Growth and Yield of Squash Influenced by Leaf Pruning and Gibberellic Acid (GA$_3$)

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Authors’ contributions

This work was carried out in collaboration among all authors. Author TB conducted the experiments, collected the data and writing the manuscript. Author JU supervise the experimental works and edit the manuscript. Author BD performed statistical analysis. Authors AA and SC hypothesized the paper concept and designed the experiment. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was conducted at Sher-e-Bangla Agricultural University’s Horticulture Farm, Sher-e-Bangla Nagar, Dhaka-1207, to determine the effect of pruning and GA3 on squash growth and yield over the period from November 2017 to February 2018. Three levels of pruning as P$_0$ = No pruning (control), P$_1$ = 1st pruning at 20 DAT (1st and 2nd leaves) and P$_2$ = 2nd pruning at 30 DAT (3rd and 4th leaves) and four levels of GA$_3$ foliar application as G$_0$ = No GA$_3$ (control), G$_1$ = 100 ppm GA$_3$, G$_2$ = 200 ppm GA$_3$ and G$_3$ = 400 ppm GA$_3$ considered for the present study. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Considering growth parameters, pruning treatment had a significant effect on growth, yield contributing parameters and yield of squash except for stem base diameter and individual fruit weight. Regarding GA$_3$ treatments, growth and yield parameters were significantly influenced except fruit diameter. In terms of the combined effect of pruning and GA$_3$ treatments, all the studied growth and yield parameters were significantly influenced. The highest stem length (64.73 cm), number of leaves plant$^{-1}$ (23.59), stem base diameter (2.09 cm), number of male flower plant$^{-1}$ (8.69), number of female flower plant$^{-1}$ (7.52), total number of fruits plant$^{-1}$ (5.74), fruit length (22.42 cm), fruit...
diameter (6.15 cm), individual fruit weight (507.66 g), dry weight of fruit (6.61%), weight of fruits plant\(^{-1}\) (2914.33 g) and fruit yield ha\(^{-1}\) (29.14 t) were also found from the treatment combination of P\(_1\)G\(_3\) compared to the other treatment combination. Hence, we can summarize that 1\(^{st}\) pruning at 20 DAT (1\(^{st}\) and 2\(^{nd}\) leaves) with 100 ppm GAs given the maximum output in terms of yield compared to other treatments.

**Keywords:** Squash; pruning; gibberellic acid; growth; yield.

1. **INTRODUCTION**

Squash (Cucurbita pepo L.) is one of the most versatile and delicious foods available throughout the world and it pack a serious punch in terms of health and medicinal benefits [1]. Squash is rich in carotenoids, beta carotene (a precursor to vitamin A), lutein, zeaxanthin, protein, vitamin C, vitamin B6, fiber, magnesium, potassium. Squash has been used in some cultures as a medicinal plant to treat diabetes, high blood pressure, cancer, high cholesterol, and inflammation [2].

To increase the production of squash, various improved production technologies can be initiated. Pruning treatment and GA\(_3\) application can be considered as important improved technologies for successful squash production. There is an imperative need for improvement of fruit quality to meet the change in market demand and making it available to the maximum extent by foliar spray of GAs and regular current season shoot pruning.

Pruning is one of the management practices for squash cultivation that increases the quantity of marketable yield harvested in the first cut, indicating that fruit maturity was also advanced [3]. It is a horticultural and silvicultural practice involving the selective removal of certain parts of the plant, such as leaves, branches, buds, or roots. It helps both harvesting and increasing the yield or quality of flowers and fruits. Its large leaves can quickly take up space in the garden and prevent fruits from receiving adequate sunlight. Pruning of squash can help alleviate any overcrowding or shading issues.

Gibberellins (GAs) are a large group of important diterpenoid acids among commercial phytohormones [4]. Gibberellins are tetracyclic diterpenoid acids that are involved in a number of developmental and physiological processes in plants [5]. These processes include seed germination, seedling emergence, stem and leaf growth, floral induction and flower and fruit growth [6]. Gibberellins (GAs) have been used in increasing stalk length and vegetative growth, flower initiation, increasing fruit size, hastening maturity and improving fruit quality in many crops. Gibberellins play an important role in enhancing the growth and flowering in fenugreek [7]. With all of this in mind, we studied the effects of leaf pruning and GAs on growth and yield of squash.

