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Effect of Decomposition Period on Phytotoxicity Dynamics of *Parthenium hysterophorus* Aqueous Extracts against *Lepidium sativum* and *Lycopersicon esculentum*

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Abstract

The presence of weeds in crop fields causes chemical competition, which is referred as allelopathy. These allelopathic plants release allelochemicals, which are secondary plant metabolites that are phytotoxic for the nearby plants. Parthenium is one of the most weeds which have a series phytotoxic effect on other plants. But little information is available on phytotoxicity dynamics during decomposition of its litter, whereas despite its potential ecological relevance, phytotoxicity related to litter decomposition has also received little or no attention. On the other hand, in Ethiopia, most of the farm lands are occupied by the weed parthenium. In addition to this, commonly, farmers are usually cultivating the crop plant such as tomato, green chilli, potato, sorghum, maize and Lepdium sativum etc. Leaves, flower heads and roots were separately taken (plants, n > 20), and dried (+40 ° C for 5 days), chopped with scissors (size < 1 cm), and stored at room temperature. From each dried plant parts 50 gram were mixed separately with 1L of distilled water in a 2L beaker and allowed for decomposition one sample in aerobic and one in anaerobic conditions. The physical properties of the extract such as PH and Electrical conductivity was tested in 1st, 10th, 20th and 30th days of decomposition that showed slightly decreasing of phytotoxicity in stem and rpidly in fruits and leaves relatively. The experiment on test plant was carried out before decomposition, after one month anaerobic decomposition and aerobic decomposition of parthenium by taking 10%, 20% and 30% of aqueous extract from all solution and treatment was carried out on germination. After 10 days of germination the bioassay result was collected and the germinated seeds were transplanted into pots on greenhouse and the data were collected. The recorded bioassay result and agronomic traits of lipdium and tomato under laboratory and green house condition were analyzed.

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Introduction

The presence of weeds in crop fields causes chemical competition, which is referred as allelopathy. These allelopathic plants release allelochemicals, which are secondary plant metabolites that are phytotoxic for the nearby plants. Allelochemicals affect neighboring plant individuals (Vivanco *et al.,* 2004) and soil microbial communities, including bacteria, nematodes (Shaukat *et al.,* 2002), and pathogenic and mycorrhizal fungi (Souto *et al.,* 2000). Due to the action of allelochemicals, a large number of physiological functions and biochemical reactions of the plants such as seed germination, cell division, cell elongation, membrane permeability and ion uptake will be affected. Little information is available on phytotoxicity dynamics during decomposition of leaf

litter (An *et al.,* 2001), whereas despite its potential ecological relevance, phytotoxicity related to litter decomposition has also received little or no attention. It is clear that the release of phytotoxic substances during litter decomposition can potentially affect population dynamics and consequently, the structure of plant communities (An *et al.,* 2001). In Ethiopia, most of the farm lands are occupied by the weed parthenium. In addition to this, commonly, farmers are usually cultivating the crop plant such as tomato, green chilli, potato, sorghum, maize and *Lepdium sativum* etc. Therefore, this research project is designed to investigate the effect of decomposition period on phytotoxicity dynamics of *Parthenium hysterophorus* aqueous extracts against *Lepidium sativum* and *Lycopersicon esculentum*.

The general objective of this study is to investigate the effect of the decomposition period on the phytotoxicity dynamics of *Parthenium hysterophorus* tissue extracts against *Lepidium sativum* and *Lycopersicon esculentum*. Specifically, the study aims to determine the decomposition behavior of aqueous extracts prepared from the stem, leaf, root, and flower of *P. hysterophorus* under both aerobic and anaerobic conditions. Furthermore, it seeks to evaluate the phytotoxic effects of these plant-part extracts on the germination and growth of *Lepidium sativum* and *Lycopersicon esculentum* through laboratory bioassays and greenhouse experiments, thereby providing insights into the allelopathic potential of *P. hysterophorus* and its implications for weed management and agricultural productivity.

Materials and Methods

Descriptions of Study Area

The study was investigated at Mettu University which is found in South West of Oromiya Regional State Ethiopia. The land around the unit is almost exclusively used for traditional agricultural purpose, primarily for crop production and cattle rearing (Agriculture and Rural Development Office of Mettu University, 2012).

Plant Material Collection

Plants samples of *Parthenium hysterophorus* were obtained carefully from natural plant communities of pasture land/farm Land of Ilu Abba Bor Zone, Yayo and Mettu Woreda in Ethiopia. Leaves, flower heads and roots were separately taken (plants, n > 20), and dried to allow storage (+40 ° C for 5 days), chopped with scissors (size < 1 cm), and then stored at room temperature. All the experiment was carried out in the Department of Biology, Mettu University.

Laboratory Aerobic and Anaerobic Decomposition Experiment

The dried plant parts (50 gram of leaf, stem, root and flower) were mixed separately with 1L of distilled water in a 2L beaker. To have anaerobic decomposition, the beaker was sealed tightly to prevent entry of air into the beaker, but for aerobic decomposition, air was pumped intermittently into the solution. Before the start of decomposition, the pH and electrical conductivity (EC) of the solution was measured. To start the process of decomposition, 10 ml of microbial inoculums was added into the beaker. For this, 1g of soil obtained from the rhizosphere of Parthenium was mixed in 10 ml of distilled water to have 10% w: w solution. Thereafter, the plant material was allowed to decompose (anaerobically and aerobically) for 30 days. To compensate for the loss of water through evaporation, distilled water was added into the beaker to maintain the water volume as necessary. The experimental conditions of decomposition in water can be considered comparable to those found in the field, because the soil microbial community always operates in thin water films either surrounding solid particles or inside the soil aggregates (Nannipieri *et al.,* 2003).

Sampling of Aqueous Suspensions for Bioassay

To analyze the physical properties such as pH and electrical conductivity, aqueous suspensions were sampled on the 10^{th}, 20^{th}, and 30^{th} days from the start of the decomposition process and centrifuged (2395 g for 10 min). The pH and electrical conductivity of the suspensions were measured. The original suspensions were diluted in distilled water to get 10%, 20% and 30% of the extract solution. The suspensions were stored in a refrigerator until bioassay (*Macias et al., 2000).*

Bioassay

The bioassay study was carried out before and after aerobic and anaerobic decomposed solution. Ten seeds of *Lepidium sativum* and *Lycopersicon esculentum* were placed in Petri dishes of 9 cm diameter, and 4 ml of the test solutions (aerobic and anaerobic decomposed solution of leaf, stem, root and flower) will be added on the seeds/filter paper separately and kept under laboratory conditions. The control will receive only

distilled water. After ten days germination %, radicle and plumule length will be recorded (*Macias et al., 2000*).

Green house experiment

After germination the germinated seeds were transferred to pots filled with soils. Then, the seedlings were watered with respective aqueous suspensions twice/week until the seedlings grow to maturity. Finally, agronomic parameters such as shoot and root length, days to flowering and fruiting, biomass, number of seeds/fruits, weight of seeds/fruits, any visible leaf injury was recorded. All the experiments were designed in a completely randomized design.

Statistical Analysis

Statistical analyses were conducted with the statistical packages SPSS for Windows 16.0 and SAS version 9.3. Data were first checked for normality of distribution and logarithmically transformed as necessary. One-way ANOVA was used to analyze laboratory bioassay result and greenhouse agronomic data. The differences between means were considered to be statistically significant at $P < 0.05$.

Results and Discussion

Physical Properties of the Extract in Different Decomposition Periods

The pH of the extracts from all plant functional parts increased rapidly during aerobic decomposition whereas it increased slightly in anaerobic conditions. Before aerobic and anaerobic decomposition fruits/heads of flower and leaves have lower pH than the stem and root, but after aerobic and anaerobic decomposition their pH became very higher. After thirty days of decomposition all functional parts of the plant showed higher pH in aerobic decomposition than anaerobic decomposition (figure 1).

Before decomposition the pH of root, stem, leave and fruit/heads of flower was 4.29, 4.26, 4.19 and 4.09 respectively. These was increased to 4.68, 4.38, 4.28 and 4.18 after 10 days, 5.02, 4.71, 5.18 and 4.73 after 20 days and 5.27, 5.31, 6.95 and 5.43 after 30 days of anaerobic decomposition period respectively. In anaerobic conditions, the phytotoxicity dynamics were completely different with the phytotoxic level slowly decreasing during the whole decomposition process according to functional parts of plant (figure 1b). This is also supported by researchers on the factors affecting the decomposition rates and related dynamics of nutrients according to environmental conditions (Gholz *et al.,* 2000), litter chemical characteristics and litter diversity (Gartner and Cardon, 2004).

