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Allelopathic effects of *Oldeania alpina* (K. Schum.) Stapleton leaf aqueous extract on seed germination and initial seedling growth of two selected crops

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ABSTRACT

Empirical evidence indicates that allelopathic chemicals produced by perennials plants result in a positive or negative change in the germination, growth, and behaviour of other plants growing in close association. This study aimed to investigate the allelopathic effects of *Oldeania alpina* leaf aqueous extract on germination and initial growth of barley (*Hordeum vulgare* L.) and wheat (*Triticum aestivum* L.) test crops under laboratory conditions. Four different solvents (i.e., hexane, ethyl acetate, methanol, and water) were used to prepare *O. alpina* leaf extracts. Then, the extracts were subjected to qualitative analysis to identify the presence of allelochemical compounds namely; flavonoids, phenols, tannins, terpenoids, steroids, quinones, coumarins, saponins, and, anthraquinones. Aqueous extract concentrations (i.e., 0 %, 2.5 %, 5 %, 7.5 %, and 10 %) were used to irrigate seeds of test crops using a completely randomized design. The analysis revealed that better germination percentage, speed, and time for both wheat and barley were observed at control while reduced as the concentration of the extract increased up to 10 %. Higher mean shoot growth for wheat (105.2 ± 14.6 mm) and for barley (94.3 ± 30.9 mm) were obtained for the control treatment. A similar trend was observed for root lengths of wheat (104.0 ± 12.4 mm) and barley (65.9 ± 18.4 mm). The mean values decreased for each of the studied parameters as the concentration of the extract increased. Except for anthraquinones, all tested allelochemicals in extracts inhibited germination and initial growth of barley and wheat crops. This implies that planting wheat and barley close to *O. alpina* may require field-level investigation.

1. Introduction

Allelopathy studies interactions among plants, fungi, algae, and bacteria with the organisms living in a certain ecosystem (Macias et al., 2017). These interactions are mediated by the bioactive secondary metabolites so-called allelochemical compounds. The major known allelochemicals found in plant tissue are flavonoids, tannins, saponins, Alkaloids, phenols, coumarins, and quinones compounds (Reigosa et al., 2006). The allelochemical compounds in plant tissue can influence the survival, and reproduction of other plants if they escape into the environment through leaching, volatilization, and root exudation (Chon and Jerry Nelson, 2012; Madhan Shankar et al., 2014; Ben Ghnaya et al., 2016). The death and decomposition of the fallen plant residues can also release allelochemicals through either organic phenomenon or abiotic means (Macías et al., 2020).

The study of allelopathy was more feasible when residues of allelopathy plants were extracted and applied to the growth of the test crops (Zhang et al., 2021). Extraction involves the separation of selected portions of chemicals from plant tissues of the inactive or intact components by using selective solvents in standard extraction procedures (Kondalkar et al., 2018). The type of solvents used for screening can affect the type of phytochemical constituents (Dhawan and Gupta, 2017). As a result, solvents used to identify the allelochemical compounds in plant tissues are hexane, chloroform, acetone, ethyl acetate, Alcohol, and water (Harborne, 1984; Deyab et al., 2016). Concentration-dependent inhibitions or stimulation of plant extract on other plant germination and growth in different chambers (like a petri dish in a laboratory and soils in a greenhouse or field) has been interpreted frequently as evidence for allelopathic interactions (Narwal et al., 2009; Zhang et al., 2021).

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Bamboo is a fast-growing perennial woody grass of plant species belonging to the largest family *Poaceae* (*Gramineae*), subfamily *Bambusoideae* composed of 121 genera with 1662 species (Vorontsova et al., 2016). Highland bamboo (*Oldeania alpina*) is one of the two bamboo species (the other is *Oxytenanthera abyssinica* A. Richard) grown in Ethiopia (Kelbessa et al., 2000). Farmers plant *O. alpina* to produce bamboo poles for different purposes such as furniture, house building, fencing, and other environmental benefits (FAO, 2020). In Ethiopia, *O. alpina* is grown in forests, as lots and intercropped with crops (Desalegn and Tadesse, 2014) where the extent of interaction is not well understood. According to various authors, the germination and initial growth of different crops were proportionately reduced with increasing concentration of leaf extract from different bamboo species due to their allelopathic effect (Wei et al., 2014; Nema and Reddy, 2016; Rawat et al., 2017).