2. **MATERIALS AND METHODS**

2.1 **Experimental Site**

The experiment was conducted during the period from November 2017 to February 2018 at the Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh, to study the impact of pruning and GA\(_3\) on squash growth and yield. At 90 ° 22' E longitude and 23 ° 41' N latitude at an altitude of 8.2 m above sea level, the experimental area was located. It was in the Madhupur Agro-Ecological Zone (AEZ No.28) with deep red-brown terrace soil, which belongs to the Nodda cultivated series. With a particle density of 2.65 (g•cc\(^{-1}\)) and a bulk density of 1.52 (g•cc\(^{-1}\)), the soil was sandy loam in texture. The pH of the soil was 6.43; organic matter 0.84(%) ; overall N 0.46(%) ; exchangeable K 0.41 (meq/100 g soil); available P 18.65, S 20.92, Fe 225, Zn 4.55, and Mg 0.81(mg•g\(^{-1}\)). Under the subtropical monsoon climate, this is characterized by scanty rainfall during the Rabi season (November to February).

2.2 **Planting Materials, Experimental Design, and Treatments**

The experiment was performed in Randomized Complete Block Design (RCBD) with three replications consisting of two factors: factor A, three levels of leaf pruning (P\(_0\) = No pruning (control), P\(_1\) = 1\(^{st}\) pruning at 20 Days After Transplanting(1\(^{st}\) and 2\(^{nd}\) leaves), and P\(_2\) = 2\(^{nd}\) pruning at 30 Days After Transplanting (3\(^{rd}\) and 4\(^{th}\) leaves) and factor B, four levels of Gibberellins foliar application (G\(_0\) = No GAs (control), G\(_1\) = 100 ppm GAs, G\(_2\) = 200 ppm GAs,
and $G_3 = 400$ ppm $GA_3$). In addition, $P_0G_0$, $P_0G_1$, $P_0G_2$, $P_0G_3$, $P_1G_0$, $P_1G_1$, $P_1G_2$, $P_1G_3$, $P_2G_0$, $P_2G_1$, $P_2G_2$, and $P_2G_3$ were the treatment combinations. Experimental plot size was 1m x 1m and plant spacing was maintained 0.5m x 0.5m.

2.3 Seeds Sowing, Pit Preparation, and Transplanting of Seedlings

Healthy and standardized 18-day-old seedlings were taken separately from the seedbed and transplanted on 25 November 2017 into the experimental site. For transplanting, plant spacing of 50 cm x 50 cm was maintained. Before uprooting the seedlings, the seedbed was watered to minimize the damage to the roots.

2.4 Pruning and GA$_3$ Application

The experiment was designed to spread a combination of pruning and various levels of GA$_3$. The plants use four levels of GA$_3$. According to the treatment, pruning was conducted. Primary pruning was completed at 20 days after transplanting by removing the first branch (1$^{st}$ and 2$^{nd}$ leaf) and secondary pruning was completed at 30 days after transplanting by removing the second branch (3$^{rd}$ and 4$^{th}$ leaf).

2.5 Data Collection

Growth parameters such as stem length (cm), number of leaves plant$^{-1}$, stem base diameter (cm), number of male flowers, number of female flowers, the total number of fruit plot$^{-1}$, fruit length (cm), fruit diameter (cm), individual fruit weight (g), % fruit dry weight, number of fruits plant$^{-1}$ and fruit yield (t/ha) were measured following the standard procedure [8].

2.6 Statistical Analysis

The data obtained for various characters was statistically evaluated using the SPSS programming software application to observe the significant variations between the treatments. The mean values of all the characters were computed and analysis of variance has been performed.

3. RESULTS AND DISCUSSION

3.1 Effects of Pruning on Growth Parameters

Growth parameters were influenced significantly by the introduction of pruning. With $P_1$ (1$^{st}$ pruning at 20 DAT) treatment, the highest stem length (62.74 cm at harvest) (Fig.1), number of leaves plant$^{-1}$ (21.85 at harvest) (Fig. 2), and stem base diameter (1.99 cm at harvest) (Fig.3) were recorded. The shortest length of the stem was 60.23 cm and the stem diameter was 1.94 cm for $P_0$ care (no pruning).