In the early stages of aerobic decomposition the pH of root, stem, leave and fruit/heads of flower were 4.29, 4.26, 4.19 and 4.09 respectively. These was increased to 5.28, 5.12, 5.44 and 4.56 after 10 days, 5.64, 5.25, 6.19 and 5.03 after 20 days and, 5.87, 5.93, 7.69 and 6.36 after 30 days of aerobic decomposition period respectively. Phytotoxicity showed contrasting trends with either a slight or rapid decrease according to the type of plant functional parts. Relatively constant low levels of phytotoxicity were observed for roots and stems, while a rapid decrease characterized the phytotoxic effects of the fruits/heads of flower and leaf (figure 1a). These changes over time of both composition and quantity of allelochemicals can either increase or decrease the phytotoxicity of decomposing plant litter (An *et al.,* 2001).

R represent the root extract, S stem extract, L leave extract and F extract of fruit/heads of flower, and the subscribed numbers 1, 10, 20 and 30 represent the days in which the samples are taken to taste the physical properties of extract, (a) aerobically and (b) anaerobically decomposed extract in both figures.

It is known that pH can affect the solubility of allelochemicals as the result phytotoxicity of compounds increased in acidic conditions and slowly decreased as the PH of the extract increased (Gholz *et al.,* 2000). This is consistent with the results of this study that show higher phytotoxicity before decomposition at low pH levels, slightly high phytotoxicity at the start of anaerobic decomposition conditions and, relatively low phytotoxicity after 30 days of decomposition period. But the direct effect of pH is not detected on test plant.

The fruits/heads of flower and leaf showed an initial significant increase in phytotoxicity followed by a slow decrease. By contrast, the roots, as mentioned before, were characterized by very low phytotoxic effects that showed in any case, before and after decomposition. After these initial dynamics, as decomposition proceeded in aerobic conditions, phytotoxicity gradually decreased for all plant function parts of parthenium (figure 1-2).

R represent the root extract, S stem extract, L leave extract and F extract of fruit/heads of flower, and the

subscribed numbers 1, 10, 20 and 30 represent the days in which the samples are taken to taste the physical properties of extract, (a) aerobically and (b) anaerobically decomposed extract in both figure. At the initial stage of decomposition the observed EC for extracts of the root, stem, leave and fruit/heads of flower were 0.36, 0.87, 1.22 and 1.21 respectively. These is increased to 0.98, 1.06, 2.24 and 1.92 after 10 days, 1.06, 1.93, 3.19 and 2.83 after 20 days and 1.75, 2.37, 4.27 and 3.34 after 30 days of aerobic decomposition condition, and 0.63, 0.99, 1.86 and 1.82 after 10 days, 0.9, 1.42, 2.31 and 2.11 after 20 days and, 1.12, 1.96, 3.44 and 3.12 after 30 days of anaerobic decomposition condition respectively. During decomposition process the EC values obtained with leaves were always higher than the others. It is ranged from 4.27 mS/cm for aerobically decomposed leaves to 0.36 mS/cm for roots before decomposition (figure 2).

The mean in the table indicates that pH of the extracts increased rapidly during aerobic decomposition whereas it increased slightly in anaerobic conditions. It is 6.46 and 5.74 after thirty days of aerobic and anaerobic decomposition respectively. The pH was 4.21 at the start of decomposition, and increased to 5.10 on 10^{th}, 5.53 on 20^{th} and 6.46 on 30^{th} days of decomposition period in aerobic condition. In anaerobic condition it was 4.21 at the start of decomposition, and increased to 4.38 in 10^{th}, 4.91 in 20^{th} and 5.74 in 30^{th} days of decomposition period (table 1). This indicates that the pH of the extract increased gradually in decomposition process. As the result the phytotoxicity of the extract is decreased gradually during decomposition process. It is known that pH can affect the solubility of allelochemicals as the result phytotoxicity of compounds increased in acidic conditions (Armstrong & Armstrong, 1999). This is consistent with results of this study that show higher phytotoxicity at low pH and EC levels in anaerobic conditions.

The EC of the extracts also increased rapidly during aerobic decomposition whereas it increased slightly in anaerobic conditions. It was 0.91mS/cm at the start of decomposition, and increased to 1.55 after 10 days, 2.25 after 20 days and 2.93mS/cm after 30 days of aerobic decomposition and 1.32 after 10 days, 1.68 after 20 days and 2.41mS/cm after thirty days of anaerobic decomposition condition (table 1). This indicates that the pytotoxicity dynamics became decreased by decomposition process. It is rapidly decreased in aerobic decomposition condition and slowly in anaerobic decomposition condition.

In anaerobic conditions the phytotoxicity dynamics were completely different with the phytotoxic level slowly decreasing during the whole decomposition process and rapidly in aerobic decomposition condition (table 1). This is also supported by researchers on the factors affecting the decomposition rates and related dynamics of nutrients according to environmental conditions (Gholz *et al.,* 2000), litter chemical characteristics and litter diversity (Gartner and Cardon, 2004).

Bioassay Results of Lipdium (L. Sativum) under Laboratory Condition

The different bioassay result and agronomic traits of lipdium under laboratory condition are shown in tables below. These result of bioassay suggested that lipdium germination rate is highly affected by concentrated aqueous extract of parthnium obtained before decomposition followedby concentrated aqueous extract of parthnium obtained at the start of anaerobic decomposition then followed followed by aqueous extract obtained at initial stage of aerobic decomposition period in comparison to control. In all cases the phytotoxic effect was highest at the start of decompostion, higher after 10 days, slightly less after 20 days and, very less after 30 days of decomposition period (table 2-3).

The germination rates of lipdium treated by 10, 20 and 30% aqueous extract of parthenium were 38.40, 39.60 and 40.26 hours before deomposition respectively. This was decreased to 38.40, 39.00 and 39.60hours after 10 days, 37.20, 37.80 and 39.60hours after 20 days and, 37.20, 37.80 and 38.40 hours after 30 days of anaerobic decomposition respectively. The tasted seeds by aerobically decomposed extract lasts less time to germinate than that of seeds treated by anaerobically decomposed extract. It was 38.40, 39.60 and 39.60hours when treated by 10, 20 and 30% extract taken after 10 days of aerobic decomposition period. This was reduced to 36.60, 37.20 and 37.20hours by extract taken after 20 days and, 36.60, 37.20 and 38.40hours by extract taken after 30 days of aerobic decomposition period respectively. Control takes less time to germinate which lasts 36.00 hours. The study proved that the effect of decomposition period on phytotoxicity dynamics of parthenium (table 2). This is in line of a study on the action of allelochemicals by researchers. They suggested that a large number of physiological functions and biochemical reactions of the plants such as seed germination, cell division, cell elongation, membrane permeability and ion uptake will be affected differently

in different decomposition period (Tomita-Yokotani *et al.,* 2005; Setia *et al.,* 2007).

In the same manner different phytotoxic effect was observed for germination percent, radicle length and plumule length of lipdim when treated by aqueous extract of parthnium obtained in different decomposition period. The highest phytotoxic effect was observed in seeds treated by extract taken before decomposition. After 10 days of decomposition it was decreased in some extent.relatively less phytotoxicity was detected when treated by extract taken after 20 days of decomposition period and, the lowest in seeds tasted by extract obtained after 20 days of decomposition period. In comparison of aerobic and anaerobic decomposition condition, the seed tasted by aerobically decomposed extract show less phytotoxicity than anaerobic decomposition extract (table 2).

The lowest germination percent was observed when the seeds treated by 10, 20 and 30% aqueous extract of prthenium taken before decomposition which was 85, 81 and 77% respectively.

The germination percent of the lipdium seeds were gradually increased when they treated by extract after 10, 20 and 30 days of decomposition period consecutively. It was 92, 91, and 90% when treated by extract taken after 10 days, which was increased to 95, 94, and 91% when treated by extract taken after 20 days, and 96, 95 and 93% when treated by extract taken after 30 days of anaerobic decomposition.