The allelopathic effects can occur through different plant parts such as leaves, stems, roots, and seeds (Chon and Jerry Nelson, 2012). However, leaves are the most effective source of allelopathy because they are the primary site of photosynthesis and the production of secondary metabolites (Nema and Reddy, 2016; Zhang et al., 2021). In addition, leaves are the most dominantly decayed plant residues/litter that could affect the adjacent crops in an agroecosystem (Rice, 1984). Besides, wheat and barley are among the potential crops cultivated in the highlands of Ethiopia where *O. alpina* has been growing as an agroforestry plant (Mamude and Befikadu, 2022). However, the potential allelopathic effects of *O. alpina* on the development of integrated/adjacent crops have also received relatively little research. In particular, no research has been done on the potential allelopathic influence of *O. alpina* species on the growth of wheat and barley crops. To do this, it was better to comprehend and evaluate the allelopathic/allelochemical effects of *O. alpina* in a controlled environment (Narwal et al., 2009). Therefore, this study was intended to evaluate the allelopathic effects of *O. alpina* leaf aqueous extract on germination and seedling growth of wheat and barley.

2. Materials and methods

2. .1. Preparation of aqueous leaf extract

The laboratory experimental study was conducted at Wondo Genet College of Forestry and Natural Resource (WGCF – NR). The extract bioassay preparation for this study was based on the procedures developed by Narwal et al. (2009) with a few modifications. First, 15 phenotypically healthy *O. alpina* culms that represent genetic variations were randomly selected from farmland in the Arbegona district, Sidama region of Ethiopia. Using a paper bag, a matured leaves sample was collected and taken to the laboratory and shade-dried for two weeks (Martin, 1995). The dried leaves were crushed using a grinder machine and passed through a 0.85 mm net sieve to get a homogeneous powdered leaf. Then, the sieved samples were stored in airtight polyethene bags at room temperature until extraction was processed.

The aqueous solution is preferred in ecological studies due to it representing the solvent in the natural ecosystem (Narwal et al., 2009). The standard ratio of 1–10 (W/V) was used to form a solution of leaf aqueous extract for this study. Accordingly, a stock solution of 10 g/100 ml was prepared and used at 10 % concentrations. Then, different diluted aqueous extract concentrations (2.5 %, 5.0 %, and 7.5 %) were prepared separately by soaking a corresponding 2.5 g, 5.0 g, and, 7.5 g of dry powdered leaf in 100 ml of distilled water respectively following the methods used by Rawat et al. (2018). An equal amount of stock-free distilled water was used as a control treatment. Using higher speed and long duration shaking time in a mechanical shaker (i.e., more than three hours and 200 rpm) could break the chemical compounds into small molecules. In addition, preparing the extract without soaking for a week will result in a low possibility of releasing compounds from the leaf tissue into the solution. Therefore, a slight mechanical shaker (200 rpm) was applied in the first three hours. Then after being macerated for 24 h, stock solutions were filtered using Whatman paper No. 1 and stored at 7 °c to prevent decay and breakdown by bacteria (Narwal et al., 2009). In total, five concentrations treatments (0 %, 2.5 %, 5 %, 7.5 %, and 10 %) were prepared following the methods used for bamboo species by different authors (Hachani et al., 2018; Moura et al., 2018; Rawat et al., 2018).

2.2. Germination test

The certified commercial seeds of wheat and barley with standard quality of high germination percentages of 99 % were bought from the Southern Ethiopian seed enterprise. Immediately a few hours before sowing, seeds were sterilized with 3% sodium hypochlorite solution for 10 min and rinsed with sterilized distilled water to avoid pathogen contamination (ISTA, 2015). Then, the seeds were stored at room temperature until used. All materials (i.e., petri dish, forceps, etc.) were sterilized in an autoclave at 120 °C for 15 min before use.