Pruning tends to generate a healthier condition of the plant; sunlight enters the entire plants more effectively, enhancing light interception for photosynthesis. We found that at the early growth stage of 40 d after transplanting, the stem length and diameter of squash were greatest with pruning techniques. [9]

![Fig. 1. Stem Length (cm) of squash influenced by pruning](image-url)

$P_0 = $ No pruning (control), $P_1 = 1^{st}$ pruning at 20 DAT (1$^{st}$ and 2$^{nd}$ leaves), $P_2 = 2^{nd}$ pruning at 30 DAT (3$^{rd}$ and 4$^{th}$ leaves)
Fig. 2. Number of leaves plant\textsuperscript{1} of squash influenced by pruning
$P_0 = \text{No pruning (control)}, P_1 = 1\textsuperscript{st} \text{ pruning at 20 DAT (1\textsuperscript{st} and 2\textsuperscript{nd} leaves)}, P_2 = 2\textsuperscript{nd} \text{ pruning at 30 DAT (3\textsuperscript{rd} and 4\textsuperscript{th} leaves)}$

Fig. 3. Stem base Diameter (cm) of squash influenced by pruning
$P_0 = \text{No pruning (control)}, P_1 = 1\textsuperscript{st} \text{ pruning at 20 DAT (1\textsuperscript{st} and 2\textsuperscript{nd} leaves)}, P_2 = 2\textsuperscript{nd} \text{ pruning at 30 DAT (3\textsuperscript{rd} and 4\textsuperscript{th} leaves)}$

The availability of light and CO\textsubscript{2} increases the photosynthesis rate in plants, and non-pruned plants display extreme vegetative growth, causing suboptimal use of photosynthesis and resulting in decreases of plant yield [3]. Stem pruning is expected to create optimal space for the vegetative growth, which helps promote photosynthesis, resulting in cell enlargement in fruit length and diameter [10, 11]. Pruning helps reduce unproductive plant parts, which allow the photosynthesis process to be more widely allocated, enhancing fruit weight and production [12, 13].

We also observed that yield-contributing parameters were significantly improved by proper pruning. Compared to no pruning, we observed increased flowering, fruit number per plant, fruit length and diameter, and eventually increased yield. With regard to fruit setting, fruits per plant, and ultimate yield with early-stage stem pruning in bell pepper, [1] described a similar finding.
3.2 Effects of GA$_3$ Application on Growth Parameters

In addition, at different growth stages, stem length was greatly influenced by various GA$_3$ levels. However, the results on growth parameters like stem length (63.31 cm at harvest) (Fig.4), number of leaves plant$^{-1}$ (21.77 at harvest) (Fig.5), and stem base diameter (2.05 cm at harvest) (Fig.6) were found from the treatment G$_1$ (100 ppm GA$_3$) compared with the control treatment. Gibberellins (GAs) are a large group among commercial phytohormones of essential diterpenoid acids. Gibberellins are tetracyclic diterpenoid acids involved in a number of plant developmental and physiological processes [4]. These processes include germination of seeds, emergence of seedlings, growth of stems and leaves, floral induction and growth of flowers and fruits [6, 14].

![Fig. 4. Stem Length (cm) of squash influenced by GA$_3$](image)

$G_0 = $ No GA$_3$ (control), $G_1 = 100$ ppm GA$_3$, $G_2 = 200$ ppm GA$_3$, $G_3 = 400$ ppm GA$_3$

![Fig. 5. Number of leaves plant$^{-1}$ of squash influenced by GA$_3$](image)

$G_0 = $ No GA$_3$ (control), $G_1 = 100$ ppm GA$_3$, $G_2 = 200$ ppm GA$_3$, $G_3 = 400$ ppm GA$_3$
Gibberellins are also involved in promoting root development, abundance of root hair and inhibition of differentiation of floral buds in woody angiosperms, regulating dormancy of vegetative and reproductive buds and delaying senescence in many organs of a variety of plant species [15,16]. Gibberellic acid is such a plant growth regulator that a number of growth and development phenomena in various plants can be manipulated. GA₃ promotes plant growth activities, enhances stem elongation and increases dry weight and yield [5].

In many crops, gibberellins (GA₃) have been used to increase stalk length and vegetative development, flower initiation, increase fruit size, accelerate maturity and improve fruit quality. Gibberellins play a significant role in the improvement of fenugreek growth and flowering [9]. Exogenous growth regulator treatments – gibberellins (usually gibberellic acid; GA₃) have been shown to break dormancy in many seed species [7, 17].