When treated by aerobically decomposed extract taken after 10, 20 and 30 days of decomposition period, it was 93, 93 and 91% by extract taken after 10days, 96, 96, and 94% by extract obtained after 20 days and, relatively the highest was 98, 97 and 95% which was treated by10, 20and 30% aqueous extract of prthenium taken after 30 days of aerobic decomposition. The highest germination percent (99%) were observed when the seeds treated by only distilled water (table 2).

The seeds treated by 10, 20 and 30% aqueous extract of parthenium taken before decomposition bear very short radical and plumul which were 3.73, 3.70 and 3.64cm and, 3.75, 3.70 and 3.67cm length of radical and plumul respectively. Their lengths were highly affected by extracts taken before decomposition then followed by extract taken after 10 days of decomposition period. When tasted by extract obtained after 20 days, they bear relatively long radical and plumul and, very long radical and plumul were observed when the seeds treated extract taken after 30 days of decomposition period. Even if they bear long radical and plumul, they were highly affected in comparison to control which is 4.88 and 4.84cm radical and plumul respectively (table 2).

In comparison to plant functional parts, plant tissue showed highest phytotoxity (table 1) and roots showed slightly less phytotoxic effect than the others (table 2). The experiments evidence that phytotoxicity is significantly affected by the type of plant material /functional groups (An *et al.,* 2001), decomposition conditions (Gholz *et al.,* 2000), litter chemical characteristics and litter diversity (Gartner and Cardon, 2004). Also it is suggested by Reinhardt that high level of Parthenon are found in fruits/leaves (Reinhardt *et al.,* 2004).

Agronomic Traits of Lipdium (L. sativum) Grown under Greenhouse Condition

Green house experiment result suggested that, the date of flowering of lipdium is highly affected by phytotoxic effect of partheniuma in comparison to control. The highest phytotoxic effect was observed in lipdium treated by 30% aqueous extract of parthnium tissue obtained before decomposition. It took 59.5 days for flowering. When the plant is treated by 10% aqueous extract taken after 10 days of aerobic decomposition, it lasted 52.2 days for flowering, which is reduced to 48.2days in plants treated by the same concentration taken after 20 days of decomposition period. Relatively less phytotoxic effect is seen in lipdium treated by 10% aqueous extract taken after 30 days of aerobic decomposition that bears the first flower after 47.6 days. The control bears the first flower after 42.6 days, which was the shortest day of flowering in comparison to experimental one (table 4).

Days of fruiting of lipdium is interfered by parthenium aqueous extract in the same manner as days of flowering in comparison to control. When the days of flowering increased, the days of fruiting also increased as the phytotoxicity increased. The highest inhibitory effect of parthenium is observed when the concentration of treatment increased, particularly before decomposition. For instance lipidium treated by 30% concentration of extract before decomposition took much more (63.2) days for fruiting than lipdium treated by others. This is reduced to 57.2, 54.6 and 52.5 days for plants treated by extract taken after 10, 20 and 30 days of aerobic decomposition period respectively. Less inhibitory effect is observed in lipdium treated by 10% aqueous extract of

parthenium obtained after 30 days of aerobic decomposition that bears its first fruit after 52.5 days of seedling. In control the first fruit was observed after 46.1 days of seedling (table 4). This is supported by researchers in the presence of highest phytotoxic effect in parthenium before decomposition that is gradually decreased through decomposition process (Belz *et al.,* 2009).

Compared to the control plant, the numbers of leave were highly inhibited in plants treated by higher concentration taken before decomposition and slightly affected in plants treated by lower concentration of root extract obtained after 30 days of aerobic decomposition. In this treatment the minimum found 299.5in plant treated by 30% concentration aqueous extract of parthenium obtained before decomposition, this is increased to 325.5, 356.5 and 357.55 in plant treated by 10% aqueous extract of parthenium obtained after 10, 20 and 30 days of aerobic decomposition period respectively. The maximum number of leave found 361.80 in control and, followed by plants treated by 10% aqueous extract of parthenium taken after 30 days of aerobic decomposition condition which is 357.5 leaves (table 4). The numbers of injured leaves was 45.2 in plants treated by 30% aqueous extract of parthnium tissue obtained before decomposition. This is decrease to 36.7, 33.8 and 31.6 successively in plants treated by 10% aqueous extract taken on 10, 20 and 30 days of decomposition period. In control the number of observed injured leave was very low, which are 27.5 (table 4). It is also suggested that phytotoxicity is significantly affected by decomposition conditions (Gholz *et al.,* 2000), the type of plant material /functional organs (An *et al.,* 2001), litter chemical characteristics and litter diversity (Gartner and Cardon, 2004).

The result indicates that the presence of phytotoxicity regarding to the number of flowers and seeds of test plant. Because low number of flowers and seeds are observe in test plant treated by higher concentration of parthenium extract obtained before decomposition, and high number of flowers and seeds are observed in plant treated by lower concentration of extract obtained after 30 days of aerobic decomposition. The number of flowers and seeds are increased on decomposition process of parthenium, when the plants are treated by extract taken on 10, 20 and 30 days of decomposition period sequentially. In control the number of flower and seeds are 80.4 and 268.7 per plant respectively. This is reduced to 58.6 and 216.5 respectively in plant treated by 30% aqueous extract of parthenium obtained before decomposition (table 4).The experiments provided evidence on the phytotoxicity dynamics of this noxious invasive weed which affected crop production (Shabbir, 2002).

Inhibition of root and stem length is also observed in the test plant when compared to control plant. Both are strongly interrupted by concentrated extract of tissue taken before decomposition. Comparatively moderated inhibition of root and stem length were detected in plants treated by exteract taken on 10 days, less inhibition by extracts taken on 20 days and very less inhibition by extracts taken on 30 days of decomposition period when treated by the same concentration. The test plan bear shortest stem which measured 60.82 cm and root which measured 5.05cm when treated by 30% aqueous extract obtained before decomposition, and slightly long stem which measured 72cm and root which measured 7.54cm when treated by 10% of parthenium extract obtained after 30 days of aerobic decomposition. Considerably the control developed long stem and root which are measured 98.31cm and 8.15cm respectively (table 4). This study showed similar result with Rice and others. They suggested that, fruit and leaf tissues produced greater allelochemicals which degrade through decomposition.

In contrast to control the weight of fruit was highly inhibited when the taste plant is treated by aqueous extract taken before decomposition and relatively less inhibitory effect is observed in plant treated by aqueous extract of parthenium after aerobic decomposition. It was 145.8kg for control. This is reduced to 110.9kg in plants treated by 30% aqueous extract of parthenium taken before decomposition. In plants treated by 10% aqueous extract of parthenium taken after 10, 20 and 30days of aerobic decomposition, it was 122, 137.7 and 139.6kg respectively (table 4).

Dry biomass of the test plant is also highly reduced to 92.9kg in plants treated by 30% aqueous extract of parthenium before decomposition from 123.3kg which are measured for control. This is increased to 101.9kg in plants treated by 10% aqueous extract taken from parthenium after 10 days, 116.2kg in plants treated by extract taken from parthenium after 20 days and, 118kg in plants treated by extract taken from parthenium after 30 days of aerobic decomposition. Regarding to the weights of dry biomass slightly less phytotoxic effect is observed in test plan treated by diluted aqueous extract of root after aerobic decomposition (table 6). Plants treated by extract taken from parthenium after aerobic

decomposition showed relatively less phytotoxic effect than plants treated by extract taken from parthenium after anaerobic decomposition. This is also proved by researchers regarding to phytotoxicity dynamics (Inderjit and Duke 2003).

Agronomic traits of tomato (*S. lycopersicun L.)* under Laboratory condition

The different bioassay result and agronomic traits of tomato under laboratory condition are shown in tables below. These result of bioassay suggested that lipdium germination rate is highly affected by concentrated aqueous extract of parthnium obtained before decomposition followed by concentrated aqueous extract of parthnium obtained at the start of anaerobic decomposition then followed followed by aqueous extract obtained at initial stage of aerobic decomposition period in comparison to control. In all cases the phytotoxic effect was highest at the start of decompostion, higher after 10 days, slightly less after 20 days and, very less after 30 days of decomposition period (table 6-7).

