was also observed from this research that the plumule and radicle lengths of the two test crops (maize and cowpea) were higher with the extract of *Leucaena leucocephala* than that of *Eucalyptus camaldulensis* and *Eucalytus torelliana* in both first and second trials. The higher the concentration the lower the plumule and radicle length. This may be

as a result of the report that *Leucaena* plant is a nitrogen fixing plant (Meena *et al*., 2013). It was also observed that rodents attack seeds that were not treated with the plants extracts used; and this may be attributed to the presence of the phytochemicals in them.

Better performance in the plant height of cowpea and maize was recorded with the lower concentrations (50% and 25%) in the three botanical extracts used. This shows phytotoxic attribute of the plant extracts at higher concentration. This finding aligns with Saxena *et al.* (2016) that allelochemicals usually exhibit inhibitory role on plant growth when present in high concentration, whereas, they induce plant growth at low concentrations. However, the Paraquat used as the synthetic herbicide affected the plant height of *Vigna unguculata* after 3 WAS in the second trial which may be as a result of the concentration of Paraquat.

The phytotoxic effects result of *Eucalyptus camaldulensis, Eucalyptus torelliana* and *Leucaena leucocephala* indicated that, at lower concentration, the mean stem, number of leaves and grain yield increased which showed phytotoxic attribute of the extracts used on the weed especially with the *Eucalyptus camaldulensis* and *Eucalyptus torelliana.* This phytotoxic action was observed in both first and second trials, which is in line with the report of Miri and Armin (2003). However, the grain yield (100% seed weight) of maize was higher with the extract of *Eucalyptus camaldulensis* than in the other two extracts (*Eucalyptus torelliana* and *Leucaena leucocephala).* These results are also in accordance with the finding of Ayopola and Adeniyi (2008) that reported the great phytotoxic potential of *Eucalyptus camaldulensis.*

The response of treatments (extracts and paraquat) on weed at varying concentrations and intervals showed that there was inhibitory activity on the population of weeds with paraquat at 3 WAS, each of *Leucaenia leucocephala* and paraquat at 5 WAS, *Eucalyptus camaldulensis, Eucalyptus torelliana,* and *Leucaenia leucocephala* at 7 WAS and *Leucaena leucocephala* at 9 WAS. The reduction effect of extracts on weeds population corroborates the suggestion of Cheema *et al.* (2001) that the reduction in number of weeds due to sorgaab spray is phytotoxic.

The relative importance value (RIV) data, a function of frequency of occurrence and density of weeds in the sampled pots indicated that some species found to have the

highest RIVs may have a greater weeds suppressive/phytotoxic effect with the treatments (extracts and Paraquat) at varying concentrations in comparison with the control. The weed species with the highest Relative Importance values (RIV) according to the response to treatments were *Mitracarpus villosus* and *Cyperus esculentus* for *Eucalyptus camaldulensis, Eucalyptus torelliana and Leucaena leucocephala* but with the use of Paraquat, *Mitracarpus vilosus, Cyperus esculentus* and *Oldenlandia lancifolia,* they had the highest RIV at 3 WAS: *Mitracarpus villosus* and *Mariscus alternifolius* for *Eucalyptus camaldulensis, Eucalyptus torelliana* and Paraquat but *Mariscus alternifolius* and *Oldenlandia lancifolia* for *Leucaena leucocephala* at 5 WAS, *Ageratum conyzoides* and *Cyperus esculentus* for *Eucalyptus camaldulensis* and *Eucalyptus torelliana* but *Amaranthus spinosus* and *Cyperus esculentus* for *Leucaena leucocephala* while *Mariscus alternifolius, Oldenlandia lancifolia* for Paraquat at 7 WAS. Other weed species inhibited by the botanical extracts used include *Talinum fruticosum* and *Oldenlandia corymbosa* for *Eucalyptus camaldulensis, Oldenlandia corymbosa* and *Mitracarpus villosus* for *Eucalyptus torelliana* but *Mitracarpus villosus* and *Cyperus esculentus* for *Leucaena leucocephala* while *Mariscus alternifolius* and *Oldenladia corymbosa* for paraquat at 9 WAS. These results align with the findings that maximum inhibitory activities were obtained in individual weeds population and density with the application of Sorgaab (Ahmad *et al*., 2000; Cheema *et al.,* 2001).

