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Effect of Willow Bark Extracts and Pinching On Performance of Flax (Linum Grandiflorum)

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Abstract

A field research was conducted on the "effect of Willow bark extracts and Pinching on performance of flax" at ornamental horticulture nursery, The University of Agriculture Peshawar, in 2022-2023. Research study was laid out in Randomized complete block design (RCBD) with two factors. Factor A was Willow bark extracts concentrations (O, 2, 4, and 6%) and Factor B was pinching types (un-pinched, 1 inch pinching and 2 inch pinching). The result showed that WBE and pinching had significantly affected almost all the parameters and the interaction between WBE and pinching was non-significant. Means data referring to WBE concentrations revealed that WBE sprayed at 6% concentrations resulted in maximum plant height (52.83), branches plant^{-1} (27.33), tillers plant^{-1} (5.73), capsules plant^{-1} (192.55), number of seed per capsule (8.06), and least days of flowering (72.22).While plants that are sprayed with distilled water (contro/0%WBE) produced least plant height (37.93), branches plant^{-1} (22.44), number of tillers plant^{-1} (4.3), number of flowers plant^{-1} (54.99), number of capsules plant^{-1} (75.55), number of seed per capsules (5.53), and more days of flowering (82.22). Among the mean data referring to pinching types revealed that 2″pinched plants resulted in maximum branches plant^{-1} (26.58), tillers plant^{-1} (6.47), number of flowers plant^{-1} (64.58), capsules plant^{-1} (144.49), number of seed per capsule (6.97), minimum days to flowering (69.99), plant height (34.83). While plants that are were un-pinched (control) produced least number branches plant^{-1} (21.74), number of tillers plant^{-1} (4.12), number of capsules plant^{-1} (125.66), number of seed per capsules (5.95), maximum plant height (53.02) and days of flowering (83.33). It is concluded from the result that WBE at 6% concentrations was most effective while 2″ pinching is recommended for better production of flax.

Key words: Flax, plant extracts, pinching, willow bark extract

Introduction

The local name of flax is Alshi (Raghuwanshi et al., 2019). Flax is herbaceous annual. Flax is also utilized for fibres and showy flowers (Amit et al., 2010). Flax generally refers to the fibre crop while linseed refers to the oil crop. Different fibre cultivars and oilseed of flax are developed (Milliam et al., 2005). There are annual and perennial flax varieties. Linum flavum (golden flax or yellow flax) is a perennial with bright yellow flowers native to central and southern Europe. Linum lewissi (wild blue flax) is herbaceous perennial native to North America. Linum grandiflorum required low

maintenance. Linum grandiflorum is easy to grow. Linum gradiflorum is an annual plant used as an ornamental plant (Lyakh et al., 2005). Its seed is shine because of high oil content. Linum usitatissimum species is used commercially for linseed content but it can also be obtained from Linum gradiflorum and other flaxes. It is having reasonable amount of fatty acid and linoleic acid (Hall et al., 2009). Linseed has become popular ingredients in breads, and breakfast bars (Ridges et al., 2001). Linum gradiflorum grows to a height of 12-24 inches. Linum gradiflorum is an ornamental member of flax family (Goncharuk et al., 2018). Linum gradiflorum is not widely used in food and medicines however, linum usitatissimum is commercially important in both food and medicines. They are also a good source of omega-3fatty acids and can be used to make linseed oil, which is used in cooking. It is also used for ornamental purposes. It is used as a border and container plant. Linum gradiflorum is good for cut flowers. It is great for cottage garden and wildflower garden. It is a perfect indoor and outdoor flowering plant for edges, rockeries, and hedges. It has health benefits including anti-proliferative action against cancers cells and anti-inflammatory activities. Linum species are known as one of the lucrative sources of valuable and diverse anticancer and antioxidant medicines (Smýkal et al., 2011).

Willow extract which is derived from the bark of the willow trees can several effects on plants. The main active ingrediants in willow extract is salicylic acid which is natural plant hormone found in plants, salicylic acid plays essential role in plants. defence against abiotic and biotic stress through physiological, morphological and biochemical mechanisms (War et al., 2011). Salicylic acid role in development and growth of plant, transpiration, photosynthesis, absorption of iron and transportation (Vlot et al., 2009). very less quantity of natural salicylic acid was identifying in plants. It is an important element in activating the plant's disease resistance response after a pathogen attack. The plant's response to both abiotic and biotic stress signals is controlled by chemical reactions based on salicylic acid, height of plant, more branches, heights number of leafs, dried and fresh mass of the plants, total number of carbohydrate is increases by salicylic acid (Gharib., 2006). However, plants were damaged by the high levels doses of salicylic acid (Sweify and Abdel-Wahid., 2008). It plays a role in the establishment of systemic developed immunity, when a bacterial infection is on mature leaf cause the new leaf to become resistant (Davies., 2004).