### 3.3 Effects on Growth Parameters by the Combined Impact of Pruning and GA₃ Application

Differences in stem length and diameter were statistically significant in the combined impact of pruning and GA₃. Compared to other treatments, the highest stem length (64.73 cm at harvest) (Table 1), number of leaves plant⁻¹ (23.59) (Table 2), stem base diameter (2.09 cm at harvest) (Table 3) was found from the treatment combination of P₁G₁. On the other hand, the lowest stem length (57.22 cm) (Table 1), number of leaves plant⁻¹ (17.26) (Table 2), stem base diameter (1.90 cm) (Table 3), were found from the treatment combination of P₀G₀.

### 3.4 Yield Attributes Influenced by Pruning

Yield contributing parameters in squash were significantly influenced by pruning. The highest number of male flower plant⁻¹ (7.39), number of female flower plant⁻¹ (6.17), total number of fruits plant⁻¹ (4.95) (Table 4), fruit length (21.18 cm), fruit diameter (5.83 cm), individual fruit weight (419.60 g) (Table 5), % fruit dry weight (6.09%), weight of fruits plant⁻¹ (2114.38 g) and fruit yield ha⁻¹ (21.14 t) (Table 6) were also found from the treatment P₁ (1st pruning at 20 DAT). Similarly, the lowest stem length (60.23 cm at harvest), number of leaves plant⁻¹ (19.07 at harvest) and stem base diameter (1.94 cm at harvest) were found from the control treatment P₀ (no pruning). The lowest number of male flower plant⁻¹ (4.99), number of female flower plant⁻¹ (4.69), total number of fruits plant⁻¹ (4.27) (Table 4), fruit length (20.16 cm), fruit diameter (3.83 cm), individual fruit weight (371.00 g) (Table 5), % fruit dry weight (5.80%), weight of fruits plant⁻¹ (1605.59 g) and fruit yield ha⁻¹ (16.05 t) (Table 6) were also found from the control treatment P₀ (no pruning).
Table 1. Stem Length (cm) of squash influenced by the combined effect of pruning and GA$_3$

| Treatments Combination | Stem Length (cm) |            |            |
|------------------------|------------------|------------|------------|
|                        | At 30 DAT        | At 45 DAT  | At Harvest |
| P$_0$G$_0$             | 17.88 h          | 42.27 j    | 57.22 h    |
| P$_0$G$_1$             | 21.69 c          | 46.62 d    | 61.74 e    |
| P$_0$G$_2$             | 19.70efg         | 44.66 g    | 61.27 cd   |
| P$_0$G$_3$             | 19.36 fg         | 44.24 h    | 60.72 de   |
| P$_1$G$_0$             | 20.47de          | 45.22 f    | 60.24 ef   |
| P$_1$G$_1$             | 25.28 a          | 49.73 a    | 64.73 a    |
| P$_1$G$_2$             | 23.43 b          | 48.45 b    | 64.35 a    |
| P$_1$G$_3$             | 22.67 b          | 47.76 c    | 61.65 c    |
| P$_2$G$_0$             | 18.88 g          | 43.81 i    | 58.71 g    |
| P$_2$G$_1$             | 23.24 b          | 48.46 b    | 63.45 b    |
| P$_2$G$_2$             | 21.02 cd         | 46.26 e    | 61.24 cd   |
| P$_2$G$_3$             | 19.86 ef         | 44.69 g    | 59.74 f    |
| Standard Error(±)      | 1.76             | 2.52       | 3.11       |
| Significance           | 0.000            | 0.000      | 0.000      |

$P_0$ = No pruning (control), $P_1$ = 1st pruning at 20 DAT (1st and 2nd leaves), $P_2$ = 2nd pruning at 30 DAT (3rd and 4th leaves) $G_0$ = No GA$_3$ (control), $G_1$ = 100 ppm GA$_3$, $G_2$ = 200 ppm GA$_3$, $G_3$ = 400 ppm GA$_3$.

