International Journal of Contemporary Issues in Social Sciences
Volume 3, Issue 3, 2024 ISSN(P):2959-3808 | 2959-2461

RESPONSE OF CUCUMBER TO FOLIAR APPLICATION OF ACETYLSALICYLIC ACID AND DIFFERENT SOWING DATES

Hazib Ali [1], Aqsa[2], Muhammad Qasim[3], Taimoor Munir[4], Qudrat Ullah[5], Muqadas Liaquat[6], Shafiq ur Rahman Memon[7], Mehmood Ul Hassan[8], Irfan Haidri[*9]

[1,8]Department of Agriculture, Hazara University Mansehra, Pakistan;
[2]Department of Zoology, Wildlife and Fisheries, University of Agriculture Faisalabad;
[3,5,*9]Department of Environmental Science, Government College University Faisalabad 38000 Punjab Pakistan;
[4]Department of Plant Pathology University of Agriculture Faisalabad;
[6]Department of Plant Pathology, Muhammad Nawaz Shareef Agriculture University Multan;
[7]Department of Soil Science University of Sindh Agriculture University Tandojam

[*9]haidaryirfan807@gmail.com

Corresponding Author: *

Received: June 05, 2024 **Revised:** July 21, 2024 **Accepted:** July 29, 2024 **Published:** August 02, 2024

ABSTRACT

Acetylsalicylic acid (C9H8O4), known as aspirin, is an effective alternative to salicylic acid. Both salicylic acid and aspirin influence photosynthesis-related processes, including physiological and biological activities and enzyme actions, and act as plant growth regulators, thereby impacting plant growth. At the Horticulture Research Farm in 2022. The effects of foliar spray of acetylsalicylic acid and varying dates of seeding on cucumber growth were evaluated through an experiment. Acetylsalicylic acid concentrations (162, 216, and 270 mg L^{-1}) and sowing dates (5, 15, and 25 April) Using a Randomized Complete Block Design with three replications, were changed in this split-plot experiment. The data analysis showed that dissimilar planting dates and acetylsalicylic acid damaged the growth and production of cucumbers. On the 5th of April, plantings resulted in the most favorable outcomes in terms of the ratio of male to female plants (2.78), the length of fruits (17.01 cm), the width of the fruits (4.27 cm), the length of the vines (167 cm), the yield per plant (1.90 kg), and the overall production (42.2 tons per hectare). The application of 270 mg L^{-1} of acetylsalicylic acid on a specific date led to the lowest male-to-female flower ratio (2.93), the earliest first harvest (62), the shortest time to first flowering (40days), the highest number of fruits per plant (10.9), fruit length (16.78 cm), the widest fruit (4.32 cm), the most excellent vine length (167 cm), yield per plant (1.80 kg), and the highest yield (40.2 tons per hectare) in this experiment. However, this date also dictated the maximum number of days until the first harvest (54 days) and the first blossoming (34 days). Finally, it can be said that the Peshawar Valley's agro-climatic conditions for the cucumber development and productivity were much enhanced by planting on April 5th and applying acetylsalicylic acid at a concentration of 270 mg L^{-1}.

Keywords: Acetylsalicylic acid, Sowing date, Cucurbitacin, plant growth regulator.

INTRODUCTION

The cucumber, scientifically known as Cucumis sativus L., is a member of the Cucurbitaceae family and has a rich history of cultivation dating back approximately 3,000 years. Originating in Asia, cucumbers were well-established as vegetables in France by the ninth century and were widely grown in England by 1327. The journey of cucumbers can be traced back to India, where they have been grown for the past 2,000 years, as well as in the Islamic Republic of Iran and China. From India, cucumbers spread to China, North America, and Southern Europe, eventually becoming a globally cultivated crop through the efforts of merchants. Today, cucumber is one of the most significant crops grown worldwide. In Pakistan, cucumbers are highly valued for their nutritional benefits and are typically consumed as a salad. Immature cucumbers, measuring 3 to 15 cm in length, are preferred for sweet pickles, while mature and more giant cucumbers are used for sour pickles and slicing. According to Shrestha and Ghimire (1996), cucumbers have extraordinary value in generating the highest production and cash, underscoring their historical and economic significance.

Cucumbers and essential minerals like magnesium, potassium, and copper are rich sources of vitamins A, B6, and C (Vimala et al., 1999). China leads the world in cucumber production, manufacturing an estimated 54.34 million tons annually, which accounts for roughly 73% of the global supply. Based on an average production of 2.25 tons per hectare, cucumbers are grown on 23,268 hectares in Pakistan, yielding 52,765 tons (MINNFSR, 2015). A valuable produce and fruit, cucumber is an annual herb with hairy leaves and branches. It is a monoecious plant that produces flowers that are both staminate (male) and pistillate (female). Insects, particularly honey bees, pollinate (Muqarab, 1992). Despite being able to withstand somewhat colder temperatures than melons, cucumbers are highly temperature-sensitive and do best in warm seasons. Cucumbers can be grown in various soil types, although loam and silt loam soils produce the best results (Pant et al., 2001). Cucumbers require high humidity due to their vast leaf surface (Arshad et al., 2014). Cucumber cultivars vary by geography; in the hills, Kusle and Bakhtapur native kinds are produced, while Poinsett and Green's long types are grown in the plains. Cucumber harvest season is usually from March to April (Pandey & Adhikari, 1996). Cucumber is ranked fourth in Asia in terms of economic value, behind potatoes, tomatoes, and onions (Eifediyi & Renison, 2011). Cucurbitacin, a terpene found in cucumber leaves, inhibits insect eating and assault, making cucumbers a delicious addition to meals and a nutritious one.

Despite being a vital vine crop in Pakistan, cucumber production remains relatively low compared to global standards. Expanding the cultivation area, selecting superior varieties, and adopting improved growing practices could enhance production.

A significant synthetic medication created in 1897 as an anti-inflammatory is acetylsalicylic acid ($C_9H_8O_4$), better known by its popular name, aspirin (Weissman, 1999). Aspirin is an adequate substitute for salicylic acid, made from plant polyphenols (Raskin, 1992). The primary difference between acetylsalicylic acid (ASA) and salicylic acid (SA) is the presence of an acetyl group (CH_3CO) in ASA, which enhances its performance and effectiveness compared to the natural form. As a result of this acetylation, aspirin is less toxic and burning in the stomach, making it more suited for the digestive system (Senaratna et al., 2000). Salicylic acid and aspirin affect similar physiological and biological processes, including photosynthesis (Hayat & Ahmad, 2005). Additionally, they influence total plant growth (Hayat & Ahmad, 2007). Since it provides the best growing conditions the right amount of light, temperature, humidity, and rainfall—the ideal sowing time is critical to achieving the genetic potential of crop output (Iraddi, 2008). In line with the genetic potential of a variety, a suitable sowing date guarantees satisfactory growth and development, according to Ahmad et al. (2015). On the other hand, varying the date of sowing might result in different environmental circumstances in the same area, which can affect the variety's rate of growth development, as well as output. Therefore, better quality and a larger yield can only be obtained by choosing the ideal sowing date.