Pinching is a technique in the plant. We remove the apical bud to encourage lateral growth and force the plant to grow more branches (Islam etal., 2010). The unpinched plants are shorter form pinched plants. Root elongation and plant height in pinched plants are relatively higher than unpinched plants (Antonio et al., 2000). Pinching increased the number of branches. The time of first emergence of flower buds to flower harvesting decreased in pinched plants while compared to unpinched plants (Mutlu and Agan., 2015)

Keeping in view the importance of flax, an experiment was designed with the following objectives

- To find optimum concentrations of willow bark extract for better growth and production of flax
- To study the effect of pinching on performance of flax
- To study the interaction between willow bark extract and pinching on production of flax

Material and Methods

An experiment the ‘‘effect of Weeping willow extract and Pinching on the performance of flax (Linum gradiflorum)’’ was carried out at Ornamental Horticulture Nursery, The University of Agriculture Peshawar, during 2022- 2023.

Willow Bark Extract Preparations (WBE)

For preparation of WBE the procedure proposed by Martin and Stephens (2008) was followed. Willow bark was collected from mature shoots of weeping willow tree (Salix babylonica) from Pakistan Forest Institute (PFI). For preparation of WBE, fresh willow barks were collected from a

younger shoots of weeping willow trees from PFI. For preparation of 2% WBE, Willow bark (20g) were cut into small pieces of 1 cm. These were placed in flask, distilled water were added and final volume was made 500ml. The mixture was continuously stirred for 30 minutes at 90 centigrade. Then it was filtered through cloth and cooled at room temperature for further use. Similarly for preparation of 4% WBE, Willow bark (40g) were cut into small pieces of 1 cm. And for preparation of 6% WBE, Willow bark (60g) were cut into small pieces of 1 cm and the same procedure was followed. Hence 2, 4 and 6% concentrations of WBE were achieved.

Experimental Design

Experimental trail was conducted in Randomized complete block design with two factors. Willow bark extract (WBE) concentrations and pinching types. There were 12 treatments; treatments were replicated three times. Seed were raised in pots and seedlings were transplanted in the field. Seed of flax (Linum gradiflorum) were sown on 10 November 2022 in pots and were transplanted to the field after 40 days i.e. 20 December.

Factor A: Pinching types

P1= No pinching
P2= 1 inch pinching
P3= 2 inch pinching

Factor B: WBE levels

C1= Distilled water
C2= 2%
C3= 4%
C4= 6%

Parameters:

Days to Flowering

The date of transplantation to the 1st flower produce days to flowering count selected randomly five plants and calculate the average.

Plant Height (cm)

Select five random plants of every treatment and used the measuring tape the tip to the base of plant and mean as calculated.

Number of branches plant^{-1}

For the branches five plants selected of every treatment and count the branches their average was measured.

Number of tillers plant^{-1}

Tillers of five plants from each treatment were counted in randomly selected plants of each replications and finally their average was measured.

Number of capsules plant^{-1}

The data were recorded by counting the number of capsules in five plants selected randomly from each treatment of the three replications. Then their means were measured.

Number of seeds capsules^{-1}

Data was recorded by collecting capsules from 5 plants from each treatment and replication, threshed manually, seeds were counted and average was worked out.

Statistical analysis

The LSD test with a 0.01 possibility was applied to find differences in treatment means when statistical analysis of the data was conducted using Statistic-8.1 software (Abbas et al., 2025).

Results and Discussion

Days to flowering

Among levels of pinching in **Table 1** maximum days to flowering (83.33) were recorded in un-pinched plant while days to flowering (78.33) were recorded in 1" pinched plants that was statistically

similar to control. While minimum days to flowering (69.99) were recorded in 2" pinched plants.
Data regarding days to flowering in response to WBE **Table 1** shows that maximum days to flowering (82.22) were recorded in distilled water (control) that are statistically similar to (78.88) noted in plant sprayed with WBE at 2%. While minimum days to flowering (72.22) were recorded in plant sprayed with WBE at 6% concentrations. It is evident that from mean data of days to flowering that WBE caused earliness in flowering of flax. It might be due to the reason that WBE has a salicylic acid that induce flowering (Zong-You et al., 2021). Our results are in line with Ullah et al., (2019); they also reported early flowering in zinnia sprayed with SA.