The germination rates of lipdium treated by 10, 20 and 30% aqueous extract of parthenium were 49.20, 55.80 and 58.80 hours before deomposition respectively. This was decreased to 56.40, 56.40 and 57.00 hours after 10 days, 45.00, 46.80 and 56.40 hours after 20 days and, 43.20, 50.40 and 57.00 hours after 30 days of anaerobic decomposition respectively. The tasted seeds by aerobically decomposed extract lasts less time to germinate than that of seeds treated by anaerobically decomposed extract. It was 55.20, 55.80 and 55.80 hours when treated by 10, 20 and 30% extract taken after 10 days of aerobic decomposition period. This was reduced to 44.40, 46.20 and 48.00 hours by extract taken after 20 days and, 42.60, 49.80 and 54.00 hours by extract taken after 30 days of aerobic decomposition period respectively. Control takes less time to germinate which lasts 36.00 hours. The study proved that the effect of decomposition period on phytotoxicity dynamics of parthenium (table 6).

This is in line of a study on the action of allelochemicals by researchers. They suggested that a large number of physiological functions and biochemical reactions of the plants such as seed germination, cell division, cell elongation, membrane permeability and ion uptake will be affected differently in different decomposition period (Tomita-Yokotani *et al.,* 2005; Setia *et al.,* 2007).

In the same manner different phytotoxic effect was observed for germination percent, radicle length and plumule length of lipdim when treated by aqueous extract of parthnium obtained in different decomposition period. The highest phytotoxic effect was observed in seeds treated by extract taken before decomposition. After 10 days of decomposition it was decreased in some extent.relatively less phytotoxicity was detected when treated by extract taken after 20 days of decomposition period and, the lowest in seeds tasted by extract obtained after 20 days of decomposition period. In comparison to aerobic and anaerobic decomposition condition, the seed tasted by aerobically decomposed extract show less phytotoxicity than anaerobic decomposition extract (table 6). It is suggested by Reinhardt that tissue carry most of the capitate sessile trichomes on the upper and lower surface, high levels of parthenin are found in leaves (Reinhardt *et al.,* 2004).

The lowest germination percent was observed when the seeds treated by 10, 20 and 30% aqueous extract of prthenium taken before decomposition which was 84, 80 and 76% respectively.

The germination percent of the lipdium seeds were gradually increased when they treated by extract after 10, 20 and 30 days of decomposition period consecutively. It was 91, 90 and 89% when treated by extract taken after 10 days, which was increased to 94, 93 and 90% when treated by extract taken after 20 days, and 95, 94 and 92% when treated by extract taken after 30 days of anaerobic decomposition. When treated by aerobically decomposed extract taken after 10, 20 and 30 days of decomposition period, it was 92, 92 and 90% by extract taken after 10days, 86, 95 and 94% by extract obtained after 20 days and, relatively the highest was 97, 96 and 93% which was treated by10, 20 and 30% aqueous extract of prthenium taken after 30 days of aerobic decomposition. The highest germination percent (98%) were observed when the seeds treated by only distilled water (table 6).

The seeds treated by 10, 20 and 30% aqueous extract of parthenium taken before decomposition bear very short radical and plumul which were 3.53, 3.40 and 3.22cm and, 3.93, 3.80 and 3.66cm length of radical and plumul respectively. Their lengths were highly affected by extracts taken before decomposition then followed by extract taken after 10 days of decomposition period. When tasted by extract obtained after 20 days, they bear relatively long radical and plumul and, very long radical and plumul were observed when the seeds treated by

extract taken after 30 days of decomposition period. Even if they bear long radical and plumul, they were highly affected in comparison to control which is 4.78 and 5.07cm radical and plumul respectively (table 6).

In comparison to plant functional parts, plant tissue showed highest phytotoxity (table 7) and roots showed slightly less phytotoxic effect than the others (table 6). This is also suggested by some researchers on the inhibition of seed germination, and seedling and plant growth both in the laboratory and field conditions in a variety of plant species including almost all major crop plants (Tefera, 2002; Regina *et al.,* 2007). Therefore, the experiment result is in line of evidence that phytotoxicity is significantly affected by the type of plant material /functional groups (An *et al.,* 2001), decomposition conditions (Gholz *et al.,* 2000), litter chemical characteristics and diversity (Gartner and Cardon, 2004). Also it is suggested by Reinhardt that high level of parthenin are found in fruits/ leaves (Reinhardt *et al.,* 2004).

Agronomic Traits of Tomato (*S. lycopersicun L.*) Grown Under Greenhouse Condition

Green house experiment result suggested that, the date of flowering of lipdium is highly affected by phytotoxic effect of partheniuma in comparison to control. The highest phytotoxic effect was observed in lipdium treated by 30% aqueous extract of parthnium tissue obtained before decomposition. It took 98.7 days for flowering. When the plant is treated by 10% aqueous extract taken after 10 days of aerobic decomposition, it lasted 101.6 days for flowering, which is reduced to 97days in plants treated by the same concentration taken after 20 days of decomposition period. Relatively less phytotoxic effect is seen in lipdium treated by 10% aqueous extract taken after 30 days of aerobic decomposition that bears the first flower after 83.9 days. The control bears the first flower after 78.7 days, which was the shortest day of flowering in comparison to experimental one (table 8).

Days of fruiting of lipdium is interfered by parthenium aqueous extract in the same manner as days of flowering in comparison to control. When the days of flowering increased, the days of fruiting also increased as the phytotoxicity increased. The highest inhibitory effect of parthenium is observed when the concentration of treatment increased, particularly before decomposition. For instance lipidium treated by 30% concentration of extract before decomposition took much more (111.7) days for fruiting than lipdium treated by others. This is reduced to 101.6, 97 and 96.7 days for plants treated by 10% extract taken after 10, 20 and 30 days of aerobic decomposition period respectively. Less inhibitory effect is observed in lipdium treated by 10% aqueous extract of parthenium obtained after 30 days of aerobic decomposition that bears its first fruit after 96.7 days of seedling. In control the first fruit was observed after 89.7 days of seedling (table 8). This is supported by researchers in the presence of highest phytotoxic effect in parthenium before decomposition that is gradually decreased through decomposition process (Belz *et al.,* 2009).

Compared to the control plant, the numbers of leave were highly inhibited in plants treated by higher concentration taken before decomposition and, slightly affected in plants treated by lower concentration of root extract obtained after 30 days of aerobic decomposition. In this treatment the minimum found 92.9 in plant treated by 30% concentration aqueous extract of parthenium obtained before decomposition, this is increased to 101.9, 116.2 and 118.1 in plant treated by 10% aqueous extract of parthenium obtained after 10, 20 and 30 days of aerobic decomposition period respectively. The maximum number of leave found 123.5 in control and, followed by plants treated by 10% aqueous extract of parthenium taken after 30 days of aerobic decomposition condition which is 118.1 leaves (table 8). The number of leave are highly inhibited in plants treated by extract taken before decomposition than after anaerobic decomposition, and less inhibitory effect is detected in test plant treated by extract obtained after aerobic decomposition than anaerobic decomposition. The numbers of injured leaves was 16.4 in plants treated by 30% aqueous extract of parthnium tissue obtained before decomposition. This is decrease to 15.5, 12.2 and 12.1 successively in plants treated by 10% aqueous extract taken on 10, 20 and 30 days of aerobic decomposition period. In control the number of observed injured leave was very low, which are 11.1 (table 8). It is also suggested that phytotoxicity is significantly affected by decomposition conditions (Gholz *et al.,* 2000), the type of plant material /functional organs (An *et al.,* 2001), litter chemical characteristics and litter diversity (Gartner and Cardon, 2004).

The result indicates that the presence of phytotoxicity regarding to the number of flowers and seeds of test plant. Because low number of flowers and seeds are observe in test plant treated by higher concentration of parthenium extract obtained before decomposition, and high number of flowers and seeds are observed in plant

treated by lower concentration of extract obtained after 30 days of aerobic decomposition. The number of flowers and seeds are increased on decomposition process of parthenium, when the plants are treated by extract taken on 10, 20 and 30 days of decomposition period sequentially. In control the number of flower and seeds are 30.8 and 18.5 per plant respectively. This is reduced to 12.2 and 12 respectively in plant treated by 30% aqueous extract of parthenium obtained before decomposition (table 8). The experiments provided evidence on the phytotoxicity dynamics of this noxious invasive weed which affected crop production (Shabbir, 2002).