Climate change poses significant challenges to agriculture, necessitating the determination of suitable sowing times to achieve better yields under changing conditions. Sowing time plays a critical role in crop production. In light of these difficulties, the current study looked at how cucumbers responded to various sowing dates and the reaction of acetylsalicylic acid usage on their development and yield.

1. Material and Methods

1.1. Experimental site

The research study titled "The Effect of Foliar Application Of Acetylsalicylic Acid And Different Sowing Dates On Cucumber Yield." The experiment occurred at the end of April 2023 at the Horticulture Research Farm of the University of Agriculture Peshawar, located at a longitude of 71.4685° and a latitude of 34.0198°.

1.2. Field Preparation and Sowing Techniques

The field was leveled, harrowed, and plowed to prepare it for seeding. Poinsett 76 seeds were planted on ridges using a 30-cm plant-to-plant and a 1-meter Spacing between rows. The seeds should be planted two to three centimeters apart. Thinning was done to keep only one healthy plant per location after germination. Herbicides and insecticides were applied as needed, and agronomic practices such as weeding, watering, and hoeing were followed.

1.3. Experimental Design and Treatment

The Randomized Complete Block Design (RCBD) experiment used a factorial split-plot layout and three replications. Three sowing dates were given to the main plots (5, 15, and 25 April), and different levels of Acetyl salicylic acid were applied to the subplots together with a control (0, 161, 215, and 270 mg L^{-1}). The cucumbers and acetylsalicylic acid were sprayed on them as a liquid at dosages of 0.00, 161 mg L^{-1}, 215 mg L-1, and 270 mg L-1, 181.156 g is the molecular weight of acetylsalicylic acid.

1.4. Preparation of acetylsalicylic acid solution

After calculating the weight of acetylsalicylic acid (in milligrams) at each concentration level, the acid was dissolved in one liter of deionized water. Twenty and forty days after transplantation, these solutions were sprayed on the cucumber plants. During the trial, we collected data for the following variables.

1.5. Plant Growth and Yield Measurements

Days to flowering were recorded by measuring the time from planting to the beginning of flowering for each treatment group, calculating the average duration. Days to harvest were determined by counting the interval between the initial harvest and planting for each experiment. Vine length was measured from bottom to top on five randomly chosen plants per treatment, with the average height computed. The number of fruits per plant was assessed by counting the total fruits on randomly selected plants at each picking and averaging the results. The male-to-female flower ratio was derived from the average of male and female flowers. Fruit length and diameter were measured using a measuring tape and digital vernier caliper, respectively, with averages calculated from five randomly chosen fruits. Fruit weight was determined by weighing randomly selected fruits from each treatment, and the total yield was computed using specific formulas for overall productivity.

Yield tons' ha^{-1}**:** Yield per subplots (kg) x 1000 (m^2)

Area of subplots m^2

x 1000

1.6. Statistical Analysis

Data was interpreted using statistical methods such as Microsoft Excel and Statistic 8.1 software according to the model for the randomized complete block. Means of different traits were separated at a probability level of 5% using the minimum noticeable difference (LSD) test (Steel & Torrie, 1980).

2. Results

2.1. Days to flowering

The initial blossoming of cucumber seeds was notably impacted by various planting dates and concentrations of acetylsalicylic acid, as illustrated in (Table 1). Early seed planting (SD1) caused a 40-day delay in flowering. Conversely, late planting (SD3) resulted in early flowering by 34 days (see Fig. 1a). Application of acetylsalicylic acid to the leaves revealed that the group without acetylsalicylic acid took the longest time to flower (41 days), followed by the group treated with ASA3 (270 mgL^{-1} acetylsalicylic acid), which flowered the fastest (34days), and ASA2 (215 mgL^{-1}), which took 37 days to flower (see to Fig. 1b).

Table 1. Mean Square value of growth and yield attributes of cucumber as affected by application of acetylsalicylic acid and different sowing times

SOV	DF	Mean Square (MS)								
		DTF	DTFH	MTFFR	VL	NOFPP	FL	FD	FW	TY
Replication	2	12.1111^{ns}	26.08^{ns}	0,0508^{ns}	24.25^{ns}	4.5753^{ns}	5.8878^{ns}	0.1806^{ns}	37.4178^{ns}	10.9869^{ns}
Sowing dates (SD)	2	11.0278*	208.58**	4.7508*	412.333*	27.7553**	18.7511*	2.7698**	838.159**	616.338*
Error I	4	6.5278	11.91	0.2754	49.7083	1.5678	1.1207	0.1591	47.2094	37.3257
Acetyl Salicylic acid (AS)	3	74.3981**	78.91*	1.4092*	172.444*	11.6077*	6.4299*	1.7264*	77.3277*	164.899**

SD×ASA	6	0.0648^{ns}	0.58^{ns}	0.0119^{ns}	4.5556^{ns}	0.1827^{ns}	0.2596^{ns}	0.0194^{ns}	1.2305^{ns}	5.193^{ns}
Error II	18	14.6481	20.3	0.2957	41.0741	2.8732	1.4542	0.3491	20.8115	32.8624
Total	35									

**:LSD≤0.01, *:LSD≤0.05, ns:Non significant

2.2. Days to harvest

Days to first harvest varied significantly depending on the sowing date and acetylsalicylic acid content (Table 1). Plots sown earlier (SD1) had the highest number of days to first harvest (62) as compared to (53) plots sown later (SD3) (Fig 1a). Regarding foliar acetylsalicylic acid treatment, control plants (treated with no acetylsalicylic acid) took the longest (61) to harvest. In contrast, plants treated with ASA3 took the shortest (54) to harvest, followed by ASA2 (57 days) (Fig 1b).

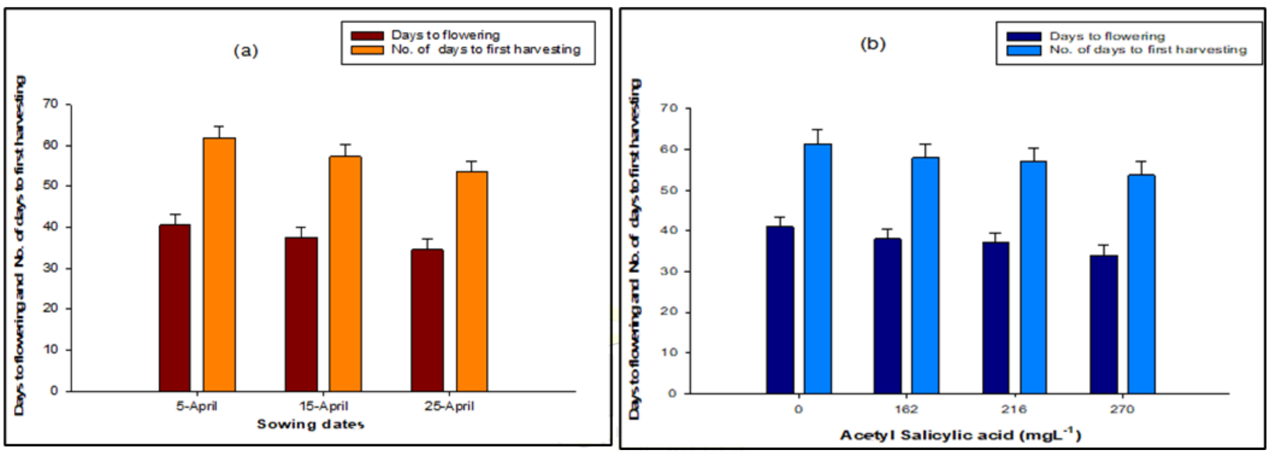

Fig 1a. Days to flowering and No. Of days to first harvesting as affected by Sowing times (a) Acetylsalicylic acid application

2.3. Male-to-female flower ratio

When the seeds were planted late (SD3), there was a higher ratio of male-to-female flowers (4.04) compared to (2.78) when they were planted early (SD1) (Fig. 2c). When it comes to applying ASA, the Control group (ASA0) had the highest male-to-female flower ratio (3.90). In contrast, the lowest ratio (2.93) was seen in the ASA3 group, followed by ASA2 (3.37).

