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Potential of Kirinyuh Leaf Extract (Chromolaena odorata L) in Controlling Ajeran Weed (Bidens Pilosa L) and Eleusine Indica L

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ABSTRACT

Kirinyuh (Chromolaena odorata L.) It contains tannins, steroids, phenols, and other compounds that can inhibit the growth of other plants around it, so it can be used as a vegetable herbicide. This study aims to determine the concentration of kirinyuh leaf extract that is effective in controlling ajeran weed (Bidens pilosa L.) and bone grass (Eleusine indica L.) research was conducted in the experimental garden of the Faculty of Agriculture, Siliwangi University. This study uses a group random design (RAK) with 5 replicates. The treatment consisted of 0%, 10%, 20%, 30%, and 40% kirinyuh leaf extract concentrations. The results showed that the concentration treatment of kirinyuh leaf extract was effective in suppressing the growth of ajeran weed (Bidens pilosa L.) and bone grass (Eleusine indica L.)

Introduction

Plants are considered weeds if they grow in places where their presence is not desired by humans and are consumptive to growing, competitive, and invasive factors. Weeds exist because of the presence of weed seeds that become seeds in the soil, when the situation is in accordance with the nature of weed growth, then the dormant weed seeds will grow on their own.

(Definiati, Sahputra, & Setyowati, 2023) stated that weeds can reduce crop yields indirectly because they act as substitute hosts for insect pests, nematodes, and pathogens that cause plant diseases including bacteria, fungi, and viruses. The detrimental effect of weeds on cultivated plants can also occur directly through allelopathy and competition for limited water, nutrients, and light. According to (Muhammd, Ashiq, Gaffar, Sattar, & Arshad, 2012), the existence of weeds is not only detrimental in terms of productivity, but the worse impact is that plants die because weeds have chemical compounds called allelopathy.

Ajeran weed (Bidens pilosa L.) and bone grass (Eleusine indica L.) are weeds that are often found in cultivated crops, these weeds usually grow among bushes, plantation areas, roadsides or vacant land that is not maintained (Rodino, Butu, Fidler, Marin, & Butu, 2017), therefore they are often the dominant weeds that are difficult to control.

Various ways of weed control have been carried out, including weed control using synthetic herbicides. The use of synthetic herbicides is carried out because it has the ability to inhibit growth and kill weeds quickly, in addition to synthetic herbicides are more practical to use. According to (Soltys, Krasuska, Bogatek, & Gniazdowska, 2013) the use of synthetic hebicide is not appropriate in the long term, such as the type of synthetic herbicide that is not suitable for the type of weed, the application time that is not in accordance with the growth phase of weeds and the weather, causes the accumulation of active compounds in the soil and can cause weed resistance, therefore it is felt necessary to find alternative materials as a substitute for synthetic herbicides.

Weed control can be done in an environmentally friendly manner to produce safer agricultural products, namely by using plant-based herbicides. Junaedi, Chozin, and Ho kim (2006) proposed that one of the secondary metabolites that can be used as a plant-based herbicide is an allelopathic compound. Alelopathic compounds are secondary metabolite compounds that directly or indirectly affect one plant to another, including microorganisms either positive or stimulating, or negative or inhibiting growth. (Rodino et al., 2017) also explained that plants contain many chemical compounds of secondary metabolites, these compounds are used by plants as a defense tool from the attack of disruptive organisms. The content of these compounds has the potential to be used as a substitute for synthetic herbicides.

One of the plants that has the potential to be used as a plant-based herbicide is kirinyuh (Chromolaena odorata L.). The plant is a very fast-growing weed, because each individual can produce a large number of seeds. The Department of Natural Resources, Mines and Water (2006) reported that one adult kirinyuh plant is able to produce 80 thousand seeds per season. These weed seeds are easily spread to other areas through the intermediary of humans, animals, and wind. In addition to its rapid growth, kirinyuh causes reduced grazing capacity, poisoning, and can cause fire hazards in the dry season.