Inhibition of root and stem length is also observed in the test plant when compared to control plant. Both are strongly interrupted by concentrated extract of tissue taken before decomposition. Comparatively moderated inhibition of root and stem length were detected in plants treated by extract taken on 10 days, less inhibition by extracts taken on 20 days and very less inhibition by extracts taken on 30 days of decomposition period when treated by the same concentration. The test plan bear shortest stem which measured 87.36 cm and root which measured 5.28cm when treated by 30% aqueous extract obtained before decomposition, and slightly long stem which measured 97.86cm and root which measured 7.82cm when treated by 10% of parthenium extract obtained after 30 days of aerobic decomposition.

Considerably the control developed long stem and root which are measured 99.84cm and 7.92cm respectively (table 8). This study showed similar result with Rice and others. They suggested that, fruit and leaf tissues produced greater allelochemicals at early stage of decomposition which is degraded through decomposition process (Shabbir, 2002).

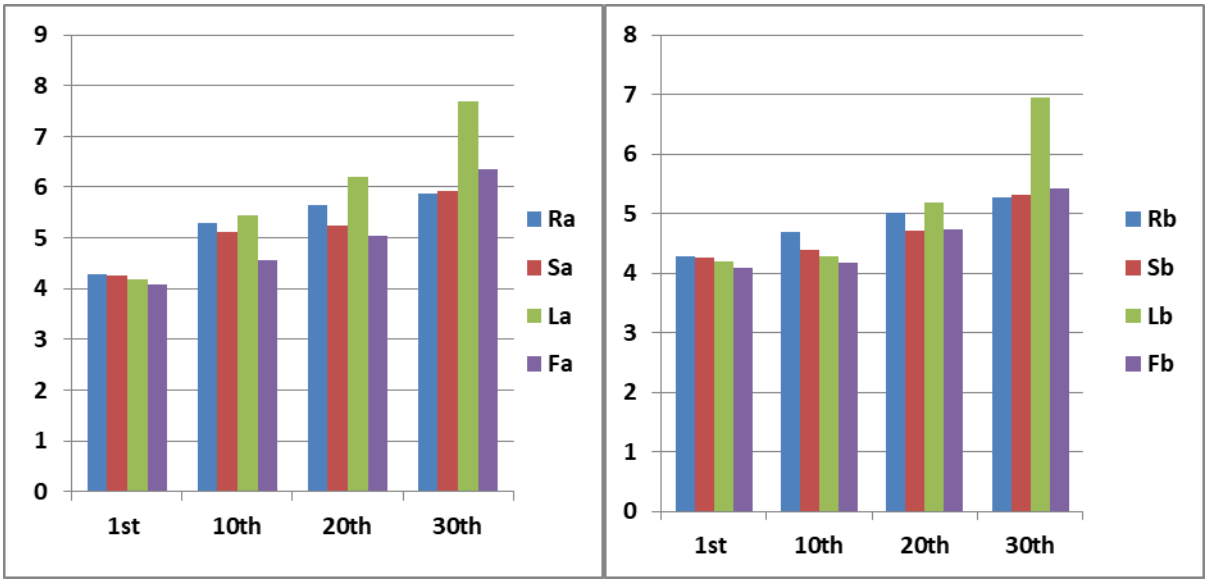
In contrast to control the weight of fruit was highly inhibited when the taste plant is treated by aqueous extract taken before decomposition and relatively less inhibitory effect is observed in plant treated by aqueous extract of parthenium after aerobic decomposition. It was 3.01kg for control. This is reduced to 2.08kg in plants treated by 30% aqueous extract of parthenium taken before decomposition. In plants treated by 10% aqueous extract of parthenium taken after 10, 20 and 30days of aerobic decomposition, it was 2.26, 2.69 and 2.79kg respectively (table 8).

Dry biomass of the test plant is also highly reduced to 0.78kg in plants treated by 30% aqueous extract of parthenium before decomposition from 1.18kg which are measured for control. This is increased to 0.97kg in plants treated by 10% aqueous extract taken from parthenium after 10 days, 1.16kg in plants treated by extract taken from parthenium after 20 days and, 1.17 kg in plants treated by extract taken from parthenium after 30 days of aerobic decomposition. Regarding to the weights of dry biomass slightly less phytotoxic effect is observed in test plan treated by diluted aqueous extract of root after aerobic decomposition. Plants treated by extract taken from parthenium after aerobic decomposition showed relatively less phytotoxic effect than plants treated by extract taken from parthenium after anaerobic decomposition. This is also proved by researchers regarding to phytotoxicity dynamics (Inderjit and Duke 2003).

Parthenium is one of the most weeds which have a series phytotoxic effect on other plants. But little information is available on phytotoxicity dynamics during decomposition of its litter, whereas despite its potential ecological relevance, phytotoxicity related to litter decomposition has also received little or no attention. On the other hand, in Ethiopia, most of the farm lands are occupied by the weed parthenium. In addition to this, commonly, farmers are usually cultivating the crop plant such as tomato, green chilli, potato, sorghum, maize and Lepdium sativum etc.Therefore, this research project is designed to investigate the effect of decomposition period on phytotoxicity dynamics of Parthenium hysterophorus aqueous extracts against *Lepidium sativum* and *Lycopersicon esculentum*.To carry out the study plants samples of Parthenium hysterophorus were obtained carefully from natural plant communities of pasture land/farm Land of Haramaya University in Ethiopia. Leaves, flower heads and roots were separately taken (plants, $n > 20$), and dried (+40 °C for 5 days), chopped with scissors (size < 1 cm), and stored at room temperature. From each dried plant parts 50 gram were mixed separately with 1L of distilled water in a 2L beaker and allowed for decomposition one sample in aerobic and one in anaerobic conditions.

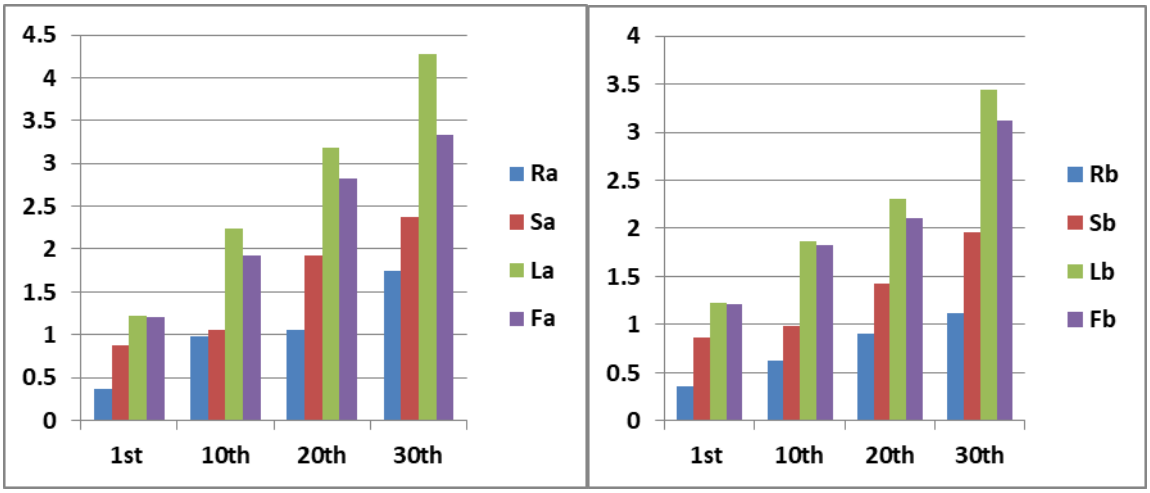
The pH of the extracts from all plant functional parts increased rapidly during aerobic decomposition where as it increased slightly in anaerobic conditions. It is known that phytotoxicity of compounds increased in acidic conditions at low pH levels in anaerobic conditions.

Figure.1 The pH of aqueous suspensions of parthenium sampled on 1st 10th, 20th, and 30th days of the decomposition period.



A) pH of aerobically decomposed extract **B**) pH of anaerobically decomposed extract

Figure.2 Electrical conductivity of aqueous suspensions of parthenium extract tasted on 1st, 10th, 20th, and 30th days of decomposition.