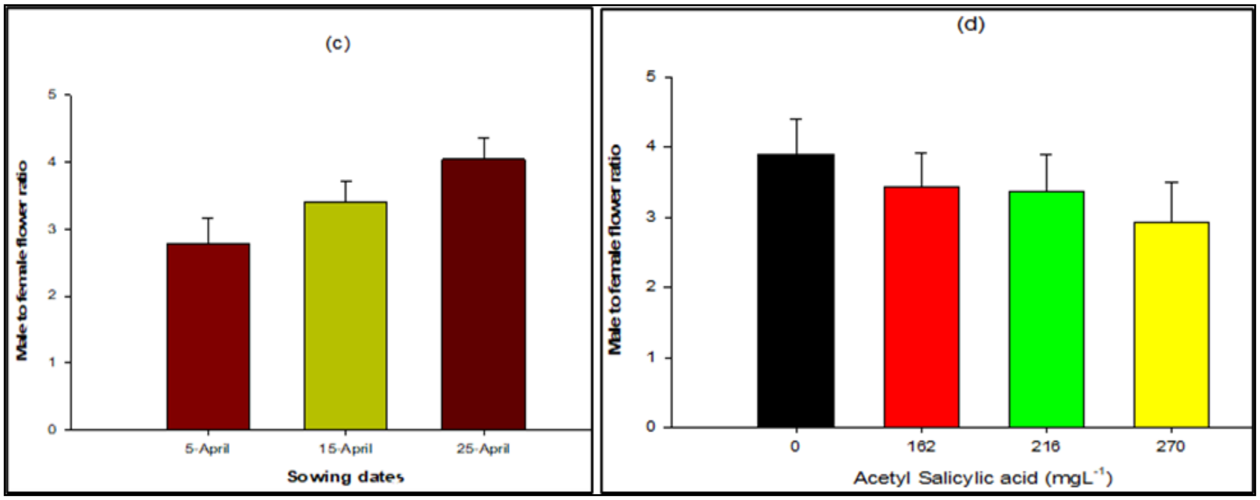

Fig 2. Male-to-female flower ratio as affected by Sowing times (c) and Acetylsalicylic acid application (d).

2.4. Number of fruits per plant^{-1} and Vine length

Table 1 shows that the highest number of fruits per plant (11.1) was noticed at the early drill date (SD1); therefore, the least number of fruits (8.0) was reported at the late drill date (SD3) (Fig 3e). Regarding ASA usage, plants treated with ASA3 produced the most fruits plant-1 (10.9), followed by ASA2 (9.7), while regulated plants (ASA0) churned out the fewest fruits plant^{-1} (8.2) (Fig 3f). Table 1 shows that the timing of drilling and foliar application of ASA yiel03 had substantial outcomes on the vine length of cucumber plants. In the experiment, we observed that lengthy plants (167 cm) were seen in plots drilled on April 5th (SD1), while the plants having a length (156 cm) were seen in cultivated places drilled later (April 25th or SD3) (see to Figure 3e). Similarly, in terms of ASA concentrations, the most extended vine length (167 cm) was recorded in ASA3. During the experiment, we noticed that plots planted on April 5th (SD1) produced taller plants (167 cm), while plots sown later (April 25th or SD3) resulted in shorter plants (156 cm) (see Figure 3e). Similarly, concerning ASA concentrations, ASA3 had the highest vine length (166 cm), followed by ASA2 (162 cm). In contrast, untreated plots exhibited the shortest vine length (156 cm) (see Figure 3f), followed by ASA2 (162 cm). In comparison, untreated plots had the shortest vine length (156 cm) (see Figure 3f).

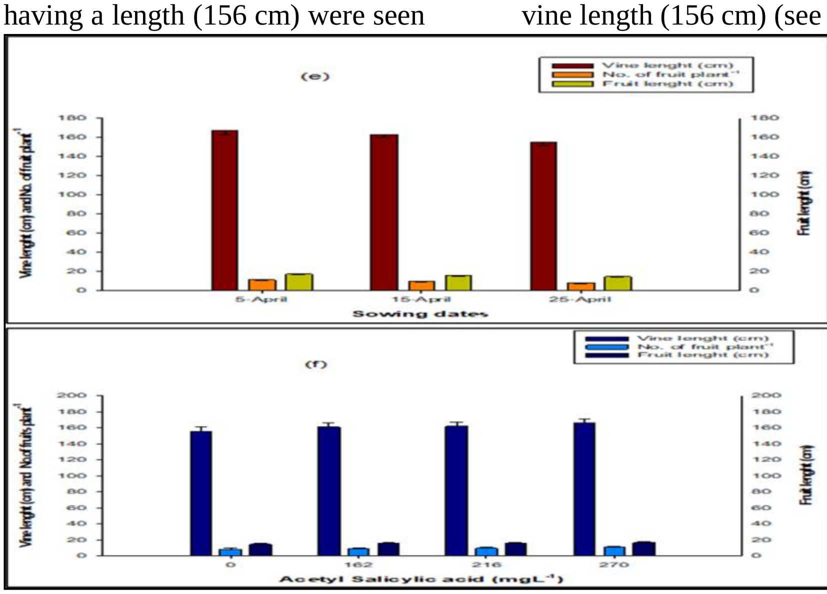

Fig 3a. Vine length (cm), No. Of fruits plant^{-1} and fruit length (cm)

2.5. Physical parameters

Table 1's clear findings revealed that drill dates and acetylsalicylic acid (ASA) amount substantially impacted cucumber fruit diameter, although their interaction was insignificant. During the first drilling dates (DD1), the highest diameter of fruit(4.7cm) was noted; similarly, the lowest cucumber diameter (3.31 cm) appeared on the last drilling dates (DD3) (Fig 4g). The usage of acetylsalicylic acid revealed that the highest value for fruit diameter (4.32 cm) was noticed in ASA3 (270 mg L^{-1} acetylsalicylic acid), preceding by ASA2 (216 mg L^{-1}), i.e., 3.86 cm. The lowest value for cucumber fruit diameter (3.26 cm) was registered in ASA0 (control treatment) (Fig 3h).