(Vaisakh & Pandey, 2012) stated that kirinyuh is a plant that contains tannins, steroids, phenols, and other compounds that are suspected to be used as vegetable herbicides. In addition, it contains flavonoids 4', 5-dihydroxy-3,7-dimethoxy flavones. Flavonoid content is found in all parts of plants, namely in roots, stems, and leaves (Che Man, 2010). Furthermore, according to (Akinmoladun, Ibukun, Afor, Obuotor, & Farombi, 2007) Kirinyuh is able to produce several alkaloid compounds, saponins, tannins, coumarinic acid, anthracquinone, terpenoids, flavonoids, flavonoids, p-hydroxy benzoate, and cardiocide glucosides and compounds – these compounds have the potential to inhibit plant growth. According to Gultom, Sulistiarini, and Sakinah (2020) based on the results of chromatographic fraction screening, the compounds contained in young leaves of Kirinyuh are dominated by flavonoid compounds, while in old leaves there are 3 compounds, namely flavonoids, steroids, and phenols. The difference in the number of bioactive compounds in young and old leaves is due to the fact that old leaves have a greater ability to synthesize bioactive compounds. Phenolic compounds and terpenoids are the two main groups of compounds involved in allelopathy. Phenolic compounds are synthesized by plants through the shikimat pathway, while terpenoids are

synthesized by the mevalonic acid pathway. Phenolic is a chemical compound composed of hydroxyl (-OH) that is directly bound to an aromatic hydrocarbon ring. Phenolic compounds that are classified as allelopathic are derivatives of cinnamic acid, benzoic acid, kumaranic acid, tannins, complex polyphenols, and certain flavonoids. Each of these compound derivatives shows a similar mechanism of action in inhibiting target growth (Ziadaturrif'ah, Darmanti, & Budihastuti, 2019).

Several experiments have been carried out that show the potential of kirinyuh as a plant-based herbicide. (Kadapi et al., 2021) based on the results of their research on the germidarnation and growth response of jawan grass weed (Echinochloa cruss-galli) with the administration of kirinyuh extract stated that kirinyuh leaf and root extracts with a concentration of 200 g/L, can inhibit the time and percentage of germination, as well as inhibit the growth of the height and length of jawan grass roots, while at a concentration of 100 g/L from kirinyuh leaf extract causes the percentage of death of jawan grass tall. Muzaiyanah (2014) reported that the administration of kirinyuh leaf extract with a concentration of 40% was able to suppress the growth of purslane (Portulaca oleraceae). According to (Kertagosa, Hardiastuti, & Rizal-Az, 2023) The concentration of 40% kirinyuh extract on vegetative growth stadia is more effective than that of generative growth stadia in inhibiting the growth of spinach (Amaranthus spinosus) (Frastika, Pitopang, & Suwastika, 2017) reported the results of an experiment of kirinyuh leaf extract as a vegetable herbicide against mung bean seeds and putri malu seeds (Mimosa invisa), showing that the administration of kirinyuh extract did not inhibit the germination of mung bean seeds, But inhibiting the germination of Putri Malu seeds to reduce the percentage of germination.

In an effort to find compounds that are useful as vegetable herbicides for other types of weeds, it is necessary to study the effect of kirinyuh leaf extract on the inhibition of weed growth of Ajeran weed (Bidens pilosa L.) and bone grass (Eleusine indica L.). The purpose of this study is to test kirinyuh leaf extract as a vegetable herbicide in inhibiting the growth of ajeran weed (Bidens pilosa L.), and bone grass (Eleusine indica L.), aiming to obtain an effective concentration of kirinyuh leaf extract.

Method

This experiment was carried out at the Experimental Garden of the Faculty of Agriculture, Siliwangi University, Mugarsari District, Tamansari District, Tasikmalaya City with an altitude of 374 meters above sea level.

The instruments used for experiments in the laboratory include: blenders, digital scales, ovens, seed dryers, measuring cups, and rotary evaporators. The tools used for experiments in the field consisted of agricultural tools, stationery, hygrometers and chlorophyll meters. The material used in the experiment was the seed of ajeran (Bidens pilosa L.) and bone grass seeds (Eleusine indica L.), 96% ethanol solvents, aquades and kirinyuh leaves.