The experiment was laid out in a completely randomized design with six replications separately for each of both test crops. Each replication was composed of five different concentrations (treatments). A set of 50 seeds for each of the five treatments of barley and wheat crops were placed on two layers of filter paper in Petri dishes having a 9 cm diameter. Using a separate droplet, all the experimental glass Petri dishes were moistened with 10 ml of each of the control and four concentrations of extracts on the first day. An additional 5 ml of each of the extracts and control was applied later on the fourth day after sowing. Then, Petri dishes were placed at room temperature (20 °C) in the laboratory until the completion of the experiment following the procedures used by Hachani et al. (2018).

Seeds were considered germinated when they exhibited a radicle extension longer than 2 mm. Based on the standard duration of germination for the two crops (ISTA, 2015), germinated seeds were counted from the 4th day of sowing and continued until the eighth day at every 24-h interval. It helped to determine germination kinetics such as speed of germination (SG) and mean germination time (MGT). Then, the final germination percentage was counted on the eighth day. Finally, shoot and root length were measured from a total of 27 seedlings (9 seedlings per replication) for each of the respective treatments (Kheloufi et al., 2020).

a) Final germination percentage

The Final germination percentage (FGP) was determined as follows (Eq. (1));

$$\text{FGP}\ (\%) = \text{Number of germinated seeds} \times 100/\text{total number of seeds sown} \quad (1)$$

b) Speed of germination

The speed of germination (S) was calculated as follows (Eq. (2));

$$S = (G1/d1) + (G2/d2) + (G3/d3) + \ldots.(Gn/dn) \quad (2)$$

Where G1, G2…Gn = the number of germinated seeds on daily counts; d1, d2…dn = the number of counting days.

c) Mean germination time

The mean germination time (MGT) was calculated as (Eq. (3)):

$$\text{MGT} = (\text{Number of germinated seeds} \times \text{days})/\sum \text{germinated seeds} \quad (3)$$

d) Shoot and root lengths

The shoot and root lengths of seedlings were measured by a measuring ruler in millimetres.

e) Seedling vigour index

Seedling vigour index (SVI) was calculated by multiplying the FGP with seedling length (root and shoot length) following the formula used by Abdul-Baki and Anderson (1973) as follows (Eq. (4));

VI = (shoot height (mm) + root length (mm)) × final germination percentage (4)

2.3. Preliminary qualitative analysis of allelochemicals

Similar to the above bioassay preparation, a cold extraction method was used to screen the preliminary allelochemicals following Ingle et al. (2017) with some modifications. Four solvents (i.e., water, methanol, hexane, and, ethyl acetate) were used to identify the possible allelochemicals in *O. alpina* leaf extract (Dhawan and Gupta, 2017). The stock sample (powdered leaves) weighed in a ratio of 1:10 w/v were soaked into each of the solvents simultaneously. The solutions were slightly shaken for 6 h at room temperature by a mechanical shaker (at 400 rpm) simultaneously. Then after 24 h, the crudes were shaken again for 30 min and, filtered through Whatman No. 1 filter paper into the plastic bottles to get a supernatant.

Then, the extracts were separated from different solvents using a rotary evaporator and stored in a sealed plastic container at a 4 °C refrigerator until the next use. The present study was carried out by employing more than three replication tests to minimize the false result. Finally, the four different extracts were tested simultaneously to identify the presence of nine selected allelochemical compounds. The selected allelochemicals were; Flavonoids, Alkaloids, Anthraquinones, Phenols, Tannins, Terpenoids, Steroids, Quinones, Coumarins and, saponins in *O. alpina* leaves. The qualitative analysis techniques were used to observe a colour change in the extract following a standard method by Harborne (1984) as described by Balamurugan et al. (2019).