A) EC of aerobically decomposed extract **B**) EC of anaerobically decomposed extract

Table.1 The mean of physical property which indicates the effect of decomposition period on phytotoxicity dynamic of parthenium on different decomposition period in both aerobic and anaerobic condition.

	Aerobically decomposed parthenium extract				Anaerobically decomposed parthenium extract					
Dec. p	1st	10th	20th	30th	1st	10th	20th	30th	F. val	p.val
Ph	4.21d	5.10bc	5.53bc	6.46a	4.21d	4.38d	4.91cd	5.74b	11.08	.0001
EC	0.91c	1.55bc	2.25ab	2.93a	0.91c	1.32bc	1.68bc	2.41ab	3.53	.0095

Dec. p: decomposition period, EC: electric conductivity and, 1st, 10th, 20th and 30th are days in which the samples are tasted.

Table.2 Effect of decomposition period on the Phytotoxicity Dynamics of Parthenium Root extract against the Germination time (GT), Germination percent (G %), Radicle length (RL) and Plumule length (PL) of Lipdium

Dec. type	Dec. period	Conc.	Gt	G%	Rl	Pl
Before decomposition	1st day	10%	38.40a-d	85.00ef	3.73h	3.75fg
		20%	39.60ab	81.00fg	3.70h	3.70g
		30%	40.20a	77.00g	3.64h	3.67g
After anaerobic decomposition.	10th day	10%	38.40a-d	92.00b-d	4.35d-f	4.35b-e
		20%	39.00a-c	91.00c-e	4.15fg	4.19c-e
		30%	39.60ab	90.00de	4.05g	4.05ef
	20th day	10%	37.20b-d	95.00a-d	4.55b-d	4.55ab
		20%	37.80a-c	94.00a-d	4.45b-d	4.45bc
		30%	39.60ab	91.00c-e	4.15fg	4.19c-e
	30th day	10%	37.20b-d	96.00a-d	4.60bc	4.63ab
		20%	37.80a-c	95.00a-d	4.50b-d	4.55ab
		30%	38.40a-d	93.00a-d	4.41c-e	4.45bc
After aerobic decomposition.	10th day	10%	38.40a-d	93.00a-d	4.38de	4.39b-d
		20%	39.60ab	93.00a-d	4.22e-f	4.20c-e
		30%	39.60ab	91.00c-e	4.10g	4.10de
	20th day	10%	36.60cd	96.00a-d	4.60bc	4.60ab
		20%	37.20b-d	96.00a-d	4.50b-d	4.50bc
		30%	37.20b-d	94.00a-d	4.40c-e	4.40b-d
	30th day	10%	36.60cd	98.00ab	4.65b	4.67ab
		20%	37.20b-d	97.00a-c	4.55b-d	4.61ab
		30%	38.40a-d	95.00a-d	4.45b-d	4.49bc
Control			36.00d	99.00a	4.88a	4.84a

Germination time (Gt): expressed by hours, Germination percent (G %): by percent out of total number of seeds, Radical length (Rl) and Plumule length (Pl): by centimeters. 10%, 20% and 30% represents concentration of extract in the test solution. P<0.05

Table.3 Effect of decomposition period on the Phytotoxicity Dynamics of Parthenium Tissue extract against the Germination time (GT), Germination percent (G %), Radicle length (RL) and Plumule length (PL) of Lipdium

Dec. type	Dec. period	Conc.	Gt	G%	Rl	Pl
Before decomposition	1st day	10%	38.40a-d	85.00cd	3.73g	3.73gh
		20%	39.00a-c	79.00de	3.67g	3.69h
		30%	40.20a	73.00e	3.60g	3.62h
After anaerobic decomposition.	10th day	10%	37.80a-d	94.00ab	4.34c-e	4.35b-f
		20%	38.40a-d	93.00ab	4.12f	4.15d-f
		30%	39.00a-c	90.00bc	4.05f	4.05fg
	20th day	10%	37.80a-d	94.00ab	4.45bc	4.45b-d
		20%	38.40a-d	94.00ab	4.34c-e	4.35b-f
		30%	39.60ab	91.00bc	4.15ef	4.19c-f
	30th day	10%	37.20b-d	95.00ab	4.55bc	4.55ab
		20%	37.80a-d	93.00ab	4.45bc	4.45b-d
		30%	38.40a-d	92.00b	4.35c-e	4.35b-f
After aerobic decomposition	10th day	10%	37.20b-d	95.00ab	4.40b-d	4.40b-e
		20%	38.40a-d	94.00ab	4.20d-f	4.20c-f
		30%	39.60ab	91.00bc	4.10f	4.10ef
	20th day	10%	37.10b-d	96.00ab	4.50bc	4.50bc
		20%	38.40a-d	95.00ab	4.40b-c	4.40b-e
		30%	39.60ab	93.00ab	4.22d-f	4.20c-f
	30th day	10%	36.60cd	96.00ab	4.60b	4.60ab
		20%	37.20b-d	96.00ab	4.50bc	4.49bc
		30%	38.40a-d	93.00ab	4.38cd	4.39b-e
Control			36.00d	99.00a	4.88a	4.84a

Germination time (Gt): expressed by hours, Germination percent (G %): by percent out of total number of seeds, Radical length (Rl) and Plumule length (PL): by centimeters. 10%, 20% and 30% represents concentration of extract in the test solution. P<0.05

Table.4 Effect of decomposition period on the Phytotoxicity Dynamics of Parthenium root extract against Lipdium before and, after aerobic and anaerobic decomposition

Dec. period	Conc.	Dfl	Dfr	NL	NIL	Nfl	Nfr	SL	RL	FrW	DBM
1st day	10%	54.4b-g	60.0b-e	321.2c-f	41.9bc	67.9c-e	233.2h-j	63.21b-d	6.74e	124.8fg	99.6j-l
	20%	55.9b-e	61.4ab	319.3c-f	43.6ab	64.7ef	221.7kl	62.09d	5.61g	115.3j-l	96.8k-m
	30%	59.5a	63.2a	299.5f	45.2a	58.6f	216.5l	60.82d	5.05h	110.9l	92.9m
After anaerobic decomposition											
10th day	**10%**	**53.1c-h**	**58.1c-g**	**321.0c-f**	**38.1d-g**	**70.2b-e**	**230.4jk**	**64.62b-d**	**6.73e**	**118.3h-k**	**105.3g-i**
	20%	55.5b-e	60.5a-d	309.5d-f	40.5b-e	67.9c-e	222.0kl	62.41cd	6.17f	117.7i-k	99.0j-l
	30%	57.5ab	62.4ab	308.0ef	42.4a-c	67.6ed	218.5l	62.10d	5.54g	114.8kl	96.1lm
20th day	10%	52.0f-h	57.0e-h	339.5a-e	36.5g-i	73.9a-d	247.0b-e	68.40b-d	7.43bc	132.3de	112.0c-f
	20%	52.2f-h	57.2e-h	334.0a-e	37.2f-h	70.5b-e	243.1d-g	66.21b-d	7.31bc	130.2de	108.5e-g
	30%	55.5b-e	60.5a-d	309.5d-f	40.5b-e	67.9c-e	222.0kl	62.41cd	6.17f	117.7i-k	99.0j-l
30th day	10%	50.3h-j	55.2g-i	339.0a-e	35.3g-i	74.7a-d	248.7b-d	69.20b-d	7.44bc	134.3b-d	114.0b-d
	20%	51.8f-i	56.8f-h	330.5a-f	36.8f-i	72.2a-e	246.1b-e	66.69b-d	7.25b-d	127.3ef	107.3f-h
	30%	52.5f-h	57.5d-h	322.5c-f	37.0f-h	70.4b-e	234.5g-j	64.89b-d	7.11b-e	120.0g-j	101.3i-k
After aerobic decomposition											
10th day	**10%**	**52.2f-h**	**57.2e-h**	**325.5b-f**	**36.7f-i**	**72.5a-e**	**239.6e-i**	**67.80b-d**	**6.83de**	**122.0g-i**	**101.9ij**
	20%	54.9b-f	59.9b-f	319.0c-f	39.8c-f	69.8b-e	236.5e-i	64.30b-d	6.18f	121.5g-i	101.4i-k
	30%	56.2bc	61.2a-c	312.5d-f	41.1b-c	68.5c-e	232.4ij	62.98b-d	5.52g	118.8h-k	98.7j-l
20th day	10%	48.8ij	54.6hi	356.5ab	33.8ij	76.3a-c	253.2bc	71.80bc	7.53b	137.7bc	116.2bc
	20%	51.3g-i	56.3gh	348.5a-c	36.3g-i	75.7a-d	248.2b-e	68.29b-d	7.25b-d	134.8b-d	113.3b-e
	30%	53.0d-h	58.0d-g	341.0a-d	37.9e-g	74.2a-c	246.8b-e	67.01b-d	7.02c-e	133.5cd	112.1c-f
30th day	10%	47.6j	52.5i	357.5ab	31.6j	77.3ab	254.3b	72.01b	7.54b	139.6b	118.1b
	20%	50.3h-j	55.3g-i	338.5a-e	34.6h-j	73.8a-d	244.2c-f	70.23b-d	7.40bc	131.8de	110.8d-f
	30%	51.3g-i	56.3gh	331.5a-f	36.3g-i	72.8a-e	241.6d-h	68.19b-d	7.38bc	123.3f-h	103.2h-j
Control		42.6k	46.1j	361.8a	27.5k	80.4a	268.7a	98.31a	8.15a	145.8a	123.3a