Plant height (cm)

Data regarding in plant height of flax is affected by pinching and WBE are given in **Table 1**, In case of pinching tallest plants (53.02 cm) were observed un-pinched (control) plants that are statistically similar to (45.70 cm) noted in plants in which 1" pinching was done. Minimum plant height (34.83 cm) was found in 2" pinched plants. Plant height was more in un-pinched plants pinched plants have more number of branches and they have lower plant height due to the removal of apical portion of the plant. This technique is commonly used to promote branching and bushier growth in plants (Rezazadeh and Harkess., 2015).
Data regarding in plant height of flax is affected by pinching and WBE are given in **Table 1** Data pertaining to WBE showed that the tallest plants (52.83 cm) were observed when the plants are treated with 6% WBE that are statistically similar to (45.44 cm) that were treated with 4% WBE. Minimum plant height (37.93) was found in control plants sprayed with distilled water (control) that were statistically similar to (41.87 cm) noted in plants sprayed with 2% WBE concentrations. WBE increased plant height because WBE contain salicylic acid which is a growth regulator that promote the plant growth. WBE significantly increased the height of flax. This might be due to the fact that SA present in the WBE regulates the growth and development of the plant (Amin et al., 2008).

Number of branches plant^{-1}

Data regarding the number of branches plant^{-1} is effected by Willow bark extract (WBE) & Pinching are in **Table 1.** Mean data of pinching revealed that highest number of branches plant^{-1} (26.58) were noted in plants pinched at 2" that were statistically similar to no of branches (24.49) in plant pinched at 1" and the least branches plant^{-1} (21.74) were recorded in plants that were un-pinched (control). Pinching resulted in bushy growth and promote branching decreasing the apical dominance effect and hence produced more branches plant^{-1} as compared to un-pinched (control). The plant usually adjusts to encourage the establishment of auxiliary buds, which can grow into branches, when apical dominance is disappeared. More branches and leaves absorb more light as a result of the pinching plant's apical dominance, expanding the area of the leaf that is opened to the sun (Ona et al., 2015).
Data regarding the number of branches plant^{-1} is effected by Willow bark extract (WBE) & Pinching are in **Table 1.** Portrays that branches plant^{-1} were increased to the maximum (27.33) in plants that are treated with WBE at 6% concentrations followed by branches number plant^{-1} (24.33) observed in plants sprayed with 4% of WBE, while the least branches plant^{-1} (22.44) were observed in control treatment (0% WBE) that are statistically similar (22.99) to plants treated with 2% concentrations of WBE. Willow bark extract has important growth regulator effect due to the presence of salicylic acid and hence improved the growth of plants and produced more number of branches. SA stimulates the synthesis of auxin and cytokinin which has a role in cell division, enlargement and activation of photosynthesis, which in turn increase number of branches in plants (Mohammed et al., 2020).

Number of Tillers Plant^{-1}

Data regarding the number of tillers plant^{-1} is effected by Willow bark extract (WBE) & Pinching are in **Table 2.** Among various types of pinching, maximum number of tillers plant^{-1} (6.47) was produced by the plant that were pinched at 2" followed by (4.37) that were pinched at 1". The minimum number

of tillers plant^{-1} (4.12) were produced in plant that were un-pinched (control) that are statistically similar to the plants that are 1" pinched. The plant that were severe pinching produced maximum number of tillers plant^{-1}. One of the reasons could be the vigorous vegetative growth (branches and leaves) and greater photosynthetic formation in pinched plants (Ali et al., 2021).
Data regarding the number of tillers plant^{-1} is effected by Willow bark extract (WBE) & Pinching are in **Table 2.** WBE, maximum number of tillers (5.73) were produced by the plants that were treated with WBE at 6% concentrations. Minimum number of tillers (4.3) were recorded in plants that were sprayed with distilled water (control). There is salicylic acid in willow bark extract significantly increased number of tillers as compared with the control The foliar application of willow bark extract on plants increased the number of tillers (Sajjad et al., 2014).