Test for Flavonoids: To 2 ml of extracts, 1 ml of 2 N sodium hydroxide was added. The yellow colour indicates the presence of flavonoids.

Test for Tannins: To 1 ml of extract, 2 ml of 5 % ferric chloride was added. The formation of dark blue or greenish-black indicates the presence of tannins.

Test for Saponin: To 2 ml of extract, 2 ml of distilled water was added and a graduated cylinder was used to shake for 15 min lengthwise. It resulted in the formation of a 1 cm layer of foam that indicated the presence of Saponin.

Test for Terpenoids: 5 ml of the extract was treated with 2 ml of chloroform followed by a 3 ml of concentrated sulfuric acid. The formation of reddish-brown colour at the interface indicates the presence of Terpenoids.

Test for Phenols: 2 ml of distilled water followed by a few drops of 10 % ferric chloride was added to 1 ml of the extract. The formation of blue or green colour indicates the presence of phenols.

Test for Steroids: equal amount of chloroform and a few drops of concentrated sulfuric acid were added to 1 ml of extract, the presence of a brown ring indicates the presence of steroids.

Test for Coumarins: equal amount of 10 % Sodium hydroxide (NaOH) was added to the extract. The formation of yellow colour indicates the presence of Coumarins in the extract.

Test for Anthraquinones: a few drops of 10 % ammonia (NH4) solutions were added to 1 ml of extract. The appearance of a pink colour precipitate indicates the presence of Anthraquinones.

Test for Quinones: 1 ml of concentrated sulfuric acid was added to 1 ml of extract. The appearance of red colour indicates the presence of Quinones in the extract.

2.4. Statistical analysis

All data collected from the experimental study were subjected to a one-way analysis of variance (ANOVA) done by SPSS software version 27. Significant effects of treatments regarding growth variables were determined by the F-test ($P \leq 0.05$). Treatment means were separated for significance using Tukey's HSD test at a 5 % level of significance (Hachani et al., 2018).

3. Results

3.1. Allelopathic effects of Oldeania alpina leaves on germination parameters

The effect of O. alpina leaves extract on seed germination parameters of wheat and barley crops was analyzed and shown in Figs. 1–3. The highest final germination percentage (FGP) was observed in the corresponding controls for both wheat and barley crops as shown in Fig. 1. A statistically significant lowest FGP was observed in 7.5 % and 10 % concentrations for the wheat crop. However, only the highest concentrations of leaf extract (10 %) statistically ($P \leq 0.05$) affected the FGP of barley. Nevertheless, the application of low-dose of extracts (i.e., 2.5 % and 5 %) has no statistically significant effect on the FGP of both tested crops. In addition, it was shown that the mean germination time (MGT) for both tested crops was significantly affected by the aqueous extracts of *O. alpina* leaves (Fig. 2). Germination speed is another parameter evaluated for the allelopathic effect of O. alpina leaf extract on wheat and barley as illustrated in Figs. 3a and 3b respectively. Statistically, all extract concentrations significantly delayed the germination speed of both crops. From the first to final (fifth) days of germination, the significantly highest germination speed of wheat and barley seeds was recorded in the control. A delay in the germination of both crop species in all extract concentrations during the first three days of germination than later on, especially in barley, was observed.

3.2. Allelopathic effects of Oldeania alpina leaves on initial growth of tested crops

3.2.1. Shoot and root lengths

The statistical analysis result indicated that both evaluated crops were significantly inhibited by the leaf extracts of *O. alpina* species as shown in Table 1. Wheat shoot length was affected by all treated extract concentrations while barley shoot was only inhibited by the highest concentrations (10 %) when compared with controls. The highest mean value of wheat (10.5 cm) and barley (9.4 cm) shoot lengths were observed at controls (0 %). The lowest mean value of wheat (3.3 cm) and barley (6.2 cm) were observed at the highest concentration of 10 %. In other findings, root length is significantly affected by the same treatments as shown in Table 1. The longest root length in terms of mean values for wheat (104.0 mm) and barley (66 mm) was observed at controls (0 %, no extract). In contradiction, the shortest root length in terms of mean values for wheat (38 mm) and barley (50 mm) was observed at the highest concentration (10 %) treatments. Similar to