Table 2. Number of leaves plant$^{-1}$ of squash influenced by combined effect of pruning and GA$_3$

| Treatments Combination | No. of Leaves |            |            |
|------------------------|---------------|------------|------------|
|                        | At 30 DAT      | At 45 DAT  | At Harvest |
| P$_0$G$_0$             | 9.31 j         | 15.24 f    | 17.26 h    |
| P$_0$G$_1$             | 12.67 e        | 18.79 d    | 20.58 de   |
| P$_0$G$_2$             | 10.86 g        | 17.11 e    | 19.43 fg   |
| P$_0$G$_3$             | 10.38 h        | 16.63 e    | 19.02 g    |
| P$_1$G$_0$             | 11.33 f        | 18.23 d    | 19.96 ef   |
| P$_1$G$_1$             | 15.75 a        | 21.27 a    | 23.59 a    |
| P$_1$G$_2$             | 13.92 c        | 20.35 bc   | 22.57 b    |
| P$_1$G$_3$             | 13.38 d        | 20.65 ab   | 21.28 cd   |
| P$_2$G$_0$             | 9.766 i        | 16.74 e    | 21.83 c    |
| P$_2$G$_1$             | 14.37 b        | 19.88 c    | 21.15 cd   |
| P$_2$G$_2$             | 12.26 e        | 18.73 d    | 20.69 de   |
| P$_2$G$_3$             | 10.72 gh       | 16.89 e    | 19.17 g    |
| Standard Error (±)     | 1.36           | 1.52       | 2.11       |
| Significance           | 0.000          | 0.000      | 0.000      |

$P_0$ = No pruning (control), $P_1$ = 1st pruning at 20 DAT (1st and 2nd leaves), $P_2$ = 2nd pruning at 30 DAT (3rd and 4th leaves) $G_0$ = No GA$_3$ (control), $G_1$ = 100 ppm GA$_3$, $G_2$ = 200 ppm GA$_3$, $G_3$ = 400 ppm GA$_3$.

3.5 Yield Attributes Influenced by GA$_3$

Yield contributing characteristics of squash were also significantly influenced by GA$_3$. The highest number of male flower plant$^{-1}$ (7.26), number of female flower plant$^{-1}$ (6.48), total number of fruits plant$^{-1}$ (5.37) (Table 4), fruit length (22.15 cm), fruit diameter (5.41 cm), individual fruit weight (455.50 g) (Table 5), % fruit dry weight (6.50%), weight of fruits plant$^{-1}$ (2451.21 g) and fruit yield ha$^{-1}$ (24.51 t) (Table 6) was found from the treatment G$_1$ (100 ppm GA$_3$). The lowest stem length (58.72 cm at harvest), number of leaves plant$^{-1}$ (19.68 at harvest), stem base diameter (1.91 cm at harvest), number of male flower plant$^{-1}$ (4.25), number of female flower plant$^{-1}$ (4.20) (Table 4), total number of fruits plant$^{-1}$ (3.85), fruit length (19.15 cm), fruit diameter(4.44 cm), individual fruit weight (375.13 g) (Table 5), % fruit dry weight (5.29%), weight of fruits plant$^{-1}$ (141.50 g) and fruit yield ha$^{-1}$ (14.41 t) (Table 6) were found from the control treatment G$_0$ (0 ppm GA$_3$).
Table 3. Stem base Diameter (cm) of squash influenced by the combined effect of pruning and GA₃

| Treatments Combination | Stem base Diameter (cm) |         |         |         |
|------------------------|-------------------------|---------|---------|---------|
|                        | At 30 DAT               | At 45 DAT | At Harvest |
| P₀G₀                   | 1.11 d                  | 1.35 e | 1.90 e |
| P₀G₁                   | 1.15 bc                 | 1.45 ab | 1.97 bc |
| P₀G₂                   | 1.15 bc                 | 1.42 abc | 1.96 bcd |
| P₀G₃                   | 1.15 bc                 | 1.42 abc | 1.94 cde |
| P₁G₀                   | 1.13 cd                 | 1.36 de | 1.93 de |
| P₁G₁                   | 1.18 a                  | 1.45 a | 2.09 a |
| P₁G₂                   | 1.16 ab                 | 1.43 ab | 1.98 b |
| P₁G₃                   | 1.15 b                  | 1.41 bc | 1.96 bcd |
| P₂G₀                   | 1.12 d                  | 1.35 de | 1.91 e |
| P₂G₁                   | 1.15 b                  | 1.41 bc | 2.08 a |
| P₂G₂                   | 1.15 b                  | 1.41 bc | 1.95 bcd |
| P₂G₃                   | 1.13 cd                 | 1.39 cd | 1.93 de |
| Standard Error(±)      | 0.28                    | 0.36   | 0.44   |
| Significance           | 0.000                   | 0.000  | 0.000  |