The data analysis revealed that drilling dates and acetylsalicylic acid amount affected cucumber fruit weight, while the relation between sowing dates and acetylsalicylic acid was determined to be non-essential (Table 1). Plants sown earlier (SD1) produced the highest fruit weight (172.1 g), whereas late sowing (SD3) produced the lowest fruit weight (155.4 g) (Fig 3g). In terms of ASA, the highest fruit weight (167.4 g) was determined in plots dealing with ASA3, escorted by ASA2 (164.6 g); therefore, the minimum value for one plant -1(160.4 g) documented in plots dealing with no acetylsalicylic acid (ASA0) (Fig 3g) The data presented in Table 1 indicates that the most substantial crop yield (42.2 tons per hectare) occurred when seeds were drilled early (SD1). In contrast, the least productive fruit yield (27.8 tons per hectare) was observed for late planting (SD3) (as shown in figure 3g). Regarding acetylsalicylic acid (ASA) treatment, the highest overall output (40.2 tons per hectare) achieved in plots deals with 270 mg L-1 of ASA (designed as ASA3). I was following closely ASA2 (216 mg L-1), resulting in a yield of 35.8 tons per hectare. In contrast, non-attended plots (Designed as ASA0) yielded the lowest yield production (29.9 tons per hectare 9 as depicted in Fig 3h). The data mentioned in Table 1 showed that the maximum yield (42.2 t ha^{-1}) gained at the early drilling date (SD1), despite the minuscule fruit yield (27.8 t ha^{-1}) determined at the later planting date (SD3) (Fig 3g). during the time of ASA, the maximum total output (40.2 tons' ha^{-1}) collected in plots deal with 270 mg L^{-1} acetylsalicylic acid implication (ASA3), come after ASA2 (216 mg L^{-1}), i.e., 35.8 tons' $ha^{-1,}$ while the lowest fruit yield (29.9 tons' $ha^{-1)}$ noticed in non-attended plots (treated with ASA0) (Fig 3h).

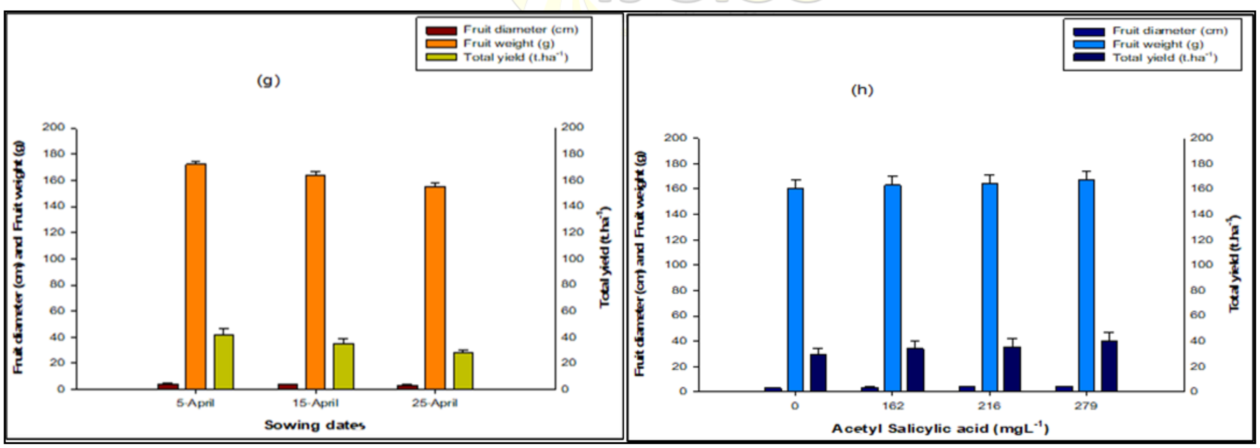

Fig 3b. Vine length (cm), No. Of fruits plant^{-1} and fruit length (cm) as affected by (e) Sowing times and (f) Acetylsalicylic acid application

3. DISCUSSION

Tindal gourd (Catullus vulgaris) plants that were sown late and exposed to high temperatures experienced disruptions in their growth pathways, which led to early blooming and poor fruit sets (Khan et al., 2001). Lower temperatures may cause early-sown plants' delayed flowering because they reduce the growth evaluation of plants and cause flowering to occur later (Sharma et al., 2005). Salic acid acts as a chemical that induces flowering while increasing cellular metabolism. Similar findings of Raskin et al. (1987) show that ethylene acid is an endogenous growth regulator of peanut and other fluorogenic effects. Kumar et al. (1999) had similar findings, indicating that soybeans treated with folic acid enhanced flowering and formation—premature flowering under stress, SA synthesis in stress plants, promoting flowering (Blee, 2002). Stress stimulates the production of several metabolites (such as aspirin, CH4, and SA) that promote early bloom. SA is critical to ion absorption, plant development, and flower start (Hayat & Ahmad, 2007).

The delay in planting leads to early flowering. This early nature can be attributed to late planting, which allows early flowering and, eventually, early results. Khan et al. (2001) found that high temperatures during late planting inhibited plant growth, leading to early flowering. Delayed planting can also hurt the growth and development of plants. This can be attributed to the short lifespan and the possibility of early bloom, which results in high temperatures. Robert and Cockmas (1998) had similar results. Similarly, Lorenz and Maynard (1980) discovered that most fruit development occurs best at a temperature of 25°C.In addition, it was found that high temperatures facilitated respiration, shortened the growth phase of the plants, and led to earlier fruit formation and development. Acids may contribute to the formation of female flowers, increasing the percentage of early fruit yields and early fruits. These findings are comparable with those of Mady (2014), who examined the percentage of early fruit and fruit yields in SA surface applications. Our findings were confirmed by Solamani et al. (2001), who pointed out that SA improves the photosynthesis of plants, which may facilitate the absorption of supply and, help flowers form fruit and seed development, and ultimately increase the yields. Zhang et al. (2010) found that SA may involve the phase of fruit development of real maturity and aging. Saavedra and Martin-Max (2007) found that acid significantly increased tomatoes' yield. In soybeans, applying acid leaves increases flowering and formation (Kumar et al., 1999).

As for the date of sowing, early sowing is encouraging for female cucumbers. The increase in the number of females in cucumbers can be attributed to low temperatures and delayed cultivation, resulting in male sex due to rising temperatures. Our findings are consistent with the Vienna (1997) study, which found that increased temperatures resulted in increased performance of male flowers in cucumbers due to limited supply and accumulation of carbohydrates. According to Miao et al. (2007), relatively low temperatures can increase the amount of carbohydrates by reducing respiratory consumption. According to Roldan et al. (1999), the femininity of grapes increases with the accumulation of sugar due to low temperatures. Based on available resources, monolithic cucumbers adjust their femininity. According to Smith et al. (1994), planting dates significantly influence the number of females in some winter flowers than in others.

The ratio of male and female flowers in cucumbers increases with the increase of ASAs, while the highest number of ASAs produces more females. Femininity may be due to increased glucose absorption caused by ASA. These consequences are relevant to the findings of Maddy (2014), who discovered that increased carbohydrate absorption increases the possibility of femininity, which can be attributed to the use of acids, thereby stimulating the movement and transfer of nitric acids in plant tissues and enhancing photosynthesis to increase the photosynthetic mechanism, which gives more carbonate production. The fluctuations in the length of cucumbers may be affected by temperature, which has the levels and activity of growth promoters such as Auxin, Cytokinin, and Gibberellins, which cause the early plants to grow at a higher height. Dash et al. (2013) also showed that early cultivation can provide the best environment, water, and other natural resources for plants, thus bringing them to the highest level. The cucumber's length is reduced because of the delay in the growth process. When seeds are delayed, plants attain their full height in less time. These findings are comparable with those of Seghatoleslami et al. (2013), who discovered that the planting date substantially impacted Rosselle's plant height. The length of a cucumber can also increase due to hormonal changes, which are required for cucumber length, and ethylene acid is thought to trigger changes in plant hormone levels.