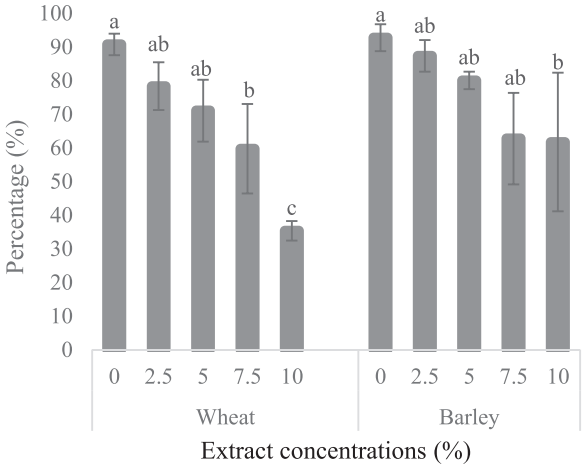

Fig. 1. Effect of extract concentrations on final germination percentage of wheat and barley crops. Mean values ± SD followed by different letters are significantly different according to ANOVA with the Tukey test at $p \leq 0.05$).

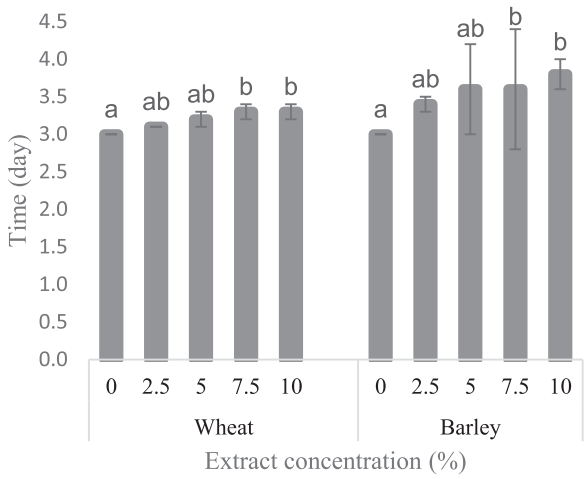

Fig. 2. Effect of extract concentrations on mean germination time of wheat and barley crops. Mean values ± SD followed by different letters are significantly different according to ANOVA with the Tukey test at $p \leq 0.05$).

germination traits, the reduction in initial shoot and root lengths across increasing concentrations of extract up to 10 % was noticed. Each of the extract's concentrations had a statistically significant negative influence on the shoot and root length of wheat when compared with the control. However, the statistically significant effect of the extract was only observed at a higher concentration for both shoot and root lengths of barley crops (Table 1).

3.2.2. *Seedling vigour index*

The effect of extract concentrations on the seedling vigour index of the two tested crops was analyzed and shown in Fig. 4. The result indicated that the seedling vigour index (SVI) of wheat and barley was significantly influenced by the aqueous extract of *O. alpina* leaves. The highest SVI (Mean = 1897.6, SD = 105.8) and (Mean = 1493.5, SD = 443.3) were recorded in control for wheat and barley respectively. The treatment with 10 % *O. alpina* aqueous extracts registered a drastic decrease in SVI (Mean = 250.2, SD = 24.6) and (Mean = 705.7, SD = 317.2) for wheat and barley respectively). Increasing the concentration of the *O. alpina* leaves extract significantly reduced the SVI of both tested crops. However, the significant difference between concentration levels was more observed in wheat than in barley as shown in Fig. 4. The SVI of wheat was affected by the lower leaves extract

Table 1
Effect of extract on shoot and root length of tested crops.