This experimental research method uses a group randomized design (RAK) with five treatments and is repeated five times. The treatment is as follows:

A = 0% Kirinyuh leaf methanol extract
B = Methanol extract of kirinyuh leaves 10%
C = Methanol extract of kirinyuh leaves 20%
D = Methanol extract of kirinyuh leaves 30%
E = Methanol extract of kirinyuh leaf 40%
Preparation of kirinyuh leaf extract

Kirinyuh leaf extract is made using the maceration extraction method in the following way:

Kirinyuh leaves are washed with running water until clean then dried in the oven at a temperature of 500 C for 24 hours. Drykirinyuh is mashed using a blender and sifted, 250 g of finely refined kirinyuh leaf powder is dissolved in 2.5 liters of 96% ethanol. and maceration for 6 hours then the next maceration for 4 hours. Next, the solution is filtered using filter paper. Then a separation was carried out between the solvent and the active compound extracted using a rotary evaporator, so that a viscous extract was obtained. The thick extract of kirinyuh leaves was sprayed according to the treatment level with

Planting

Seeds of ajeran (Bidens pilosa L.) and bone grass seeds (Eleusine indica L.) are planted in a polybag measuring 20 cm x 20 cm which contains planting medium in the form of a layer of top soil that has beensifted so that it is smooth and clean, Furthermore, at the age of 35 days after planting (HST) it is rare to get a uniform plant.

The treatment was carried out by spraying kirinyuh leaf extract with a concentration according to the treatment, namely 0%, 10%, 20%, 30%, and 40% as much as 10 ml per plant. The treatment began at 35 days after planting (HST) with an interval of 3 days to 47 days after planting (HST).

Observation Variables

To find out the effect of treatment, observations were made at the age of 50 HST plants on the following variables;

1. Symptoms of Poisoning
2. Plant height
3. Number of leaves
4. Leaf area
5. Amount of chlorophyll
6. Root length
7. Wet and dry weight

Results and Discussion

Symptoms of poisoning

Symptoms of poisoning caused by the administration of Kirinyuh leaf extract against Ajeran weed (Bidens pilosa L.) and bone grass (Eleusine indica L.) are not permanent or only temporary wilting, because the next day the leaves are fresh again. Riskitavani and Kristanti (2013) explained that wilting in plants is caused by the administration of extracts that act as vegetable herbicides. The allelochemical content will

accumulate in the cell and is toxic which can make the cells inelastic and inhibit the transport of dissolved ions through the cell membrane. Furthermore, after the leaves experience wilting, along with the growth period, the part of the leaf that has absorbed allelochemical compounds becomes dry. Dry leaves will inhibit the photosynthesis process, so leaf growth is not perfect. The part of the leaf that experiences brownish dry symptoms can be seen starting from the smallest leaf on the lower stem. Leaves on the shoots are less symptomatic. Suwarto, Octavianty, and Hermawati (2014) explained that damage to plant tissues caused by vegetable herbicides begins with yellow patches on leaf blades. The spots are parallel to the vascular bundles in severe condition, the spots fuse into one, so that the entire surface of the leaf becomes yellow. In very severe conditions, the leaves experience necrosis or tissue death. This makes the leaves fall off, so that the photosynthesis process is inhibited which eventually the weeds will die.

Plant height

Based on the results of statistical analysis, it was shown that the treatment of 10%, 20%, 30%, and 40% concentrations of kirinyuh leaf extract had an effect on the height of ajeran weed (Bidens pilosa L.), and bone grass (Eleusine indica L.). Data from the analysis of the effect of the concentration of kirinyuh leaf extract on the height of the ajeran plant can be seen in Table 1.

Table 1
Effect of kirinyuh leaf extract on plant height

Concentration of kirinyuh leaf extract (%)	Plant height (cm)	
	Ajeran	Grass Bone
0	21.88c	22.16 c
10	20.28 BC	21.64 BC
20	19.63ab	21.05 b
30	19.21ab	20.68 b
40	18,21 A	18.77 A

Remarks: numbers followed by the same letter are different from each other according to the Duncan Multiple Distance Test at a real level of 5%.