Ethylene acid and its counter-effects result in the maximum length of cucumber. Our results are comparable to those of Gharib (2007).

Similarly, our findings are comparable with those of Sayyari (2012) in cucumber, and Syari et al. (2013), who discovered that leaf SA treatment promoted vegetative development in cucumber plants. Fewer branches in late-seeded sites can be attributed to high temperatures, which reduce the supply of absorbents and lead to a decline in plant development, which harms the length of the vineyard and the number of branches. The results were consistent with those of

Nawaz et al. (2009), who believed that the most significant number of branches could be associated with increased plant height. Poonam et al. (2002) found that early-planted trees have the most branches, which supports our findings. Salic acid increases photosynthesis and stimulates plant growth to promote the synthesis of hormones such as cell growth and Auxin. This promotes cell extension and division, producing more excellent reproduction and branches (Gharib, 2007).

These findings are compatible with those of El-Yazeid (2011), who discovered that the growth qualities of the SA extractive spray for the sweet are statistically significant when compared to controllers. Mady (2009) also noted that using SA resulted in the most branches per tomato plant. Due to the high temperature and sweating rate, plants do not have enough time to grow when planting is delayed, resulting in a decrease in the branches and buds of plants, thereby reducing the fruit of each plant. While regular cultivation provides full-time plant growth, increased plant height, the number of branches, and producing larger fruits, a giant shell and more photometers allow plants to support more fruit plants-1. Our findings are consistent with those of Khan and others. (2001). According to Nunez-Elisea and Davenport (1986), high temperatures may lead to increased ethylene synthesis in the peel, leading to premature peeling and excess leaf loss within approximately 30 days after fertilization. The increase in female flower plant1 most likely causes the rise in fruit plant-1. Vazirimehr and Regi (2014) found the same results: a direct relationship between flowers, yields, and fruit yield.

Locally used ethylene acid inhibits ethanol production, resulting in the fall of fruit trees and the increase of 1 liter. Our research is consistent with the findings of Ngullie et al. (2014). They also found that adding salic acid increased the amount of fruit. Kazemi (2014) discovered that using SA substantially impacted Fruit Plant-1. Similarly, Abdul Wahid et al. (2006) reported a considerable hike in cucumber production and yield elements after applying SA. Fruit length reduction with late planting may be caused by the inhibition of growth promoters such as Auxin, Cytokinin, and Gibberellin, as well as growth inhibitors such as ethylene and ABA, that divide the cell and cause proliferation, which becomes the shortening fruit length. (Blee, 2003). Our findings are consistent with those of Kamali et al. (2016), who observed that changing the planting date substantially affected the length of the fruit. They found that later planting resulted in shorter fruits, while earlier seeds produced longer fruits.

Salic acid increases the synthesis of Auxin and cellular genes, which are responsible for the proliferation and division of the cell wall, thereby increasing the fruit length. Our results are congruent with those of Gharib (2007). Likewise, Tayeb (2005) and Blokhina (2003) discovered that salic acid elevates plant biochemical and physiological procedures such as nutrient absorption, cell division, cell prolongation, and cell differentiation, as well as protein synthesis, dehydration/source regulation, and enzyme activity, resulting in increased fruit length. El-Yazeid (2011) reports that several spray treatments have improved the pattern parameters of the dessert, such as the length, diameter, and size of the fruit. In cases of delayed planting, the minor diameter of the fruit can be attributed to the high temperature, which increases the speed of breathing and evaporation, thereby reducing the absorption of photosynthesizes to the developing fruit. Kamali et al. (2016) also found that early seed dates produced the most significant fruit diameter, while late ripening dates generated the most miniature fruit. Acids are a growth hormone that enhances plant physiological features such as photosynthesis and transfers absorption from the source to the reservoir (Haidri, et al., 2024; Faazal et al., 2023).

Thus, in the case of acids, an increase in fruit diameter can be attributed to increased photosynthesis activity and the availability of additional assimilates to the fruit in development, resulting in larger fruit diameters. Hubbard et al. (1989) and Marcelis (1993) found similar results, indicating that higher levels of absorbed carbohydrates and consistency can lead to increased fruit diameter (Haidri, et al., 2024; Sajid et al., 2024). This increase in the fruit parameter may be linked to sialic acid, which stimulates plant growth, food intake, and photosynthesis, indirectly increasing fruit diameter. El-Yazeid (2011) supports our findings by pointing out that various spray therapies enhance the physical characteristics of sweet fruits (fruit diameter, size, and length) (Haidri, et al., 2024; Ummer et al., 2023). The decrease in fruit capacity of late-seeded plants can be attributed to higher temperatures during flowering and in the early stages of fruit formation and development. Sunil and Sarma (2005) similar findings. When temperatures rise above normal levels, plants shift from plant growth to reproductive growth to resist harsh environmental conditions. As a result, the fruit is produced earlier and more negligible, reducing its weight. Our findings are similar to those of Khan and others. (2001).

According to Yildirim et al. (2006), SA increases the production of carbohydrates and accelerates the degradation of hydrocarbons from the source of the treated plants and the reservoir tissue, resulting in higher fruit weight. Salic acid increases membrane permeability, improves mineral nutrient absorption, and enhances growth, yield, and fruit weight (Javaheri et al., 2012). Elwan et al. (2009) also observed that using SA enhanced NPK absorption and the production of photosynthetic pigments, consequently enhancing cucumber plant growth and productivity and the weight of a single fruit. Similarly, Vasirimehr and Rigi (2014) discovered that adding acid to the soil increased photosynthesis and carbon dioxide absorption, enhancing cucumber growth and yield, as well as the weight of each fruit (Waseem et al., 2023; Hussain et al., 2024). The results of the increase in fruit volume were consistent with those of Hafeznia et al. (2014), who noted that the morphological characteristics of the fruit were strongly influenced by the surface application of sialic acid on tomatoes if they were to be measured. Cucumber has the most significant total production (one tonne per hectare) at early planting dates due to the maximum length of branches, number of female flowers, fruit length, fruit diameter, weight, and plant-1 yield. Hahn's and another finding (2001) match those findings we determined. The rise in overall yields (tonne ha-1) is primarily due to the effect of plant growth regulators in raising fruit concentration, as discussed below (Haidri et al., 2023;Ullah et al., 2024; Fatima et al., 2024). Auxin is responsible for the fruit collective, and the use of ASA may have boosted auxin inheritance levels, improving fruit combination and, as a result, increasing overall production. Our findings are comparable to those of Kazemi (2014), who discovered that SA significantly improved tomato output and quality. Surface application of acid considerably boosted grass yield (tonne ha-1), changed the sex ratio, and promoted female flowering, increasing the number of fruit plants per plant and, thus, overall yield (Al-Rubaye & Abdatia, 2016).