Extract concentration (%)	Shoot length (mm)		Root length (mm)	
	Wheat	Barley	Wheat	Barley
0 (Control)	105.2 ± 14.6^{a}	94.3 ± 30.9^{a}	104.0 ± 12.4^{a}	65.9 ± 18.4^{a}
2.5	85.3 ± 17.2^{b}	90.8 ± 20.0^{a}	77.1 ± 19.9^{b}	61.5 ± 6.0^{a}
5	66.7 ± 17.3^{c}	88.0 ± 16.0^{a}	59.5 ± 8.5^{c}	61.8 ± 13.0^{a}
7.5	56.7 ± 17.0^{c}	80.4 ± 21.4^{ab}	45.5 ± 13.2^{d}	59.8 ± 11.9^{ab}
10	32.9 ± 8.4^{d}	62.0 ± 21.1^{b}	37.9 ± 10.2^{d}	49.8 ± 15.2^{b}
P-value	*0.000*	*0.000*	*0.000*	*0.004*

Note: Mean values ± SD (n = 21) followed by different letters in column are significantly different according to ANOVA with Tukey test. $p \leq 0.05$).

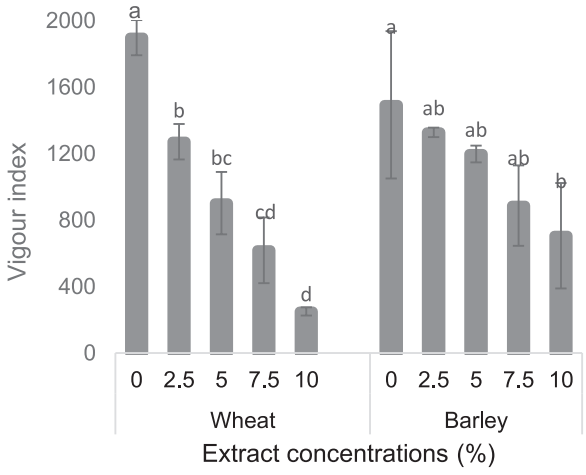

Fig. 4. Effect of extract on seedling vigour index of wheat and barley crops. Mean values ± SD followed by different letters are significantly different according to ANOVA with the Tukey test at $p \leq 0.05$).

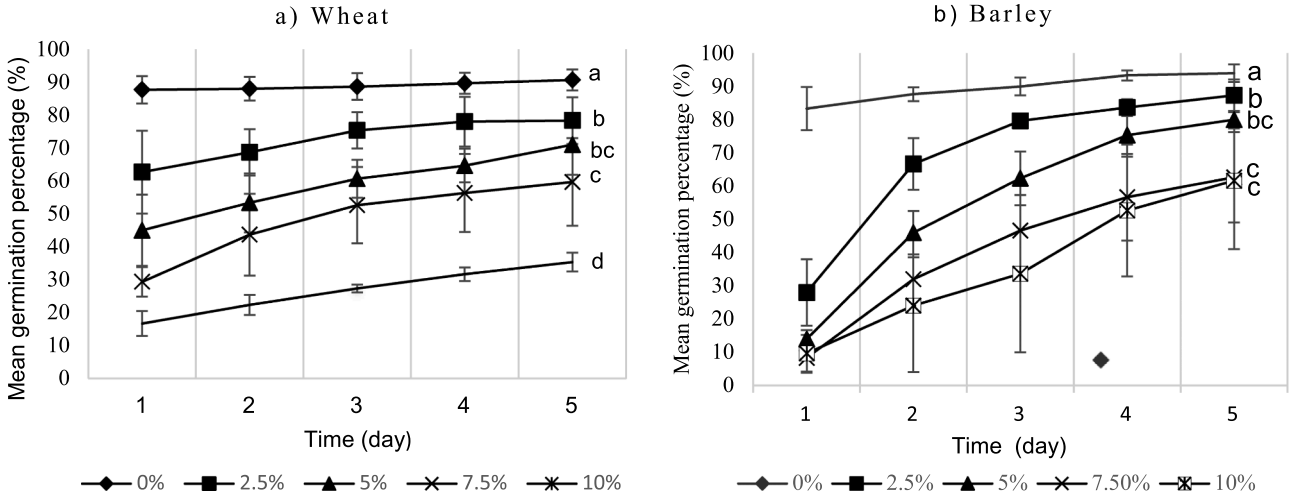

Fig. 3. Effect of extract concentrations on seed germination speed of wheat (a) and barley (b) crops. Mean values ± SD followed by different letters are significantly different according to ANOVA with the Tukey test at $p \leq 0.05$).