In Table 1. It can be seen that the high growth of ajeran weed (Bidens pilosa L.) and bone grass (Eleusine indica L.) is highest at a concentration of 0%, while the concentration of kirinyuh leaf extract that is most effective in inhibiting the tall growth of ajeran plants is a concentration of 40%. The analysis data showed that at the height of ajeran weed (Bidens pilosa L.), and bone grass (Eleusine indica L.) the concentration of 0% was not significantly different from the concentration of 10%, but was significantly different from the concentration of 20%, 30%, and 40%. It is suspected that at high concentrations of allelopathic compounds contained in kirinyuh leaf extract are absorbed, so that ajeran weeds (Bidens pilosa L.) and bone grass (Eleusine indica L.) are poisoned by allelopat compounds. The poisoning results in disrupted physiological processes and stunts growth. At a concentration of 10% there is no real difference with a concentration

of 20% and 30%, but there is a real difference with a concentration of 40%. This shows that the higher the concentration of kirinyuh leaf extract given, the more ajeran weed (Bidens pilosa L.), and bone grass (Eleusine indica L.) will be inhibited.

Plant height is inhibited, because the allelopathic compounds from the absorbed kirinyuh leaf extract, will damage the reactions of ATP and protein formation. Diana et al. (2015) stated that allelochemical compounds in vegetable herbicides inhibit the formation of nucleic acids, proteins, and ATP. A reduced amount of ATP will suppress the entire cellular metabolic process, so that the synthesis of other substances needed by plants does not occur.

Pebriani, Riza, and Mukarlina (2013) explained that some allelochemical compounds that can inhibit cell division are terpenoids, flavonoids, and phenolic compounds. These compounds result in inhibition of the synthesis of ketoglutaric acid, which is a precursor of amino acids, proteins, and ATP in plants, resulting in disruption of cell division and enlargement.

According to (Hambali, Purba, & Kardhinata, 2015), the mechanism of inhibition of plant height is caused by alleocymal compounds in the form of phenols starting from the inhibition of cell membranes, so that the process of water diffusion into plants is inhibited which causes the absorption of nitrogen (N), magnesium (Mg), iron (Fe), manganese (Mn), copper (Cu), zinc (Zn) inhibition. This results in inhibition of amino acid transport and causes inhibition of IAA synthesis which inhibits plant tall growth. Phenolic compounds that include allelochemical compounds in kirinyuh leaf extract are able to inhibit the entry of CO2 into the stomata in the photosynthesis process.

The results of the research that have been carried out are in line with the results of research conducted by (Alridiwirsah et al., 2020) regarding the administration of kirinyuh extract to jawan grass (Echinochloa crussgalli) which showed that the height of jawan grass measured for four weeks decreased at concentrations of 50 g/L, 100 g/L, 150 g/L, and 200 g/L. Javan grass that was not given kirinyuh extract, The height does not experience obstacles. The higher the concentration of kirinyuh leaf and root extracts, the higher the inhibition against the weed height of jawan grass.

Number of leaves

Based on the results of statistical analysis, it was shown that the concentration treatment of 10%, 20%, 30%, and 40% kirinyuh leaf extract had an effect on the number of leaves of ajeran weed (Bidens pilosa L.) and bone grass (Eleusine indica L.). Data from the analysis of the effect of the concentration of kirinyuh leaf extract on the number of leaves of ajeran weed (Bidens pilosa L.) and bone grass (Eleusine indica L.) can be seen in Table 2.

Table 2
Effect of kirinyuh leaf extract on the number of leaves

Concentration of kirinyuh leaf extract (%)	Number of leaves	
	Ajeran	Grass Bone
0	10.26 c	3.87 c

10	6.73 b	3.52 b
20	6.13 ab	3.34 ba
30	5.53 ab	3.15 A
40	4.46 A	3.11 A

Remarks: numbers followed by the same letter are different from each other according to the Duncan Multiple Distance Test at a real level of 5%.

In the results of the analysis of the number of leaves of ajeran weed (Bidens pilosa L.), and bone grass (Eleusine indica L.), the concentration of 0% was significantly different from the concentration of 10%, 20%, 30%, and 40%. It is suspected that the phenol compounds contained in kirinyuh leaf extract are absorbed by the leaves and inhibit the photosynthesis process. Photosynthesis is the process of entering CO2 into the stomata. Gassa (2011) stated that kirinyuh leaves have bioactive compounds in the form of phenols that are able to damage the chlorophyll structure in the leaves, so that they can inhibit the absorption of light needed during photosynthesis. The higher the concentration of kirinyuh leaf extract, the more effective it will be in inhibiting the growth of ajeran plants.