There were inhibitory effect at all the concentrations with *Eucalyptus camaldulensis, Eucalyptus torelliana and Leucaena leucocephala* and chemical at 3 WAS but the extracts of *Eucalyptus camaldulensis* showed the highest inhibitory activity at 75% and 25% (highest RIVs*: Mitracarpus villosus)* while 100% and 50% were inhibitory (highest RIVs *Mariscus alternifolius*) at 5 WAS. Also, *Eucalyptus torelliana and Leucaena leucocephala* and paraquat at all concentrations were inhibitory at 5 WAS. The inhibitory activity was the highest only for 25% *Eucalyptus camaldulensis* at 7 WAS while there were phytotoxicity at all concentrations for *Eucalyptus camaldulensis*: 100%, 50% and 25% for *Eucalyptus torelliana,* as well as 75%, 50% and 25% for *Leucaena leucocephala* and Paraquat at 9 WAS. The concentration of extracts may be phytotoxic (inhibitory) or stimulatory (Bhowmik and Indjerit, 2003) and the phytotoxic activity may

be determined by a lower or higher concentration of the plant extracts (Ahmed *et al*., 2007). This was also similar to the report by Joshi *et al*. (2015) that aqueous leaf extract of *Ricinus communis* on growth parameters of *Vigna radiata* at a low concentration of 5% shows inhibitory effect.

The weed biomass result on maize showed better result at 50% concentration of the three plant extracts when compared with the 0% (control) for both first and second trials and this agrees with the work of Miri and Armin (2003).

Pre and post harverst result on soil showed that paraquat and the botanicals (*Eucalyptus torreliana*, *Eucalyptus camaldulensis* and *Leucaena leucocephala*) were not toxic to the soil.

CHAPTER SIX

6.0 SUMMARY AND CONCLUSION

Studies were carried out on the efficacy of three botanicals (*Eucalyptus camaldulensis*, *Eucalyptus torelliana* and *Leucaena leucocephala*) as bio-herbicides on weeds associated with cowpea and maize in Ibadan, Nigeria between 2015 to 2017.

To achieve the objectives of this work, 5% open ended survey questionnaires were administered to the selected cowpea and maize farmers from Ibarapa central, Oyo west and Iseyin from a total population of registered famers between May and July, 2015. The primary aim was to assess their knowledge on bioherbicides, eco-friendly alternative to the problem of synthetic herbicides by using *Eucalyptus camaldulensis*, *Eucalyptus torelliana* and *Leucaena leucocephala* extracts and evaluating their phytotoxic effects at different does on soil and crops (cowpea and maize) in agro-ecosystem.

Knowledge of farmers on bio-herbicides, phytochemical analysis, identification and phytotoxicity of *Eucalyptus camaldulensis*, *Eucalyptus torelliana* and *Leucaena leucocephala* were conducted between 2015 and 2017. This was to establish the presence of the phytochemicals and the effectiveness of the three botanicals used as a bio-herbicides on weeds in cowpea and maize fields in Ibadan, Nigeria.

Inadequate knowledge of farmers on bio-herbicide usage was reported. Thus, making bio-herbicide usage insignificant in weed management. To ascertain if the three botanicals are capable of inhibiting weeds, four concentrations (100, 75, 50 and 25%) of each botanical were used to carry out the experiment in the Petri-dish (seed germination) and in the pot, using distilled water and paraquat as controls.

The results showed that;

1. Bio-herbicides knowledge by cowpea and maize farmers was grossly inadequate. Only 0.9% had knowledge on bioherbicides.