concentration (2.5 %) while that of barley was affected only by the higher leaves' extracts (10 %).

3.3. Allelochemicals in Oldeania alpina leaves extracts

Finding related to the identification of selected allelochemicals in leaf extracts of *O. alpina* are shown in Table 2. All the extracts of the different solvents, except for ethyl acetate extract (EAE), showed a positive result for the presence of flavonoids detected by the appearance of the yellow colour. Anthraquinone was not detected in all extract types due to the absence of pink colour after adding ammonia (NH_4) solution. The presence of phenols and tannins was detected by the appearance of the blue and greenish-black colours respectively in both EAE and methanolic extract (ME). Using a Salkowski test method, terpenoids were detected in all extracts of different solvents except in the methanolic extract. The extracts from water (WE) and hexane (HE) showed a positive result for the presence of coumarins detected by the appearance of yellow colour. A large number of allelochemicals were detected on the aqueous leaves' extracts of *O. alpina.* Finally, the frothing test showed the presence of saponins detected by the formation of the foam on the upper layer of the test tube.

4. Discussion

The present study revealed that aqueous extracts of O. alpina leaves showed an inhibitory allelopathic effect on germination parameters (i.e., final germination percentage, speed of germination and mean germination time) of the two tested crops. The inhibiting effect of the extract upon the germination parameters and initial growth was clear at the highest concentrations. The allelopathic effect reduced the germination and growth performance of the tested crops by 25 %, especially in the higher concentration. A comparable inhibitory allelopathic effect of related bamboo species on various crops was reported (Wei et al., 2014; Nema and Reddy, 2016; Rawat et al., 2017, 2018). The highest sensitivity to the effect of the extracts was demonstrated for the wheat while the lowest was for the barley crop. Studies by Hachani et al. (2018) and Patane et al. (2023) revealed higher sensitivity of root than shoot elongation with increasing concentrations of aqueous extracts. Similarly, the present study revealed that the root growth of both wheat and barley seedlings is more sensitive to allelopathic effects than the shoot's part. On the other hand, the reduction in shoot and root length at higher concentrations may be attributed to the reduced rate of cell division due to the presence of allelochemicals, which might inhibit gibberellin and indoleacetic acid function, which is supported by Einhellig (1995).

According to Narwal et al. (2009), different allelochemical compounds can be active in different solvents. Hence, the presence or absence of the allelochemicals depends upon the solvent medium used for extraction. In the present study, extracts from O. alpina leaves contain allelochemicals such as flavonoids, phenols, tannins, terpenoids, steroids, quinones, coumarins, and saponins which are among the potential allelopathic compounds of plant tissue in agroecosystems (Rice, 1984). Awol (2015) reported the presence of similar phytochemicals in the shoot part of the *O. alpina* plant. This result is also in line with the findings reported by Coffie et al. (2014) for three bamboo species. Other studies also reported the presence of different allelochemical compounds including tannins, phenols, flavonoids, flavones, xanthones, and catechins in Bambusa vulgaris leaves extract (Alencar et al., 2015; Fitri et al., 2020).