Ziadaturrifah et al. (2019) explained that growth inhibition such as the number of leaves caused by the administration of vegetable herbicide extracts, the content of allelochemical compounds in it, namely phenol compounds entering through the plasma membrane. This causes protein binding to form complex proteins, so that cells experience membrane poisoning and depolarization. Therefore, the activation of plant hormones such as auxin hormone, which plays a role in cell elongation, and cytokinin hormones, which play a role in cell division and expansion, are disrupted.

According to Ardianus (2012) the increase in the number of leaves will increase the capacity of photosynthesis, because with the increase in the number of leaves, the area of light absorption for photosynthesis will also increase. However, the growth hormone in the weeds (Bidens pilosaL), teki (Cyperus iria L.), and bone grass (Eleusine indica L.) that are disturbed make the plant unable to grow properly, as a result of which the formation of leaves is inhibited. In addition, the symptoms of damage that occur on the leaves cause ajeran weeds (Bidens pilosaL), teki (Cyperus iria L.), and bone grass (Eleusine indica L.) to not be able to carry out the photosynthesis process perfectly. The number of leaves is reduced due to damage caused by allelochemical compounds contained in kirinyuh leaf extract, causing the area of light absorption to carry out photosynthesis is reduced.

The results of the research that have been carried out are in line with research conducted by Ziadaturrifah (2019) regarding the potential for allelopathy of kirinyuh leaf extract. The results of the study showed that there was an inhibition of the number of leaves due to allelochemical stress, resulting in disruption of cell division and division. The higher the concentration of kirinyuh leaf extract from 10% to 40%, the stronger the inhibition.

Leaf area

Based on the results of statistical analysis, it was shown that the concentration treatment of 10%, 20%, 30%, and 40% kirinyuh leaf extract had an effect on the leaf area of ajeran weed (Bidens pilosa L.), and bone grass (Eleusine indica L.). Data from the analysis of the effect of the concentration of kirinyuh leaf extract on the leaf area of ajeran weed (Bidens pilosaL), and bone grass (Eleusine indica L.) can be seen in Table 3.

Table 3
Effect of kirinyuh leaf extract on leaf area

Concentration of kirinyuh leaf extract (%)	Leaf area (^{cm2})	
	Ajeran	Grass Bone
0	26.12 b	10.08 c
10	23.66 b	9.50 cb
20	24.69 b	8.84 m
30	20.65 ab	8.42 A
40	15.51 A	8.09 A

Remarks: Numbers followed by the same letter are not real according to the Duncan Multiple Distance Test at a real level of 5%.

In Table 3. It can be seen that the leaf area of ajeran weed (Bidens pilosa L.), and belulang grass (Eleusine indica L.) is highest at a concentration of 0%, while the concentration of kirinyuh leaf extract that is most effective in inhibiting leaf area is a concentration of 40%. This can be seen in the results of the analysis data which showed that the administration of kirinyuh leaf extract to ajeran weed (Bidens pilosa L.), teki (Cyperus iria L.), and bone grass (Eleusine indica L.) at a concentration of 0% was significantly different from the concentration of 30% and 40%, but not significantly different from the concentration of 10% and 20%. Although the concentration of 0% is not significantly different from the concentration of 10% and 20%, but when viewed from the leaf area data obtained, a high concentration further inhibits the leaf area. It can be said that the higher the concentration of kirinyuh leaf extract, the higher the inhibition of the leaf area.

Inhibition of leaf area occurs, due to allelopathic compounds reducing the opening of stomata, decreasing the ability of photosynthesis, inhibition of the respiration process, inhibition of water and nutrient absorption. The stomata open if the guard cells take in water during the day, thus allowing the entry of CO2 necessary for photosynthesis. Stomata also serve for gas exchange in the atmosphere.

Allelopathic compounds affect leaf area. The area of the leaf affects the rate of photosynthesis, because the leaf is a plant organ where photosynthesis takes place. Photosynthesis is the process of forming energy in the form of ATP which is used for plant growth. Photosynthesis begins when light ionizes chlorophyll molecules in

photosystem II thereby releasing electrons to be transferred towards the electron transfer chain. The energy from these electrons makes photosystem II experience a lack of electrons. The electron deficiency can result from water ionization that occurs in conjunction with chlorophyll ionization. Chlorophyll is related to leaves, the wider and more leaves that grow, the wider the photosynthesis process and produces energy.