P₀ = No pruning (control), P₁ = 1ˢᵗ pruning at 20 DAT (1ˢᵗ and 2ⁿᵈ leaves), P₂ = 2ⁿᵈ pruning at 30 DAT (3ʳᵈ and 4ᵗʰ leaves) G₀ = No GA₃ (control), G₁ = 100 ppm GA₃, G₂ = 200 ppm GA₃, G₃ = 400 ppm GA₃

Table 4. Yield contributing parameters of squash (male flower/plant, female flower/plant, and fruits/plant) influenced by pruning and GA₃

| Treatments | Yield contributing parameters |         |         |         |
|------------|--------------------------------|---------|---------|---------|
|            | Total No. of Male Flower/plant | Total No. of Female Flower/plant | Total No. of Fruits/plant |

Effect of pruning

| P₀ | 4.99 b | 4.69 b | 4.27 b |
| P₁ | 7.39 a | 6.17 a | 4.95 a |
| P₂ | 5.74 b | 4.90 b | 4.49 ab |
| Standard Error (±) | 0.48 | 0.62 | 0.77 |
| Significance | 0.000 | 0.001 | 0.033 |

GA₃

| G₀ | 4.25 c | 4.20 c | 3.85 c |
| G₁ | 7.26 a | 6.48 a | 5.37 a |
| G₂ | 7.02 a | 5.20 b | 4.62 b |
| G₃ | 5.63 b | 5.14 b | 4.44 b |
| Standard Error (±) | 0.58 | 0.74 | 0.68 |
| Significance | 0.000 | 0.000 | 0.000 |

P₀ = No pruning (control), P₁ = 1ˢᵗ pruning at 20 DAT (1ˢᵗ and 2ⁿᵈ leaves), P₂ = 2ⁿᵈ pruning at 30 DAT (3ʳᵈ and 4ᵗʰ leaves) G₀ = No GA₃ (control), G₁ = 100 ppm GA₃, G₂ = 200 ppm GA₃, G₃ = 400 ppm GA₃

3.6 Yield Attributes Influenced by the Combined Effect of Pruning and GA₃ Application

In terms of the combined effect of pruning and GA₃ treatments, all the studied growth and yield parameters were significantly influenced. The highest number of male flower plant⁻¹ (8.69), number of female flower plant⁻¹ (7.52), total number of fruits plant⁻¹ (5.74) (Table 7), fruit length (22.42 cm), fruit diameter (6.15 cm), individual fruit weight (507.66 g) (Table 8), % fruit dry weight (6.61%), weight of fruits plant⁻¹ (2914.33 g) and fruit yield ha⁻¹ (29.14 t) (Table 9) were also found from the treatment combination of P₁G₁. Similarly, the lowest number of male flower plant⁻¹ (3.47), number of female flower plant⁻¹ (3.85), total number of fruits plant⁻¹ (3.69) (Table 7), fruit length (18.83 cm), fruit diameter (3.19 cm), individual fruit weight (305.66 g) (Table 8), % fruit dry weight (5.15%), weight of fruits plant⁻¹ (1130.30 g) and fruit yield ha⁻¹ (11.30 t) (Table 9) were found from the treatment combination of P₀G₀.
Table 5. Yield contributing parameters of squash (fruit length, fruit diameter, individual fruit weight) influenced by pruning and GA3

| Treatments | Yield contributing parameters | Percent (%) fruit dry weight | Weight of fruits plant⁻¹ (g) | Fruit yield ha⁻¹ (t) |
|------------|-------------------------------|-----------------------------|-----------------------------|---------------------|
| Effect of pruning | Fruit Length (cm) | 20.16 a | 3.83 c | 371.00 a |
| | Fruit Diameter (cm) | 21.18 a | 5.83 a | 419.60 a |
| | Individual Fruit Weight (g) | 20.51 a | 4.79 b | 405.72 a |
| Standard Error (±) | 0.24 | 0.17 | 6.48 |
| Significance | 0.112 | 0.000 | 0.190 |
| Effect of GA3 | 19.15 c | 4.44 a | 375.13 b |
| | 22.15 a | 5.41 a | 455.50 a |
| | 20.90 b | 4.78 a | 396.01 b |
| | 20.26 c | 4.65 a | 368.46 b |
| Standard Error (±) | 0.41 | 0.22 | 7.33 |
| Significance | 0.000 | 0.186 | 0.000 |