4. Conclusion

Recent research has pinpointed the 5th of April as the optimal sowing date for cucumber cultivation, yielding remarkable growth and superior attributes. These benefits encompass many factors: maximum fruit production per plant, a favorable male-to-female flower ratio, elongated fruits with substantial length and diameter, abundant primary branches, substantial fruit weight, extended vine length, and, ultimately, impressive overall yield. Furthermore, acetylsalicylic acid(ASA) at a concentration of 270 mg L-1 significantly influences cucumber development. ASA-treated plants exhibit delayed flowering, which aligns with the maximization of fruit-bearing potential. Additionally, ASA-treated cucumber maintains a balanced male-to-female flower ratio, ensuring efficient pollination. The cumulative effect of these factors culminates in substantial fruit yield per plant and overall bountiful harvest. Statistical analysis corroborates the finding, emphasizing the significance of the 5th of April sowing date and ASA foliar spray.

Therefore, farmers in Peshawar Valley strongly recommend adopting the following cultivation practices: sow the Poinsett 76 cucumber cultivar during the first week of April and apply ASA foliar spray at the specified concentration. By adhering to these strategies, growers can harness the full potential of their cucumber crops, achieving optimal development and yield in the region's unique agro-climatic conditions.

Conflict of Interest

The Authors declare that there is no conflict of interest.

Acknowledgment

We are very thankful for the kind support of the department colleagues and supporting staff of the University for making this study successful.

References

Abdel-Wahed, M. S. A., A. A. Amin and S. M. El-Rashad. 2006. Physiological effect of some bio regulators on vegetative growth, yield and chemical constituents of yellow maize plants. *World J. Agric. Sci.* 2(2): 149-155.

Ahmed B., M. Sultana, J. Zaman, S. K Paul, M. Rahman, R. Islam and F. F. Majumdar. 2015. Effect of sowing dates on the yield of sunflower. Bangladesh Agron. J. 18: 1-5.

AL-Rubaye, B.C.H. and E. Abd-Atia. 2016. The influence of foliar sprays on the growth and yield of summer squash. *Int. J. Sci. Eng. Res*. 7(6): 664-669.

Amin, A.U., M. Sajid, H. Ahmad and M. Sajid. 2014. Effect of sowing dates on enhancing the flowering time in chrysanthemum (*Chrysanthemum morifolium*). *Int. J. Biosci*. 5(12): 152-159.

Arberg, B.1981 Plant growth regulators. Mono-substituted benzoic acid Swed. *Agric. Res*. 11: 93-105.

Arshad.I., W. Ali, Z. A. Khan. 2014. Effect of different levels of NPK fertilizers on the growth and yield of greenhouse cucumber (*Cucumis sativus* L.) by using Drip irrigation technology. *Int. J. Res*. 1 (8): 212–217.

Atifullaf., and I. Ahmad. 2017. The effect of different concentrations of acetylsalicylic acid on tomatoes under different growth conditions. M.Sc Thesis, Dept. Hort. Faculty of crop production Sci. Uni. Agri. Pesh.

Barkosky, R. R. and F. A Einhellig. 1993. Effects of salicylic acid on plant-water relationships. *J. Chem. Eco*. 19 (2): 237-247.

Blee, E. (2002). Impact of Phyto-oxylipins in plant defense. *Trends Plant Sci*. 7:315-322.

Blokhina, O., E. Virolainen and K.V. Fagerstedt. 2003. Antioxidants, oxidative damage, and oxygen deprivations stress (A review). *Ann. Bot*. 91: 179-194.

Cleland, C. F. and A. Ajami. 1974. Identification of the flower-inducing factor isolated from aphid honeydew as being salicylic acid. *Plant Physiol*. 54(6): 904-906.

Dash., P. K. , M. G. Rabbani and M. F. Mondal. 2013. Effect of variety and planting date on the growth and yield of okra. *Inter. J. of Biosci*. 3 (9). 123-131.

Eifediyi, E. K., S. U. Remison and V. B. Okaka. 2011. Relationship between morphological characters, dry matter yield, and fruit yield of cucumber. *African J. Plant Sci*. 5(11): 656-662.

Elhag, A. Z. and A. A. Ahmed. (2014). Effect of cultivar and sowing date on okra (*Abelmoschus et al.*.) seed yield. *J. Appl. Sci*. 2(3): 64–67.

El-Tayeb, M. A. (2005). Response of barley grains to the interactive effect of salinity and salicylic acid. *Plant Growth Regulation.* 45: 215–224.

Elwana, M. W. M. and M. A. M. El-Hamahmyb 2009. Improved productivity and quality associated with salicylic acid application in greenhouse pepper. S*ci. Hort*. 122(4): 521-526.

El-Yazeid, A. (2011). Effect of foliar application of salicylic acid and chelated zinc on growth and productivity of sweet pepper (*Capsicum et al.*) under autumn planting. Res. *J. Agric. Biol. Sci*. 7(6): 423-433.

Faazal, B., Qasim, M., Mumtaz, S., Iftikhar, M., Khalid, I., Muzaffar, M. J., Nisar, H., & Adrees, M. (2023). Crop quality and quantity as influenced by important air pollutants in Pakistan. In Advances in Botanical Research (Vol. 108, pp. 109–144). Elsevier.

Farhadi, A., K. Salmani, P. Jafari, R. Pashnam and H. Salehi. 2007. Study of best planting date of cucumber cultivars in summer cultivation. Seed and Plant Improvement Institute. *Inter. J. of Biosci*. 1124-1130.

Fatima, R., Basharat, U., Safdar, A., Haidri, I., Fatima, A., Mahmood, A., Ullah, Q., Ummer, K., & Qasim, M. (2024). AVAILABILITY OF PHOSPHOROUS TO THE SOIL, THEIR SIGNIFICANCE FOR ROOTS OF PLANTS AND ENVIRONMENT. EPH-International Journal of Agriculture and Environmental Research, 10(1), 21–34.

Gharib, F. A. E. 2007. Effect of salicylic acid on basil and marjoram's growth, metabolic activities and oil content. *Inter. J. Agric. and Bio. Pak*. 9(2): 294-301.

Gross, D. and B. Parthier. 1994. Novel natural substances acting in plant growth regulation. *J. Plant Growth Regulation*. 13(2): 93.

Grubben, G. J. H. and O. A. denton, 2004. Plant resources of tropical Africa vegetables. PROTA foundation CTA, Wageningen, Netherlands. 668 pp.

Guzmán-Téllez, E., D. D. Montenegro and A. Benavides-Mendoza. 2014. Concentration of salicylic acid in tomato leaves after foliar aspersions of this compound. *Am J. Plant Sci*. 87-91.

Hafeznia, M., K. Mashayekhi, F. Ghaderifar and S.J. Mousavizadeh. 2014. Tomato morphological and biochemical characteristics in response to foliar applying of Salicylic acid. *Int. J. Biosci.* 5(9): 237-243.

Haidri, I., Fatima, N., Abdullah, M., Ilyas, A., Parveen, A., Afzal, R., Shahbaz, M., Batool, M., & Qasim, M. (2024). SYNTHESIS CHARACTERIZATION AND APPLICATIONS OF NANOPARTICLES IN ENVIRONMENTAL DETOXIFICATION. EPH-International Journal of Agriculture and Environmental Research, 10(1), 43–57.