The results of the research that have been carried out are in line with the results of the research of (Kertagosa et al., 2023) who conducted an experiment on the use of kirinyuh extract on different growth stadia as a bioherbicide to control spinach. The results of the experiment showed that the administration of kirinyuh extract inhibited the growth of spinach leaves at a concentration of 40%.

Amount of chlorophyll

Based on the results of statistical analysis, it was shown that the concentration treatment of 10%, 20%, 30%, and 40% kirinyuh leaf extract had an effect on the chlorophyll amount of ajeran weed leaves (Bidens pilosa L.), and bone grass (Eleusine indica L.). Data from the analysis of the effect of kirinyuh leaf extract concentration on the amount of leaf chlorophyll can be seen in Table 4.

Table 4
Effect of kirinyuh leaf extract on chlorophyll amount

Concentration of kirinyuh leaf extract (%)	Amount of chlorophyll	
	Ajeran	Grass Bone
0	23.53 b	19.70 c
10	20.16 ab	19.55 b
20	18,17 A	17.73 ba
30	20.25 ab	17,33 A
40	16.69 A	16.90 A

In Table 4. It can be seen that the amount of chlorophyll in the leaves is highest at a concentration of 0%, while the concentration of kirinyuh leaf extract is the most effective in inhibiting the chlorophyll amount of the leaves of ajeran weed (Bidens pilosa L.) and bone grass (Eleusine indica L.) is a concentration of 40%. This can be seen from the results of the analysis data showing that the amount of chlorophyll at the 0% concentration looks significantly different from the 20% and 40% concentrations, but does not differ significantly from the 10% and 30% concentrations, and. The decrease in the amount of chlorophyll contained in the leaves is due to the inhibition of chlorophyll synthesis by allelochemistry from kirinyuh leaf extract.

Ziadaturrifiah et al. (2019) stated that the decrease in photosynthetic pigment levels in weeds is caused by allelochemical compounds that can damage the permeability of the membrane. This has an impact on other organelles that are in the mitochondrial cell membrane, vacuoles, and chloroplasts. When chloroplast activity is inhibited, it will affect the carretenoids and chlorophyll of green substances (leaf color).

According to Li et al. (2010) and Sharma et al. (2012), allelochemical compounds are responded to by plants by synthesizing free radicals or Reactive Oxygen species (ROS) in excess amounts. Excess free radicals can cause oxidative stress in the form of changes in cell membrane permeability, so that it can interfere with the absorption of water and dissolved nutrients. Apart from this, the decrease in chlorophyll due to the administration of kirinyuh leaf extract to the ajeran plant is caused by an increase in chlorophyll degrading enzymes and a decrease in the activity of enzymes that act on chlorophyll synthesis reactions.

Plants in synthesizing chlorophyll are affected by genetic factors, light, water, temperature, and nutrients such as nitrogen (N), magnesium (Mg), iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), sulfur (S), and oxygen (O). In plants, nitrogen nutrients will be converted by the enzyme glutamate synthetase to glutamic acid and glutamic acid is used in chlorophyll biosynthesis.

The impact of the decrease in the amount of chlorophyll due to chlorophyll damage, the leaves of the ajeran plant initially turned green and turned brown. This is a symptom of chlorosis. Chlorosis is a disease that occurs due to the destruction of color pigments (chlorophyll), causing color changes. In some events, the symptoms of chlorosis precede the events of necrosis symptoms. Necrosis is a symptom that occurs due to the physiological activity of pathogens that cause damage to plant cells, which is in the form of local tissue death that is clearly visible in brown or black color (Moralita, 2016).

The reduction of chlorophyll content in the treatment of kirinyuh leaf extract is in line with the research of (Ziadaturrif'ah et al., 2019) on the effect of kirinyuh allelochemicals on soybean vegetative growth. Kirinyuh extract had the effect of reducing the total chlorophyll content, but did not affect the kartenoid content of soybean leaves. The decrease in chlorophyll content occurred at concentrations of 40%, 60%, and 80%, while at a concentration of 20% there was no real difference when compared to a concentration of 0%. The higher the treatment concentration, the lower the total chlorophyll and carotenoid content.