2. The most common herbicide used by cowpea (13.1%) and maize farmers (29.2%) farmers was paraquat.
3. Phytochemicals present in the botanical used, includes Alkaloids, Flavonoids, Mimosine, Saponins, Tannins and Total Phenols.
4. Phytochemical present in *Eucalyptus camaldulensis* was higher than in *Eucalyptus torelliana* and *Leucaena leucocephala.*
5. Both seeds of cowpea and maize germinated adequately.
6. It was observed that the higher the concentration of the botanical extracts, the lower the plumule and radicle lengths of the test crops (cowpea and maize).
7. *Eucalyptus camaldulensis* at 50% gave the highest number of leaves in both cowpea (36.7±4.8) and maize (12.9±1.5).
8. It was also observed that 50% *Leucaena leucocephala* gave the highest grain yield of cowpea (3.8±0.4 g), while 100% *Eucalyptus camaldulensis* gave the highest grain yield (94.3±12.0 g) of maize.
9. Weeds associated with cowpea and maize field include *Ageratum conyzoides, Alternanthera brasilliana, Amaranthus spinosus, Aspilia africana, Cyperus rotundus, Digitaria horizontalis, Larpotea austeans, Mariscus alternifolius, Mitracarpus vilosus, Oldelandia lancifolia, Oldenladia corymbosa, Peperomia pellucida, Phyllantus amarus, Syndedralla nodiflora* and *Talinum fruticosum.*
10. In cowpea pots, *Mitracarpus villosus* had the highest Relative Importance value (RIV) of 52.3 with 100% *Eucalyptus camaldulensis* at 3 Weeks After Sowing (WAS) but reduced to 28.5 with 100% *Eucalyptus camaldulensis* at 9 Weeks After Sowing.
11. In maize pots, *Mariscus alternifolius* had the highest RIVs of 48.7 with 25% *Eucalyptus camaldulensis* and 48.0 with 50% *Eucalyptus torelliana* both at 3 Weeks After Sowing and reduced to 18.9 with 25% *Eucalyptus camaldulensis* and 14.26 with 50% *Eucalyptus torelliana* at 9 Weeks After Sowing, respectively.

CONCLUSIONS

The results of this present study showed that plant extracts have the potential to manage weed in eco-friendly ways, which can be attributed to the presence of some secondary metabolites (total phenols, flavonoids, tannins, saponins, alkaloids and mimosine) found in them. The extracts of *Eucalyptus camaldulensis* and *Eucalyptus torelliana* had higher phytochemical and performed better than that of the *Leucaena leucocephala* in weed management. Similarly, Allelopathic effects of *Eucalyptus* species can be considered as a natural way for sustainable weed management.

RECOMMENDATION

Weed management in the environment is ideal for both forestry and agroforestry practice in the sub-region. Since the over use of synthetic herbicides is reported to be toxic, hence causing serious health problems and considerable damage to agricultural and natural environment, the use of synthetic herbicides should be encouraged for environmental sustainability and food security. Therefore, the creation of awareness and more researches in Agro-ecosystem on the development of alternative strategies to reduce dependence on synthetic herbicides and enhancement of food security should be encouraged.

CONTRIBUTIONS TO KNOWLEDGE

This study has contributed to the existing knowledge in the following areas:

1. Phytochemicals (Total phenols, Tannins and Saponins) present in the botanicals (*Eucalyptus torreliana*, *Eucalyptus camaldulensis* and *Leucaena leucocephala*) used had inhibitory effect on weeds growth.
2. Aqueous extract of the botanicals was not toxic to cowpea (Ife brown) and maize (DTMA-Y-STR) seeds but inhibited the growth of the test crops.
3. *Eucalyptus camaldulensis's* aqueous extract at 100% concentration exhibited higher herbicidal potentials than *Eucalyptus torreliana* and *Leucaena leucocephala* by reducing the Relative Importance Value (RIV) of *Mitracarpus villosus* and *Mariscus alternifolius* at nine week after sowing.

4. *Leucaena leucocephala* enhanced growth of cowpea (Ife brown) and maize (DTMA-Y-STR).
5. Aqueous leaf extracts of *Eucalyptus torreliana*, *Eucalyptus camaldulensis* and *Leucaena leucocephala* enhanced plant height and grain yield of cowpea and maize.

The evidence from this study adds to a growing body of literature on the use of botanicals as bio-herbicides in cowpea and maize fields.

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APPENDIX

UNIVERSITY OF IBADAN

FACULTY OF AGRIC ULTURE

DEPARTMENT OF CROP PROTECTION AND ENVIRONMENTAL BIOLOGY

QUESTIONAIRE

This questionnaire is aimed at investigating cowpea and maize farmers' knowledge of bio-herbicide and preference for its utilization.

Please answer the question with all sincerity as all information will be treated with utmost confidentiality, kindly tick (√) where necessary and supply adequate information where requires.

Thank you

SURVEY INFORMATION

Name of famer:……

Name of town / village……

Name of L.G.A ……...

DEMOGRAPHIC INFORMATION

SECTION A:

1. Age: 18 – 25 ( ) 26 – 35 ( ) 36 – 45 ( ) 46 and above ( )
2. Religion: Christian ( ) Islamic ( ) Tradition ( ) Others (please specify)…….

