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Assessment of Pruning and Growth Regulators Seed Yield and Seed Quality of Bottle Gourd [*Lagenaria siceraria* (Mol.) Standl.]

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Abstract

The research experiment was carried out at the Research Farm of the Department of Vegetable Science, CCS, Haryana Agricultural University, Hisar during rainy season of 2022-23. The present investigation consists of three pruning levels (no pruning, pruning at 1.0 m and 1.5 m length of main vine) and three levels each of plant growth regulators (GA_3 @ 25, 50, 75 ppm and Ethrel @ 75, 100, 125 ppm) were sprayed at 2-4 leaves stage, flowering and fruiting stage along with control treatment. The results indicated that ethrel @ 125 ppm with pruning at 1.5 m vine length recorded maximum seed yield per plot (0.185 kg/vine) and seed yield (222.64 kg/ha). The maximum value of standard germination (88.83 %), seedling length (39.11 cm), seedling dry weight (88.11 mg), vigour index-I (3,473.99) and vigour index-II (7,824.47) were observed with GA_3 @ 75 ppm with pruning at 1.5 m vine length.

Key words : *Bottle gourd, pruning, growth regulators, seed yield, seed quality.*

Introduction

Bottle gourd is an important warm-season vegetable crop having chromosome number of 22. The bottle gourd is an annual, monoecious plant with hairy stems, long forked tendrils and a musky scent. Its fruits are hard-shelled and come in various shapes, such as long, oblong and round and colours from dark green to greenish-white. The bottle gourd originated from Africa and is most successful when cultivated in loamy soil with a pH range of 6-7. Bottle gourd can be cultivated in both the summer and rainy seasons, allowing for a year-round availability of its fruits (1). In India, bottle gourd cultivation is widespread, with major production states including Bihar, Uttar Pradesh, Madhya Pradesh, Haryana, Chhattisgarh, West Bengal, Punjab, Odisha, Tamil Nadu, Assam, Maharashtra, Tripura, Andhra Pradesh, Jharkhand, Jammu & Kashmir, Rajasthan, Telangana, Karnataka, Meghalaya, Nagaland, Sikkim, and Kerala. In India, bottle gourd is cultivated over an area of 1.93 lakh hectares, resulting in an annual production of 31.71 lakh tonnes (2). Specifically in Haryana, 18.47 thousand hectares of land are dedicated to bottle gourd cultivation, with an annual production of 261.47 thousand tonnes (3). The immature fruit is a good source of glucose and fructose. The edible fruits consist of vitamin B, ascorbic acid and minerals like potassium, calcium, phosphorus, magnesium, sodium, zinc, iron, manganese and copper. It is used to for the treatment of jaundice, diabetes, ulcer, insanity and hypertension.

Pruning is a widely practiced technique that aims to control and shape plant growth according to desired outcomes. Within this technique, vine pruning serves various purposes, including the enhancement of branch development per vine (4). The main objective of pruning is to regulate the process of flowering and fruiting by selectively removing unproductive plant components such as excessive, diseased, damaged, or weak leaves, shoots, or side branches. Additionally, thinning out excess flower buds and fruits helps redirect the plant's energy towards the primary goal of achieving a high-quality harvest. By reducing the strength of vegetative growth and improving the allocation of resources to fruit development, pruning optimizes fruit yield and enhances overall biomass partitioning.

Bottle gourd plants are monoecious, meaning they bear separate male (staminate) and female (pistillate) flowers on the same plant (5, 6). Since the presence of pistillate flowers is crucial for fruit and seed development, it is essential to explore methods for promoting their abundance. Plant growth regulators play a significant role in the physiology and morphology of plants. When applied during the two to four leaf stage, growth regulators can influence the sex expression of bottle gourd plants. The impact of growth regulators on crop growth and development can vary depending on factors such as plant species, variety, developmental stage, chemical concentration, application technique, and frequency. Ethrel, for example, hampers cell division and elongation in shoot meristematic tissue, affecting overall crop development. On the other hand, gibberellic acid (GA_3) helps overcome seed dormancy and improves seed quality. Additionally, these growth regulators have the potential to modify the sex ratio, stimulate growth, and

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Table-1 : Effect of pruning and growth regulators on seed yield parameters of bottle gourd.

Treatments	Seed yield per plot (kg)	Seed yield (kg/ha)
P_1: No pruning	0.151	181.22
P_2: Pruning at 1.0 m vine length	0.162	193.79
P_3: Pruning at 1.5 m vine length	0.168	201.43
Mean P	0.160	192.15
C.D. at 5 %	0.003	4.19
G_1: Control	0.149	178.46
G_2: GA_3 @ 25 ppm	0.154	184.13
G_3: GA_3 @ 50 ppm	0.156	187.41
G_4: GA_3 @ 75 ppm	0.160	191.93
G_5: Ethrel @ 75 ppm	0.162	194.52
G_6: Ethrel @ 100 ppm	0.166	199.50
G_7: Ethrel @ 125 ppm	0.174	209.10
Mean G	0.160	192.15
C.D at 5 %	0.004	4.22
Treatment combinations		
P_1G_1	0.142	170.35
P_1G_2	0.146	174.75
P_1G_3	0.147	176.12
P_1G_4	0.153	183.40
P_1G_5	0.154	184.38
P_1G_6	0.155	186.32
P_1G_7	0.161	193.23
P_2G_1	0.150	180.26
P_2G_2	0.155	186.28
P_2G_3	0.157	188.39
P_2G_4	0.162	193.83
P_2G_5	0.163	195.93
P_2G_6	0.167	200.43
P_2G_7	0.176	211.42
P_3G_1	0.154	184.77
P_3G_2	0.160	191.35
P_3G_3	0.165	197.73
P_3G_4	0.166	198.55
P_3G_5	0.169	203.23
P_3G_6	0.176	211.74
P_3G_7	0.185	222.64
C.D. at 5% Factor (G) at same level of P	NS	NS
C.D. at 5% Factor (P) at same level of G	NS	NS

NS = Non significant, G = levels of growth regulators, P = Pruning levels

enhance attributes that contribute to increased seed yield and improved seed quality.