Haidri, I., Ishfaq, A., Shahid, M., Shahzad, T., Hussain, S., & Mahmood, F. (2024). Green Nanoparticles for Textile Wastewater Treatment: The Current Insights. Microbes Based Approaches for the Management of Hazardous Contaminants, 277–292.

Haidri, I., Qasim, M., Shahid, M., Farooq, M. M., Abbas, M. Q., Fatima, R., Shoukat, W., & Ullah, Q. (2024). Enhancing the Antioxidant Enzyme Activities and Soil Microbial Biomass of tomato plants against the stress of Sodium Dodecyl Sulfate by the application of bamboo biochar. Remittances Review, 9(2), 1609–1633.

Haidri, I., Shahid, M., Hussain, S., Shahzad, T., Mahmood, F., Hassan, M. U., Al-Khayri, J. M., Aldaej, M. I., Sattar, M. N., & Rezk, A. A.-S. (2023). Efficacy of Biogenic Zinc Oxide Nanoparticles in Treating Wastewater for Sustainable Wheat Cultivation. Plants, 12(17), 3058.

Hayat, S. and A. Ahmad. 2007. Salicylic acid: a plant hormone, Springer (ed) dortrecht, the Netherlands: Pp. 4-5.

Hayat, S., Q. Fariduddin, B. Ali sand A. Ahmad. 2005. Effect of salicylic acid on growth and enzyme activities of wheat seedlings. *Acta Agron. Hung.* 53: (4) 33-437.

Hosseinzadeh, M., F. Shekari, M. Janmohammadi and N. Sabaghnia. 2013. Effect of sowing date and foliar application of salicylic acid on forage yields and quality of globe artichoke (*Cynara scolymus* L.).*Uni. Maragheh Iran. Agricultura*.2: 68.

Hubbard, N., L. S. C. Hubber and D. M. Pharr. 1989. Sucrose phosphate synthase and acid invertase as determinations of sucrose concentration in developing muskmelon (*Cucumis melo* L.) fruits. *Plant physiol*. 1527-1534.

Hussain, S. R., Rashid, M. Z., Haidri, I., Shafqat, U., & Mahmood, F. (2024). Assessing global good agricultural practices standard adoption: insights from fruit and vegetable farmers in Pakistan. Italian Journal of Food Safety.

Iraddi, V. S. 2008. Response of mustard (*Brassica juncea* L. Czernj and Cosson) varieties to date of sowing and rows pacing in northern transition zone of Karnataka. Dharwad Master of Science (Agriculture) In Agronomy.55-81.

Javaheri, M., K. Mashayekhi, A. Dadkhah and F.Z. Tavallaee. 2012. Effect of salicylic acid on yield and quality characters of tomato fruit (*Lycopersicum esculentum* Mill.). *Inter. J. Agri. and Crop Sci.* 4(16): 1184-1187.

Jilani, M. S., A. Bakar, K. A. S. H. I. F. Waseem and M. Kiran. 2009. Effect of different levels of NPK on the growth and yield of cucumber (*Cucumis sativus*) under the plastic tunnel. *J. Agric. Soc. Sci*. *5*(3): 99-101.

Kamali, S., P. Moaveni, S.A. Valadabadi and A. Mehraban.2016. Effects of sowing date on the morphological traits and fruit yield of bitter ground. J. Agric. Biol. Sci. 11(12): 458-462.

Kazemi, M. 2014. Effect of foliar application with salicylic acid and methyl jasmonate on growth, flowering, yield and fruit quality of tomato. Bull. *Env. Pharmacol. Life Sci*. 3(2): 154-158.

Khan, A. Q., M. Iqbal, M. S. Jilani, A. Ghafoor and K. Waseem. 2001. Effect of different sowing dates on the yield of Tinda Gourd (*Citullus vulgaris*). *J. Bio. Sci*. 1(4): 235-237.

Kumar, P., S. D. Dube and V. S. Chauhan. 1999. Effect of salicylic acid on growth, development and some biochemical aspects of soybean (*Glycine max* L. Merrill). *Int. Plant Physiol*. 4: 327-330.

Larque S. A. and M. R. Martin. 2007. Effect of salicylic acid on the bio-productivity of plants. Springer Publishers. Dordrecht. Netherlands. 645-651.

Latifi, M., A. Barimavandi, S. Sedaghathoor and S.R. Lipayi. 2012. Sowing date and plant population effects on seed yield of *Cucurbita pepo*. *Int. J. Agric. Biol.* 14(4): 641–644.

Lorenz, O. A. and D. N. Maynard. 1980. Knott's Handbook of Vegetable Growers. 2nd edn, J. Wiley, New York: 142-143.

Mady, M. A. 2009. Effect of foliar application with salicylic acid and vitamin E on growth and productivity of tomato (*Lycopersicon esculentum*, Mill.) *Plant. J. Agric. Sci*. 34(6): 6735 – 6746.

Mady, M. A. 2014. Inducing cold tolerability in squash (*Cucurbita pepo* L.) plant by using salicylic acid and chelated calcium application. *Intl. J. Agric. Sci. Res.* 4(4): 24.

Marcelis, L. F. M. 1993. Effect of assimilate supply on the growth of individual cucumber fruits. *Physiol. Plant*. 313-320.

Miao, M., X. Xu, X. Chen, L. Xue and B. Cao. 2007. Cucumber carbohydrate metabolism and translocation under chilling night temperature. *J. Plant Physio*. 621–628.

MINNFSR. 2015. Fruits, vegetables, and condiments statistics of Pakistan, Ministry of National Food Security and Research. Economic wing, Islamabad. Pp: 21-22.

Munne-bosch, S., S. Falara, L. Pateraki, M. Lopez-Carbonell, J. Cela and A. K. Kanellis. 2009. Physiological and molecular responses of the isoprenoid biosynthetic pathway in a drought-resistant Mediterranean shrub, *Cistus creticus* exposed to water deficit. *J. Plant Phys*. 166(2): 136-145.

Muqarab, K. 1992. Response of different cucumber cultivars to various doses of nitrogen under the climatic condition of Peshawer. M.Sc. (Hons) thesis, Dept. of Hort. NWFP Agri. Peshawar.

Nawaz A, S. Gul, M. A. Anjum and F. Naveed**.** 2009. Effect of various sucker sizes and planting times on growth and flower yield of chrysanthemum. *Pak. J. Agri. Sci*. 46(1):7-12.

Ne Smith, D. S., G. Hoogenboom and D. W. Groff. 1994. Starmnate and pistillate flower production of summer squash in response to planting date. *Hort. Sci*. (29): 256-257.

Ngullie, C.R., R.V. Tank and D.R. Bhanderi. 2014. Effect of salicylic acid and humic acid on flowering, fruiting, yield and quality of mango (*Mangifera indica* L.) Cv. Kesar. *Adv. Res. J. Improvement.* 5(2): 136-139.

Nunez-Elisea, R**.** and T. L. Davenport. 1986. Abscission of mango fruitlets as influenced by enhanced ethylene bio-symthesis. *Plant Physio*. 82(4): 991-994.