Days of flowering (Dfl) and Days of fruiting (Dfr) are expressed by days, Number of leave (NL), Number of injured leave (NIL), Number of flower (Nfl) and fruits (Nfr) are in number per plant, Stem length (SL) and Root length in centimeter, Fruit weight (FrW) and Dry biomass (DBM) in kilogram, and 10%, 20% and 30% represents concentration of extract in test solution.

Table.5 Effect of decomposition period on the Phytotoxicity Dynamics of Parthenium tissue extract against Lipdium before and, after aerobic and anaerobic decomposition

Dec.period	Conc.	Dfl	Dfr	NL	NIL	Nfl	Nfr	SL	RL	FrW	DBM
1st day	10%	55.9c-e	61.2b-d	320.5c-f	43.9bc	66.4de	226.7h-j	62.81b-d	6.64fg	123.9gh	104.4f-h
	20%	57.8bc	63.4ab	318.5c-f	45.8ab	63.2ef	223.4ij	61.41cd	5.28h	115.3k	96.8jk
	30%	63.3a	65.1a	288.0f	47.3a	55.8f	214.6k	58.58d	4.66i	107.8l	89.7l
After anaerobic decomposition											
10th day	**10%**	**53.9d-i**	**58.9d-i**	**332.5a-e**	**38.9e-i**	**71.7b-d**	**239.3d-f**	**66.21b-d**	**7.35b-d**	**128.8d-f**	**109.9c-e**
	20%	55.8c-e	60.8b-e	324.5c-e	41.8c-e	72.1b-d	238.6d-g	66.60b-d	6.90c-f	120.8h-j	100.8h-j
	30%	59.5ab	62.4a-c	308.0ef	42.4cd	67.6de	218.5jk	62.10cd	5.54h	114.8k	96.1k
20th day	10%	52.2g-j	57.2g-k	334.0a-e	37.2g-i	70.5b-e	243.1c-e	66.21b-d	7.31b-d	130.2c-e	108.5d-f
	20%	53.9d-i	58.9d-i	327.5b-e	38.9e-i	71.7b-d	239.5d-f	65.40b-d	6.48fg	121.5h-j	101.5hi
	30%	55.5c-f	60.5b-f	309.5d-f	40.5d-g	67.9c0e	222.0i-k	62.41cd	6.17g	117.7jk	99.0i-k
30th day	10%	52.0h-j	57.0h-k	339.5a-e	36.5h-j	73.9a-d	247.0b-d	68.40bc	7.43bc	132.3cd	112.0b-d
	20%	52.5g-h	57.5f-k	328.5b-e	37.5g-i	70.9b-e	242.5c-e	65.00b-d	7.02b-f	122.7hi	102.7g-i
	30%	53.1d-i	58.1d-j	321.0c-e	38.1f-i	70.2b-e	230.4g-i	64.62b-d	6.73e-g	118.3i-k	99.6i-k
After anaerobic decomposition											
10th day	**10%**	**53.0e-j**	**58.0e-j**	**341.0a-d**	**37.9f-i**	**74.2a-d**	**246.8b-d**	**67.01b-d**	**7.02b-f**	**133.5bc**	**112.1b-d**
	20%	55.3c-g	60.3b-g	332.0a-e	40.3d-g	71.0b-e	239.4d-f	65.49b-d	6.46fg	124.3f-h	103.3g-i
	30%	56.2cd	61.2b-d	312.5d-f	41.1c-f	68.5b-e	232.4f-h	62.98b-d	5.52h	118.8i-k	98.7i-k
20th day	10%	51.3i-k	56.3i-k	348.5a-c	36.3ij	75.7a-c	248.2bc	68.29bc	7.25b-d	134.8bc	113.3bc
	20%	53.0e-j	58.0e-j	335.0a-e	38.1f-i	71.5b-d	241.0c-f	66.01b-d	6.91c-f	125.4f-h	104.4f-h
	30%	54.9c-h	59.9c-h	319.0c-f	39.8d-h	69.8b-e	236.5e-g	64.30b-d	6.18g	121.5h-j	101.4h-j
30th day	10%	48.8k	54.6k	357.5ab	33.8j	76.3ab	253.2b	71.80b	7.53b	137.7b	116.2b
	20%	50.6jk	55.6jk	338.5a-e	36.4ij	73.7a-d	242.5c-e	68.68bc	7.33b-d	127.5e-g	106.5e-g
	30%	52.2g-j	57.2g-k	325.5b-e	36.7h-j	72.5a-d	239.6c-f	67.80b-d	6.83d-f	122.0h-j	101.9g-i
Control		42.6l	46.1l	361.8a	27.5g-i	80.4a	268.7a	98.31a	8.15a	145.8a	123.3a

Days of flowering (Dfl) and Days of fruiting (Dfr) are expressed by days, Number of leave (NL), Number of injured leave (NIL), Number of flower (Nfl) and fruits (Nfr) are in number per plant, Stem length (SL) and Root length in centimeter, Fruit weight (FrW) and Dry biomass (DBM) in kilogram, and 10%, 20% and 30% represents concentration of extract in test solution

Table.6 Effect of decomposition period on the Phytotoxicity Dynamics of Parthenium Root extract against the Germination time (GT), Germination percent (G %), Radicle length (Rl) and Plumule length (Pl) of tomato

Dec. type	Dec. period	Conc.	Gt	G%	Rl	Pl
Before decomposition	1st day	10%	49.20	84.00	3.53	3.93
		20%	55.80	80.00	3.40	3.80
		30%	58.80	76.00	3.22	3.66
After anaerobic decomposition.	10th day	10%	56.40	91.00	4.35	4.65
		20%	56.40	90.00	4.15	4.45
		30%	57.00	89.00	4.05	4.35
	20th day	10%	45.00	94.00	4.55	4.85
		20%	46.80	93.00	4.45	4.75
		30%	56.40	90.00	4.15	4.45
	30th day	10%	43.20	95.00	4.65	4.95
		20%	50.40	94.00	4.55	4.85
		30%	57.00	92.00	4.45	4.69
After aerobic decomposition	10th day	10%	55.20	92.00	4.38	4.68
		20%	55.80	92.00	4.22	4.52
		30%	55.80	90.00	4.10	4.40
	20th day	10%	44.40	96.00	4.60	4.85
		20%	46.20	95.00	4.50	4.80
		30%	48.00	94.00	4.40	4.70
	30th day	10%	42.60	97.00	4.70	4.90
		20%	49.80	96.00	4.60	4.80
		30%	54.00	93.00	4.51	4.71
Control			42.00	98.00	4.78	5.07

Germination time (Gt): expressed by hours, Germination percent (G %): by percent out of total number of seeds, Radical length (Rl) and Plumule length (PL): by centimeters. 10%, 20% and 30% represents concentration of extract in the test solution.