Root length

Based on the results of statistical analysis, it was shown that the concentration treatment of 10%, 20%, 30%, and 40% kirinyuh leaf extract had an effect on the root length of ajeran weed (Bidens pilosa L.) and bone grass (Eleusine indica L.). Data from the analysis of the effect of the concentration of kirinyuh leaf extract on the root length of the ajeran plant can be seen in Table 5.

Table 5
Effect of kirinyuh leaf extract on root length

Concentration of kirinyuh leaf extract (%)	Root length (cm)	
	Ajeran	Grass Bone
0	16.38 c	12,28 A
10	14.12 BC	11.68 A

20	12.98 b	11.58 A
30	11.84 ab	10,10 A
40	9.39 A	10.92 A

Caption: numbers followed by the same letter are not real according to the Duncan Double Distance Test at a real level of 5%.

In Table 5. It can be seen that the root length of the ajeran plant is highest at a concentration of 0%, while the concentration of kirinyuh leaf extract that is most effective in inhibiting the root length of ajeran weed (Bidens pilosa L.) and bone grass (Eleusine indica L.) is a concentration of 40%. The results of statistical analysis can be seen that at 0% concentration there is no real difference from 10% concentration, but it is significantly different from 20%, 30%, and 40% concentrations. At a concentration of 10%, there is no real difference with a concentration of 20% and 30%, but it is significantly different from a concentration of 40%. The results of the analysis showed that there was a difference in root length between plants that were not given kirinyuh leaf extract and plants that were given kirinyuh extract. When viewed from the data of the analysis results, it can be said that the higher the concentration of kirinyuh leaf extract given, the longer the growth of the roots of the ajeran plant will be inhibited.

According to Ismani (2015), the mechanism of inhibition of root elongation through allelochemicals, namely phenol, can inhibit the division of plant root cells, reduce the permeability of cell membranes, inhibit enzyme activity, and cause damage to the hormones indole-3 acetic acid (IAA) and gibberellin. Phenol compounds and their derivatives can also increase the decarboxylation of IAA, so that IAA becomes inactive and root growth becomes inhibited.

The concentration of allelochemicals present in the soil determines the occurrence of weed growth disorders. After allelochemicals are released into the environment, there will generally be interactions between allelochemicals and soil biotic and abiotic factors such as leaching, physical and chemical processes, breakdown by microbes and absorption by plants that can reduce the concentration of allelochemicals in the soil. In soil, phenolic compounds are found in both free and bound forms (De Albuquerque, 2011).

According to Gomes et al. (2017) stated that allelochemistry causes a decrease in root activity in absorbing nutrients, so that the photosynthesis process is disrupted. Root cells have a cell membrane structure composed of phospholipid bilayers, proteins, and carbohydrates. Allelochemical compounds, especially phenols, will adhere to the lipids that make up the cell membrane. This will cause fat solubility to decrease, resulting in damage to the cell membrane. Therefore, it has an impact on organelles in cells, namely mitochondria, chloroplasts, and vacuoles. Inhibition of the electron transport chain in mitochondria and chloroplasts will eliminate the cell's energy sources in the form of NADPH, FAD and ATP, metabolic products, and also produce ROS (Zhou dan Yu, 2006; Shannon-Firestone and Firestone, 2015).

At the molecular level, Li et al. (2010) stated that phenol compounds can increase the permeability of cell membranes which causes cell contents to spill and increase lipid peroxidation, so that plants experience slow growth or tissue death. The inhibition that occurs is not only in germination but also in growth. This is evidenced by the inhibition of the increase in the root length of ajeran weed (Bidens pilosa L.) and bone grass (Eleusine indica L.). Iilori et al. (2011) stated that kirinyuh extract reduced the root length of the test plant. The results of the research that have been carried out are in line with the research conducted by (Alridiwirsah et al., 2020) regarding the administration of kirinyuh extract to jawan grass (Echinochloa cruss-galli). In the results of the study, kirinyuh extract was able to inhibit high growth, root length, and high percentage of weed death. The concentration of 50 g/L of kirinyuh root extract was able to inhibit root growth significantly.

Wet and dry weight

Based on the results of statistical analysis, it was shown that the concentration treatment of 10%, 20%, 30%, and 40% kirinyuh leaf extract had an effect on the wet and dry weight of ajeran weed (Bidens pilosa L.), and bone grass (Eleusine indica L.). Data from the analysis of the effect of kirinyuh leaf extract concentration on wet and dry weight of plants can be seen in Table 6.