3. Sex: Male ( ) Female ( )
4. Marital Status: single ( ) Married ( ) widow ( ) widower ( )
5. Educational background: No formal education ( ) Primary School ( ) Secondary ( ) Tertiary ( ) adult ( ) Islamic ( ) others (please specify)……
6. What is the size of your cowpea field (in acres)? < 2 ( ) 2 – 5 ( ) 5 – 8 ( ) > 8 ( )
7. What is the size of your maize field (in acres)? < 2 ( ) 2 – 5 ( ) 5 – 8 ( ) > 8 ( )
8. Years of farming experience: 1 – 15 ( ) 16 – 30 ( ) 31 – 45 ( ) 46 and above ( )
9. Do weeds affect your crop? Yes ( ) No ( )

SECTION B: **Cowpea farmers and weed control**

Please tick as many as applicable in each case

10. How do you grow your cowpea? Sole ( ) Intercrop ( )
11. If in intercrops, with what crop(s)? Please list the crop(s) …….
12. How do you control weeds? Manual ( ) Chemical ( ) Mechanical ( ) Bio-herbicide ( ) Mulching ( ) Plant extract ( ) Others ( ) Please specify …….
13. If you use chemicals name the ones you use.

(i) …….

(ii) ……

(iii) ……

(iv) ……

14. When do you apply the chemical on your cowpea field? At planting ( ) Before planting ( ) After planting ( ) After crop emergence ( )

15. Which herbicide(s) do you use at planting? .....

16. Which herbicide(s) do you use before planting?

…… ….....

17. Which herbicide(s) do you use after planting?

……. .....

18. Which herbicide(s) do you use after crop emergence?

……. .....

19. What are the common weeds dominant on your cowpea field? Grasses ( ) broad leaves ( ) the two ( )

20. List dominant broad leaves on your field ……

21. List dominant grasses on your field …….

22. How many times do you repeat application of herbicide on your cowpea field? …….....

23. How effective is your herbicide on the field within the first 4 weeks? Very effective ( ) effective ( ) not effective ( )

24. What types of weeds do you notice after chemical application?

Mariscus alternifolius ( ) *Setaria barbata* ( ) *Phyllantus amarus* ( ) *Talinum fruitucosum* ( ) others (please specify) ……

25. Do you use plant extract to control weed? Yes ( ) No ( )

26. If yes, list the name of plant used…….....

27. How many times do you repeat application of the plant extract on your cowpea field? .....

28. How effective is the extract on the field within the first 4 weeks? Very effective ( ) effective ( ) not effective ( )

SECTION C: Maize farmers and weed control

Please tick as many as applicable in each case

29. How do you grow your maize? Sole ( ) Intercrop ( )

30. If in intercrops, with what crop(s)? Please list the crop(s) …….

31. How do you control weeds? Manual ( ) Chemical ( ) Mechanical ( ) Bio-herbicide ( ) Mulching ( ) Plant extract ( ) Others ( ) Please specify ……

32. If you use chemicals name the ones you use.

    (v) …….

    (vi) ……

    (vii) ……

    (viii) ……

33. When do you apply the chemical on your maize field? At planting ( ) Before planting ( ) After planting ( ) After crop emergence ( )

34. Which herbicide(s) do you use at planting?

    ……. .....

35. Which herbicide(s) do you use before planting?

    …… ….....

36. Which herbicide(s) do you use after planting?

    ……. .....

37. Which herbicide(s) do you use after crop emergence?

……. .....

38. What are the common weeds dominant on your maize field? Grasses ( ) broad leaves ( ) the two ( )

39. List dominant broad leaves on your field ……

40. List dominant grasses on your field …….

41. How many times do you repeat application of herbicide on your maize field? .....

42. How effective is your herbicide on the field within the first 4 weeks? Very effective ( ) effective ( ) not effective ( )

43. What types of weeds do you notice after chemical application? *Mariscus alternifolius* ( ) *Setaria barbata* ( ) *Phyllantus amarus* ( ) *Talinum fruitucosum* ( ) others (please specify)

…….

44. Do you use plant extract to control weed? Yes ( ) No ( )

45. If yes, list the name of plant used…….....

46. How many times do you repeat application of the plant extract on your maize field? .....

47. How effective is the extract on the field within the first 4 weeks? Very effective ( ) effective ( ) not effective ( )

Thank you