P₀ = No pruning (control), P₁ = 1st pruning at 20 DAT (1st and 2nd leaves), P₂ = 2nd pruning at 30 DAT (3rd and 4th leaves) G₀ = No GA3 (control), G₁ = 100 ppm GA3, G₂ = 200 ppm GA3, G₃ = 400 ppm GA3

Table 6. Yield contributing parameters and yield of squash (percent (%) fruit dry weight, the weight of fruits plant⁻¹, fruit yield ha⁻¹) influenced by pruning and GA3

| Treatments | Yield contributing parameters and yield | Percent (%) fruit dry weight | Weight of fruits plant⁻¹ (g) | Fruit yield ha⁻¹ (t) |
|------------|----------------------------------------|-----------------------------|-----------------------------|---------------------|
| Effect of pruning | 5.80 a | 1605.59 b | 16.05 b |
| | 6.09 a | 2114.38 a | 21.14 a |
| | 5.85 a | 1816.24 ab | 18.16 ab |
| Standard Error (±) | 0.29 | 7.86 | 1.03 |
| Significance | 0.269 | 0.000 | 0.45 |
| Effect of GA3 | 5.29 c | 1441.50 c | 14.41 c |
| | 6.50 a | 2451.21 a | 24.51 a |
| | 6.03 b | 1842.17 b | 18.42 b |
| | 5.83 b | 1646.72 bc | 16.46 bc |
| Standard Error (±) | 0.37 | 8.55 | 1.13 |
| Significance | 0.000 | 0.000 | 0.000 |

P₀ = No pruning (control), P₁ = 1st pruning at 20 DAT (1st and 2nd leaves), P₂ = 2nd pruning at 30 DAT (3rd and 4th leaves) G₀ = No GA3 (control), G₁ = 100 ppm GA3, G₂ = 200 ppm GA3, G₃ = 400 ppm GA3
Table 7. Yield contributing parameters of squash (male flower/plant, female flower/plant, and fruits/plant) influenced by the combined effect of pruning and GA$_3$

| Treatments | Yield contributing parameters | Total No. of Male Flower/plant | Total No. of Female Flower/plant | Total No. of Fruits/plant |
|------------|-------------------------------|--------------------------------|---------------------------------|--------------------------|
| $P_0 G_0$  |                               | 3.47 e                         | 3.85 e                          | 3.69 e                   |
| $P_0 G_1$  |                               | 6.14 c                         | 5.52 e                          | 4.82 b                   |
| $P_0 G_2$  |                               | 5.50 cd                        | 4.48 de                         | 4.17 d                   |
| $P_0 G_3$  |                               | 4.86 d                         | 4.91 d                          | 4.39 cd                  |
| $P_1 G_0$  |                               | 5.63 cd                        | 4.87 d                          | 4.19 d                   |
| $P_1 G_1$  |                               | 8.69 a                         | 7.52 a                          | 5.74 a                   |
| $P_1 G_2$  |                               | 8.32 a                         | 6.18 bc                         | 5.05 b                   |
| $P_1 G_3$  |                               | 6.92 b                         | 6.10 bc                         | 4.85 b                   |
| $P_2 G_0$  |                               | 3.64 e                         | 3.88 e                          | 3.69 e                   |
| $P_2 G_1$  |                               | 6.96 b                         | 6.40 b                          | 5.55 a                   |
| $P_2 G_2$  |                               | 7.26 b                         | 4.94 d                          | 4.65 bc                  |
| $P_2 G_3$  |                               | 5.11 d                         | 4.41 de                         | 4.10 de                  |
| Standard Error(±) |                     | 1.27                           | 1.48                            | 1.44                      |

Significance 0.000 0.000 0.000

$P_0 =$ No pruning (control), $P_1 =$ 1$^{st}$ pruning at 20 DAT ($1^{st}$ and 2$^{nd}$ leaves), $P_2 =$ 2$^{nd}$ pruning at 30 DAT ($3^{rd}$ and 4$^{th}$ leaves) $G_0 =$ No GA$_3$ (control), $G_1 =$ 100 ppm GA$_3$, $G_2 =$ 200 ppm GA$_3$, $G_3 =$ 400 ppm GA$_3$