Okonmah, L. U. 2011. Effects of different types of staking and their cost effectiveness on the growth, yield and yield components of cucumber (*Cucumis sativa* L.). *International Journal of Agri. Sci*. 1 (5): 290-295.

Pandey, I. R. and K. P. Adhikari. 1996. Research for vegetable development in Nepal. In national seminar on Vegetable Development.

Pant, T., R. P. Joshi, A. S. Bhoj and N. Kumar. 2001. Identification of suitable vegetable cropping sequences for greenhouse cultivation in Uttaranchal hills. *Vegetable Sci*. 28 (2): 143-145.

Poonam R., Kumar and R. K. Dubey. 2002. Effect of planting time and spacing on zinnia. *J. of Ornamental Hort*. 5:49-50.

Quiroz-Figueroa, F., M. Méndez-Zeel, A. Larqué-Saavedra and V. Loyola-Vargas. 2001. Picomolar concentrations of salicylates induce cellular growth and enhance somatic embryogenesis in *Coffea arabica* tissue culture. *Plant cell reports*. 20(8): 679-684.

Raskin, I. 1992. Salicylate, a new plant hormone. *Plant Physio*. 99(3): 799.

Raskin, I., A. Ehmann, W. R., Melander and B. J. D. Meeuse**.** 1987. Salicylic acid-a natural inducer of heat production in Arum lilies. *Sci.* 237:1545-125.

Robert, J. D. and A. Korkmaz, 1998. Influence of plant spacing on Connecticut Field pumpkin size, density and yield. Pp: 51–53.

Roldan M, C. Gomez-Mena, L. Ruiz-Garcı´a, J. Salinas and J. M. Martı´nez- Zapater. 1999. Sucrose availability on the aerial part of the plant promotes morphogenesis and flowering of Arabidopsis in the dark. *The Plant J*. 20: 581–590.

Rookh, N. 1995. The influence of zinc, boron and manganese on plant growth yield and fruit quality of cucumber.(*Cucum issativus* L.). M.Sc (Hons) thesis, Dept. of Hort., NWFP Agri. Uni. Peshawer.

Sajid, S. A., Tehseen, P., Mahmood, U., Ghaffar, A., Qasim, M., Arooj, R., Tahir, T., & Rafique, Z. (2024). Role of Sustainable Alternatives to Petrochemical Based Plastics in Achieving the SDGS. Indonesian Journal of Agriculture and Environmental Analytics, 3(1), 35–52.

Sayyari, M. 2012. Improving chilling resistance of cucumber seedlings by salicylic acid. *American-Eurasian J. Agric. Enviro*. Sci. 12(2): 204-209.

Sayyari, M., F. Ghanbari, S. Fatahi and F. Bavandpour. 2013. Chilling tolerance improving of watermelon seedling by salicylic acid seed and foliar application. *Sci. Biol*. (1): 67-73.

Seghatoleslami, M. J., S. G. Mousavi and T. Barzgaran. 2013. Effect of irrigation and planting date on morphophysiological traits and yield of rosell (*Hibiscus sabdariffa*) *J. of Animal and Plant Sci.* 23(1): 256-260.

Senaratna, T., D. Touchell, E. Bunn and K. Dixon. 2000. Acetyl salicylic acid (Aspirin) and salicylic acid induce multiple stress tolerance in bean and tomato plants. *J. Plant. Growth. Regulation.* 30:157-161.

Sharma, M.D.,Y. GC, K. M. Tripathi and S. P. Bhattarai. 2005. Performance of mahyco green long and Bhaktapur local cucumber cultivars at different sowing dates in mid-hill of Nepal. *J. Inst. Agric. Anim. Sci*. 26: 163-166.

Shrestha, T. N. and N. P. Ghimire. 1996. Fresh vegetable production in Nepal. In national seminar on vegetable development. Pp: 11-12.

Solamani, A., C. Sivakumar, S. Anbumani, T. Suresh and K. Arumugam. 2001. Role of plant growth regulators on rice production: A review. Agric. Rev.23: 33-40.

Steel, R. G. D., J. H. Torrie and D. A. Dickie. 1997. Principles and procedures of statistics-a biometric approach. 3rd ed. Mc Graw-Hill publish. Co Toronto, Canada.

Subedi, P. P., S. P. Bhattarai and J. P. Jaiswal. 1997. Increase female flower frequencies in cucumber (*Cucumis sativus* L.) cv. Bhaktapur Local. 97 (28): 169-171.

Sunil, K. M. and K. S. S. Sarma. 2005. Characterizing thermal environment under enaiarid conditions in relation to growth and development of bottle gourd and tomato. *J. Agric. Physics*. 5(1): 71-78.

Ullah, Q., Qasim, M., Abaidullah, A., Afzal, R., Mahmood, A., Fatima, A., & Haidri, I. (2024). EXPLORING THE INFLUENCE OF NANOPARTICLES AND PGPRS ON THE PHYSICO-CHEMICAL CHARACTERISTICS OF WHEAT PLANTS: A REVIEW. EPH-International Journal of Agriculture and Environmental Research, 10(1), 1–9.

Ummer, K., Khan, W., Iqbal, M. A., Abbas, M. Q., Batool, R., Afzal, R., Ullah, Q., Qasim, M., & Haidri, I. (2023). THE INTRICACIES OF PHOTOCHEMICAL SMOG: FROM MOLECULAR INTERACTIONS TO ENVIRONMENTAL IMPACT. EPH-International Journal of Applied Science, 9(2), 23–33.

Vazirimehr, M.R and K. Rigi. 2014. Effect of salicylic acid in Agriculture. *Inter. J. Plant Animal and Eviro. Sci*. 4(2):291-296

Vimala, P., C. C. Ting, H. Salbiah, B. Ibrahim and L. Ismail. 1999. Biomass production and nutrient yields of four green manures and their effect on the yield of cucumber. *J. tropical Agri and food Sci*. 27. 47-56.

Waseem, M., Abbas, M. Q., Ummer, K., Fatima, R., Khan, W., Gulzar, F., Qasim, M., Ullah, Q., & Haidri, I. (2023). PHYTO-REMEDIES FOR SOIL RESTORATION: A DEEP DIVE INTO BRASSICA'S PLANT CAPABILITIES IN CADMIUM REMOVAL. EPH-International Journal of Biological & Pharmaceutical Science, 9(1), 23–44.

Weissmann, G. 1991. *Aspirin Scientific American*. 264. 84-90.

White, R. F. 1979. Acetyl salicylic acid (aspirin) induces resistance to tobacco mosaic virus in tobacco. *Virology*. 99 (2): 410-412.

Wien, H. C. 1997. The cucurbits: Cucumber, Melon, Squash and Pumpkin: in the physiology of vegetable crops. *CAB Inter, H. C*. pp: 345-386.

Yildirim, E., I. Guvenc, A. Karatas. 2006. Effect of different number of foliar salicylic acid applications on plant growth and yield of cucumber. *Kansas State Uni Faculty of Agri*. 90-94.

Zhang, L., Y. Gao, Y. Zhang, J. Liu and J. Yu**.** 2010. Change in bioactive compound and antioxidant activities in pomegranate leaves. *Sci. Hort.* 123: 543- 546.