Table 6
Effect of kirinyuh leaf extract on wet and dry weight

Concentration of kirinyuh leaf extract (%)	Wet and dry weight (g)			
	Ajeran		Grass Bone	
	Wet weight	Dry Weight	Wet weight	Dry Weight
0	3.09 b	0.58 b	2.92 c	0.55 c
10	2.37 ab	0.43 ab	2.76 cb	0.52 cb
20	2.22 ab	0.39 ab	2.50 cba	0.47 cb
30	1.91 A	0.32 A	2.46 ba	0.44 ba
40	1.49 A	0,25 A	2.22 A	0.39 A

Remarks: Numbers followed by the same letter are not real according to the Duncan Multiple Distance Test at a real level of 5%.

In Table 6. Above it can be seen that the wet and dry weight of ajeran weed (Bidens pilosa L.) and bone grass (Eleusine indica L.) is highest at a concentration of 0%, while the concentration of kirinyuh leaf extract that is most effective in reducing the wet and dry weight of plants is a concentration of 40%. This can be seen in the results of the analysis data which shows that in the treatment of 0% concentration of kirinyuh leaf extract is significantly different from the concentrations of 30% and 40%, but there is no significant difference with the concentrations of 10% and 20%. At a concentration of 10% there is no real difference with a concentration of 20%, 30%, and 40%. However, when viewed from the results of the observation of the wet and dry weight values of the ajeran

plant. The higher the concentration of kirinyuh leaf extract given, the lower the wet and dry weight value of the ajeran plant.

The mechanism of wet weight inhibition is caused by damage to the membrane structure by phenolic compounds in the cell membrane. Pebriani et al. (2013) explained that phenol compounds damage the phosphate group in the phospholipid cell membrane, so that the phospholipid molecule will decompose into glycerol, carboxylic acid, and phosphoric acid, this can cause the release of cell constituent substances and metabolites from the inside.

According to Weraduwage, Jin, and Thomas (2015) the fresh weight of plants can show the primary metabolic activity of plants and the value of fresh weight of plants is influenced by water content, nutrients and photosynthesis results. The effect of allelochemistry in reducing the weight value of fresh by decreasing the speed of water absorption and photosynthesis results.

According to Yulifrianti, Riza, and Irwan (2015) the inhibition of water absorption by phenol compounds causes the moisture content to be low as a result of the closure of the stomata, so that the photosynthesis process is inhibited. Alleleochemicals affect photosynthesis and plant growth by lowering the chlorophyll content. The decrease in the capacity of plants to accumulate chlorophyll, which is an important component in the photosynthesis process, can affect the decrease in fresh weight and dry weight of plants.

Mariana and Rahayu (2016) also said that the way allelopathy owned by weeds works is by inhibiting the absorption of nutrients from the environment and will affect abnormal plant growth. The existence of allelopathy will inhibit water absorption causing an obstacle to the photosynthesis process because water is the raw material for photosynthesis. In addition, the process of exchanging water, CO2, O2 in leaf stomata needed in metabolism is inhibited due to the impact of allelopathy from weed extracts, thus causing a decrease in wet weight and inhibited photosynthesis causing photocytositates to produce a little low dry weight. The allelopathic mechanism is able to reduce the chlorophyll content and the rate of photosynthesis.

The results of the research that have been carried out are in line with the results of research from Angraini, Fatonah, and Herman (2013) which showed that the administration of kirinyuh extract caused a significant decrease in the fresh weight of the Putri malu plant (Mikania micrantha) starting at a concentration of 5%. Furthermore, Irma, Afdal, and Soesartrijo., (2016) reported that the dry weight value of jajagoan grass weed (Axonopus compressus) decreased after the administration of kirinyuh extract at a concentration of 3%.

Conclusion

Based on the results of the study, the following conclusions can be drawn:

1. Treatment of kirinyuh leaf extract (Chromolaena odorata) had an effect on the growth of weeds Ajeran weed (Bidens pilosa L.) and bone grass (Eleusine indica L.).

2. The concentration of kirinyuh leaf extract (Chromolaena odorata) 40% has the potential to control Ajeran weed (Bidens pilosa L.), teki (Cyperus iria L.), and bone grass (Eleusine indica L.).

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