Different allelochemical compounds in O. alpina leaves extract may be the cause for low germination and growth performance in wheat and barley seeds. However, this finding highlights the absence of the anthraquinone compound in the leaves of O. alpina. In the present study extracts with low concentration (2.5 %) have no inhibitory effect on the tested crops. This might be due to the lower or absence of allelochemicals in the lower concentration of the extracts. Based on the findings, a higher concentration of greater than 10 % (0.1 g/ml) could have even greater inhibitory effects on the germination and growth of wheat and barley. According to Macías et al. (2020), allelochemicals in plant tissue are potent germination and growth inhibitors. Allelochemicals inhibit seed germination by damaging subcellular structures, disturbing the synthesis and metabolism of plant hormones, and mediating the metabolism of protein and starch, which provide energy during seed germination (Feng et al., 2017). For example, allelochemicals such as; phenols, terpenoids, quinones, and coumarin cause lipid peroxidation. Phenolic acids can also change channel structure in cell membranes and lower the functioning of antioxidant enzymes. It has also an effect on the transport and accumulation of ions between membranes and the water management of the cell (MoŽDŽEŃ et al., 2021).

The less susceptibility of barley than wheat can be associated with their genetic differences (Patane et al., 2023). In general, the current findings confirmed that O. alpina is one of the bamboo species reducing the germination and seedling vigour index of wheat and barley. According to Hachani et al. (2018), allelochemical compounds appeared to have accumulated in the top 2.5 cm of the soil. This implies the growth of wheat and barley cultivated adjacent to bamboo culms/clumps becomes stunted due to the phytotoxic allelochemicals produced from bamboo leaves.

Table 2
Qualitative analysis of allelochemicals in *Oldeania alpina* leaves extracts.

No.	Name of allelochemicals	Chemical/reagent/ test type	Type of extracts			
			ME*	WE	HE	EAE
1	Flavonoids	Ferric chloride test	(+)	(+)	(+)	(-)
2	Anthraquinones	Borntrager's test	(-)	(-)	(-)	(-)
3	Phenols	Ferric chloride test	(+)	(-)	(-)	(+)
4	Tannins	Ferric chloride test	(+)	(-)	(-)	(+)
5	Terpenoids	Salkowski Test	(-)	(+)	(+)	(+)
6	Steroids	Salkowski Test	(-)	(-)	(+)	(+)
7	Quinones	Sulfuric acid test	(-)	(+)	(-)	(-)
8	Coumarins	Fluorescence test	(-)	(+)	(+)	(-)
9	Saponin	Frothing Test	(+)	(+)	(-)	(-)

Note: * ME = Methanol extract, WE = Water extract, HE = Hexane extract, EAE = Ethyl acetate extract. Signs plus (+) and minus (-) denote the presence or absence of allelochemicals, respectively.
Source; own work done on qualitative analysis test in a Chemistry laboratory (2021).

5. Conclusion

The present research provides information on how *O. alpina* leaves aqueous extracts affect the seed germination and seedling growth of barley and wheat. Besides, the result of the qualitative analysis detected the possible allelochemicals found in *O. alpina* leaves extracts which are responsible for the allelopathic effect observed in the study. In line with this, the findings showed that allelopathic plants pose a threat to seed germination, and shoot and root lengths of wheat and barley. The results suggested that the introduction of *O. alpina* as an agroforestry plant has an inhibitory effect on the survival and initial growth of wheat and barley. The detected allelochemicals could be the main reason for the restricted growth of wheat and barley crops. However, the inhibitory effect is concentration dependent. Based on the result, the *O. alpina* leaves extract with more than 2.5 % concentration has an inhibitory negative effect on the growth of wheat and barley. Thus, the study suggests planting *O. alpina* far from the crop's growing area was more advisable to reduce the allelopathic effect. Furthermore, to better understand the allelopathic effect of *O. alpina*, future research is required to evaluate the effect at the field level. Finally, this information would be helpful for further research on the active compounds in *O. alpina* that will contribute to drug industries.

CRediT authorship contribution statement

CM: Conceptualization, Visualization, Methodology, Investigation, Formal analysis, Writing – original draft, Data curation, Writing – review & editing. **ZA:** Conceptualization, Visualization, Validation, Supervision, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

We, the authors declare no conflict of interest regarding of the manuscript.

Data Availability

Data will be made available on request.

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