Table.7 Effect of decomposition period on the Phytotoxicity Dynamics of Parthenium Tissue extract against the Germination time (GT), Germination percent (G %), Radicle length (Rl) and Plumule length (Pl) of tomato

Dec. type	Dec. period	Conc.	Gt	G%	Rl	Pl
Before decomposition	1st day	10%	49.80	84.00	3.43	3.88
		20%	56.40	78.00	3.37	3.77
		30%	59.40	72.00	3.18	3.54
After anaerobic decomposition.	10th day	10%	48.60	93.00	4.34	4.63
		20%	55.20	92.00	4.12	4.42
		30%	57.00	89.00	4.05	4.35
	20th day	10%	46.80	93.00	4.45	4.75
		20%	53.40	92.00	4.34	4.64
		30%	56.40	90.00	4.15	4.45
	30th day	10%	45.00	94.00	4.55	4.85
		20%	53.40	93.00	4.45	4.75
		30%	56.40	91.00	4.35	4.65
After aerobic decomposition	10th day	10%	48.00	94.00	4.40	4.70
		20%	54.60	93.00	4.20	4.50
		30%	55.80	90.00	4.10	4.40
	20th day	10%	46.20	95.00	4.50	4.80
		20%	52.80	94.00	4.40	4.70
		30%	55.80	92.00	4.22	4.52
	30th day	10%	44.40	96.00	4.60	4.85
		20%	51.60	95.00	4.50	4.76
		30%	55.20	92.00	4.38	4.68
Control			46.00	98.00	4.78	5.07

Germination time (Gt): expressed by hours, Germination percent (G %): by percent out of total number of seeds, Radical length (Rl) and Plumule length (PL): by centimeters. 10%, 20% and 30% represents concentration of extract in the test solution.

Table.8 Effect of decomposition period on the Phytotoxicity Dynamics of Parthenium Root extract against Tomato before and, after aerobic and anaerobic decomposition

Dec.period	Conc.	Dfl	Dfr	NL	NIL	Nfl	Nfr	SL	RL	FrW	DBM
1st day	10%	94.8	106.0	105.3	12.8	24.5	14.5	77.91	6.27	2.48	0.93
	20%	95.7	107.7	96.8	15.3	22.1	13.1	74.33	5.78	2.27	0.85
	30%	98.7	111.7	92.9	16.4	20.2	12.0	72.99	5.28	2.08	0.78
After anaerobic decomposition											
10th day	**10%**	**91.6**	**104.2**	**99.6**	**16.1**	**23.0**	**13.4**	**89.30**	**7.13**	**2.16**	**0.82**
	20%	94.0	107.2	99.0	16.2	23.0	13.4	89.02	6.58	2.14	0.82
	30%	96.0	109.1	96.1	16.3	22.9	13.4	87.36	5.82	2.10	0.80
20th day	10%	89.3	102.4	112.0	12.6	25.6	16.2	93.52	7.55	2.60	1.07
	20%	89.5	103.0	109.9	12.8	25.4	16.1	90.99	7.51	2.58	0.97
	30%	94.0	107.2	99.00	16.2	23.0	13.4	89.02	6.58	2.14	0.82
30th day	10%	87.6	100.7	114.0	12.4	25.6	16.3	95.45	7.74	2.61	1.12
	20%	89.1	102.2	107.3	15.0	24.6	15.2	92.87	7.64	2.43	0.98
	30%	91.00	103.6	101.3	16.1	23.1	13.6	91.00	7.51	2.18	0.94
After aerobic decomposition											
10th day	**10%**	**90.1**	**101.6**	**101.9**	**15.5**	**25.9**	**14.0**	**91.49**	**7.13**	**2.26**	**0.97**
	20%	93.1	103.9	101.4	15.8	24.9	13.9	91.04	6.48	2.26	0.95
	30%	94.1	105.5	98.7	15.9	25.0	13.8	89.36	5.92	2.21	0.92
20th day	10%	86.0	97	116.2	12.2	29.1	16.7	95.66	7.66	2.69	1.16
	20%	88.3	100.3	113.3	12.7	27.9	16.6	93.14	7.55	2.67	1.15
	30%	90.3	102.0	112.1	12.9	27.7	16.6	92.57	7.31	2.66	1.14
30th day	10%	83.9	96.7	118.1	12.1	29.6	16.8	97.86	7.82	2.79	1.17
	20%	87.6	99.7	110.8	14.7	27.3	15.7	95.18	7.70	2.59	1.09
	30%	89.3	100.4	103.2	15.9	25.8	14.1	92.99	7.68	2.26	0.99
Control		78.7	89.7	123.5	11.1	30.8	18.5	99.84	7.92	3.01	1.18

During decomposition process the EC values obtained with leaves were always higher than the other plant organ. Laboratory bioassay result such as, germination rate, germination percent, radcle length and plumule length and green house experiment result such as, days of flowering, days of fruiting, number of leave, number of injured leave, number of flower, number of fruits, stem length, root length, fruit weight and dry biomass of the tested plant was significantly affected by aqueous extract of parthenium root, stem, leave and fruit/heads of flower as compared to the control. This is also suggested by some researchers on the inhibition of seed germination, and seedling and plant growth both in the laboratory and under field conditions in a variety of plant species (Tefera, 2002; Regina *et al.,* 2007).

The degree of inhibition was different depending on the plant functional parts (root, stem, leave and fruits/heads of flower), extract concentration (10%, 20%, and 30%), decomposition period (before decomposition and after 10, 20 and 30 days of decomposition period) and decomposition condition (aerobic and anaerobic decomposition) of parthenium. For instance, plant functional part showed very different dynamics of phytotoxicity during the decomposition processes. The highest phytotoxicity was observed at early stage of decomposion which was decreased gradually after 10, 20 and 30 days of decomposition period. Parthenium tissue was highly phytotoxic when compared to roots. Roots showed relatively less phytotoxicity than the rest of plant functional parts. This study showed similar result with Rice and others. They suggested that, leaf tissues produced greater phytotoxicity than roots, which always showed very low initial phytotoxic levels in relation to plant organs (Tefera, 2002; Regina *et al.,* 2007).

Aerobic and anaerobic decomposition conditions showed differences in phytotoxicity. However, L. sativum and tomato was significantly affected by the decomposition conditions and decomposition periods of parthenium. It seems clear that anaerobic conditions do affect tested plant by the persistence of phytotoxic compounds derived from the decomposition of any plant functional part. This durable 'phytotoxic stress' can likely interact with other stresses of anoxic environments, such as oxygen deficit, and the presence of inorganic toxic compounds, e.g. acid sulphite, ferric and nitrite ions. Conversely, aerobic condition generates a more complex and dynamic phytotoxic compounds where the microbial decomposition changes the phytotoxicity levels with their initial increase and subsequent decrease during the processes. This result demonstrates the presence of phytotoxic compounds that decrease during the decomposition processes. It is also suggested by researchers on the factors affecting the decomposition rates and the related dynamics of nutrients according to environmental conditions (Gholz *et al.,* 2000).

Inhibition of Lepidium and tomato was also significantly affected by the period of decomposition of parthenium. The extract used before decomposition was highly phytotoxic for both L. sativum and tomato. However, in aerobic conditions phytotoxicity progressively decreased during decomposition of all plant parts such as root, stem, leave and fruit/heads of flower of parthenium. Undecomposed tissue extracts were slightly more phytotoxic and their phytotoxicity decreased more slowly than that of roots. This was evident at the initial stage of the decomposition process. Phytotoxicity was also depends on the concentration of aqueous extract of parthenium. In all functional parts of the plant, an increase in extract concentration caused proportionally increased inhibition of all agronomic parameters. In contrast, when conditions were anaerobic, toxicity remained very high for concentrated extracts of all functional parts of plant, and decreased for lower extract concentrations during decomposition for roots. However, in anaerobic conditions phytotoxicity were high for all functional parts of plant reaching comparable levels.

In conclusion, the decomposition periods were a significant effect on the phytotoxicity dynamics of parthanium. Its phytotoxicity was higher at the start of decomposition period and decreased gradually by decomposition process. That mean, the parthenium release much more phytotoxic compound before decomposition. But after 10, 20 and 30 days of decomposition period it is reduced gradually by decomposition process. Generally this study suggested that the phytotoxic effect of parthenium was different in different decomposition period, decomposition conditions, plant organ and concentrations. It is higher before decomposition than anaerobic decomposition, after anaerobic decomposition than aerobic decomposition, concentrated extract than diluted extract, plant tissue (fruit/heads of flower, leave and stem) than roots.

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