Table 8. Yield contributing parameters of squash (fruit length, fruit diameter, individual fruit weight) influenced by the combined effect of pruning and GA$_3$

| Treatments Combination | Yield contributing parameters |
|------------------------|------------------------------|
|                        | Fruit Length (cm) | Fruit Diameter (cm) | Individual Fruits Weight (g) |
| $P_0 G_0$              | 18.83 l           | 3.19 e              | 305.66 g                     |
| $P_0 G_1$              | 21.84 c           | 4.94 cd             | 447.50 abc                   |
| $P_0 G_2$              | 20.12 g           | 3.71 e              | 369.33 defg                  |
| $P_0 G_3$              | 19.87 h           | 3.49 e              | 361.53 defg                  |
| $P_1 G_0$              | 19.45 j           | 5.40 bc             | 336.73 fg                    |
| $P_1 G_1$              | 22.42 a           | 6.15 a              | 507.66 a                     |
| $P_1 G_2$              | 21.61 d           | 5.96 ab             | 430.33 bcd                   |
| $P_1 G_3$              | 21.23 e           | 5.83 ab             | 403.66 cdef                  |

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### Table 9. Yield contributing parameters and yield of squash (percent (%) fruit dry weight, the weight of fruits plant\(^{-1}\), fruit yield ha\(^{-1}\)) influenced by the combined effect of pruning and GA\(_3\)

| Treatments Combination | Yield contributing parameters and yield | Percent (%) fruit dry weight | Weight of fruits plant\(^{-1}\) (g) | Fruit yield ha\(^{-1}\) (t) |
|------------------------|----------------------------------------|-----------------------------|------------------------------------|-----------------------------|
| \(P_0G_0\)             |                                        | 5.15 j                      | 1130.30 f                          | 11.30 f                     |
| \(P_0G_1\)             |                                        | 6.39 c                      | 2159.15 bc                         | 21.59 bc                    |
| \(P_0G_2\)             |                                        | 5.88 g                      | 1544.66 def                        | 15.44 def                   |
| \(P_0G_3\)             |                                        | 5.77 h                      | 1588.26 de                         | 15.88 de                    |
| \(P_1G_0\)             |                                        | 5.42 j                      | 1410.90 ef                         | 14.10 ef                    |
| \(P_1G_1\)             |                                        | 6.61 a                      | 2914.33 a                          | 29.14 a                     |
| \(P_1G_2\)             |                                        | 6.24 d                      | 2174.72 bc                         | 21.74 bc                    |
| \(P_1G_3\)             |                                        | 6.09 e                      | 1957.56 bcd                        | 19.57 bcd                   |
| \(P_2G_0\)             |                                        | 5.30 k                      | 1783.31 cde                        | 17.83 cde                   |
| \(P_2G_1\)             |                                        | 6.50 b                      | 2280.15 b                          | 22.80 b                     |
| \(P_2G_2\)             |                                        | 5.98 f                      | 1807.14 cde                        | 18.07 cde                   |
| \(P_2G_3\)             |                                        | 5.65 i                      | 1394.35 ef                         | 13.94 ef                    |
| Standard Error(±)       |                                        | 0.62                        | 13.58                              | 1.96                         |
| Significance            |                                        | 0.45                        | 0.000                              | 0.000                        |

\(P_0\) = No pruning (control), \(P_1\) = 1\textsuperscript{st} pruning at 20 DAT (1\textsuperscript{st} and 2\textsuperscript{nd} leaves), \(P_2\) = 2\textsuperscript{nd} pruning at 30 DAT (3\textsuperscript{rd} and 4\textsuperscript{th} leaves) \(G_0\) = No GA\(_3\) (control), \(G_1\) = 100 ppm GA\(_3\), \(G_2\) = 200 ppm GA\(_3\), \(G_3\) = 400 ppm GA\(_3\)
4. CONCLUSION

From the above results, it can be concluded that among the different treatment combination of pruning and GA3 treatments, P1G1 (1st pruning at 20 DAT with G1 = 100 ppm GA3) have significant positive effect on growth and yield of squash and resulted in highest fruit yield ha⁻¹ (29.14 t) compared to all other treatment combinations.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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