Number of capsules plant^{-1}

Data regarding the number of capsules plant^{-1} is effected by Willow bark extract (WBE) & Pinching are in **Table 2.** Among Willow bark extracts, the maximum no. of capsules plant^{-1} (192.55) was obtained when the plant was treated with WBE at 6% concentrations. Minimum capsules plant^{-1} (75.55) were noted in the distilled water (control). Different concentrations of salicylic acid considerably enhanced pea pods which might be due to the increased nutrient uptake and its utilization that results in more flower and pod formation. Sprayed salicylic acid in peas and observed an increase in pods (Ahmad et al., 2023).
Data regarding the number of capsules plant^{-1} is effected by Willow bark extract (WBE) & Pinching are in **Table 2.** A maximum number of capsules plant^{-1} (144.49) was observed when the plant was treated with 2-inch pinched that are statistically similar to plant treated 1-inch pinched number of capsules plant^{-1} (143.41) and minimum Number of capsules plant^{-1} (125.66) was found in control. In this study, more numbers of pods were observed in pinched plants as compared to un-pinched plants. Plants having more lateral branches have vigorous vegetative growth, which in turn have good photosynthetic efficiency (Kattel et al., 2023).

Number of Seed Capsules^{-1}

Data regarding the number of seed capsules^{-1} is effected by Willow bark extract (WBE) & Pinching are in **Table 2.** Mean data of a number of seed capsules^{-1}in plant, (Table 4.7) demonstrated that number of seed capsules^{-1} (8.06) were increased to the maximum in plants sprayed with 6% of WBE followed by number of seed capsules^{-1} in plant (6.3) were noted in plants treated with 4% of WBE, whereas minimum number of seed capsules^{-1} (5.53) were observed in plants sprayed with distilled water (control) that are statistically similar to the plants sprayed with WBE at 2% (6.06). Willow bark extract had important growth regulator and it improved the growth of plants and produced more number of branches. When the concentration of WBE increased, there was a corresponding raise in the flower numbers plant^{-1}. It is because of the positive effect of SA present in WBE as it has a role in regulation of flower responses well (Martinez et al 2004).

Conclusions and Recommendations

The application of Willow bark extract (WBE) sprayed at 6% was found more effective and resulted in the least Days to flowering, Maximum plant Height (cm), Number of branches plant^{-1}, Number of capsule plant^{-1}, Number of tillers plant^{-1}, and Number of Seed Capsules^{-1}
Among various types of pinching, 2" pinched was found more productive for almost all the parameters of flax (Linum grandiflorum) as compared to other pinching types and control.

- WBE at 6% concentrations is recommended better for flax (Linum grandiflorum)
- 2″ pinching type is recommended better for flax (Linum grandiflorum)
- WBE at 8% and even more and 3″ pinching and more will be tried for future research on flax.

Table 1: Days to flowering, Plant height (cm), Number of branches plant^{-1} as affected by Willow bark extract concentrations (%) and Pinching.

Pinching stages	Days to flowering	Plant height (cm)	Number of branches plant^{-1}
Control	83.33 A	53.02 A	21.74 B
1" pinch	78.33 A	45.70 A	24.49 A
2'inch pinch	69.99 B	34.83 B	26.58 A
LSD P≤ 0.01	5.4	8.6	2.1
Willow Bark Extract Concentrations (%)			
0	82.22 A	37.93 B	22.44 B
2	78.88 AB	41.87 B	22.99 B
4	75.22 BC	45.44 AB	24.33 B
6	72.55 C	52.83 A	27.33 A
LSD P≤ 0.01	6.2	10	2.4

NS: Non-significant; Significant at P≤ 0.01; The means that are shown by various letters differ significantly from one another at P ≤ 0.01.

Table 2: Number of tillers plant^{-1}, Number of capsules plant^{-1}, Number of seed capsules^{-1} affected by Willow bark extract concentrations (%) and Pinching.

Pinching stages	Number of tillers Plant^{-1}	Number of capsules plant^{-1}	Number of seed capsules^{-1}
Control	4.12 B	125.66 B	5.95
1" pinch	4.37 B	143.41 AB	6.55
2'inch pinch	6.47 A	144.49 A	6.97
LSD P≤ 0.01	1.03	20	NS
Willow Bark Extract Concentrations (%)			
0	4.3 B	75.55 D	5.53 B
2	4.8 AB	126.77 C	6.06 B
4	5.06 AB	156.55 B	6.3 B
6	5.73 A	192.55 A	8.06 A
LSD P≤ 0.01	1.08	17	1.16

NS: Non-significant; Significant at P≤ 0.01; The means that are shown by various letters differ significantly from one another at P ≤ 0.01.

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