Materials and Methods

During the rainy season of 2022-23, a field experiment was carried out at the Research Farm of the Department of Vegetable Science, Chaudhary Charan Singh Haryana Agricultural University, Hisar. The trial involved the application of different treatments, including three levels of pruning (no pruning, pruning at 1.0 m vine length, and pruning at 1.5 m vine length) and seven levels of growth regulators (control, GA_3 @ 25, 50, and 75 ppm, and ethrel @ 75, 100, and 125 ppm). The experimental design employed a split plot design (two-factor analysis) with four replications. GA_3, available in powder form, was dissolved with a small quantity of solvent (alcohol) after weighing the required amounts on an electronic balance. Ethrel, on the other hand, is in liquid form and was directly dissolved with water. Separate solutions of varying concentrations for each growth regulator were prepared for the study. The

Table-2 : Effect of pruning and growth regulators on seed quality parameters of bottle gourd.

Treatments	Standard germination (%)	Seedling length (cm)	Seedling dry wt. (mg)	Vigour Index-I	Vigour Index-II
P_1: No pruning	78.49	34.45	78.70	2710.81	6,185.23
P_2: Pruning at 1.0 m vine length	81.95	35.97	80.30	2953.29	6,588.78
P_3: Pruning at 1.5 m vine length	84.64	36.91	81.89	3128.80	6,938.04
Mean P	81.69	35.78	80.30	2,930.97	6,570.68
C.D. at 1%	1.49	0.77	1.08	55.43	170.64
G_1: Control	77.83	32.59	75.08	2,538.97	5,847.69
G_2: GA_3 @ 25 ppm	83.48	36.18	78.91	3,022.81	6,592.50
G_3: GA_3 @ 50 ppm	84.83	37.77	82.11	3,205.97	6,966.16
G_4: GA_3 @ 75 ppm	86.48	38.52	86.29	3,332.54	7,464.71
G_5: Ethrel @ 75 ppm	78.34	33.27	78.75	2,609.99	6,172.06
G_6: Ethrel @ 100 ppm	79.87	35.03	79.81	2,801.19	6,376.01
G_7: Ethrel @ 125 ppm	81.02	37.06	81.12	3,005.28	6,575.67
Mean G	81.69	35.77	80.30	2,930.96	6,570.69
C.D. at 1%	1.73	0.87	1.96	100.35	187.32
Treatment combinations				,	
P_1G_1	74.61	31.37	73.03	2,340.52	5,448.77
P_1G_2	79.95	34.95	77.24	2,793.04	6,176.79
P_1G_3	82.17	36.57	80.75	3,005.52	6,631.77
P_1G_4	83.94	37.91	84.47	3,182.51	7,090.42
P_1G_5	74.91	31.82	76.74	2,385.06	5,744.17
P_1G_6	76.72	33.14	78.81	2,542.48	6,045.78
P_1G_7	77.11	35.36	79.87	2,726.54	6,158.92
P_2G_1	77.83	32.67	75.84	2,542.39	5,902.81
P_2G_2	83.89	36.46	78.53	3,058.61	6,589.49
P_2G_3	85.11	38.33	81.91	3,261.03	6,972.20
P_2G_4	86.67	38.55	86.29	3,341.12	7,479.23
P_2G_5	78.39	33.11	79.33	2,594.82	6,219.70
P_2G_6	80.22	35.20	79.67	2,823.94	6,389.31
P_2G_7	81.55	37.44	80.54	3,051.12	6,568.73
P_3G_1	81.05	33.74	76.36	2,734.01	6,191.50
P_3G_2	86.61	37.14	80.98	3,216.77	7,011.20
P_3G_3	87.22	38.41	83.66	3,351.37	7,294.50
P_3G_4	88.83	39.11	88.11	3,473.99	7,824.47
P_3G_5	81.72	34.87	80.18	2,850.09	6,552.30
P_3G_6	82.67	36.74	80.96	3,037.17	6,692.95
P_3G_7	84.39	38.37	82.95	3,238.18	6,999.35
C.D at 1% Factor (G) at same level of P	NS	NS	NS	NS	NS
C.D at 1% Factor (P) at same level of G	NS	NS	NS	NS	NS

NS = Non significant, G = levels of growth regulators, P = Pruning levels.

bottle gourd cv. Pusa Summer Prolific Long seeds were sown in the first fortnight of June, with a crop spacing of 3.0 m × 0.6 m.

The pruning treatments were implemented based on the length of the vines. The first treatment involved no pruning, the second treatment involved pruning when the vine length reached 1.0 m, and the third treatment involved pruning when the vine length reached 1.5 m. Pruning was carried out

meticulously, using gentle hand techniques such as thumb and forefinger. Once the plants reached the 2-4 true leaf stage, the prepared solutions were sprayed onto the plants according to their respective treatments. This process was repeated at the flowering and fruiting stages. Throughout the experiment, all recommended cultural practices and plant protection measures for growing a healthy crop in the specific conditions of Haryana were implemented to ensure successful crop cultivation.

The observations were recorded in two yield parameters namely *i.e.*, seed yield per plot (kg), seed yield (kg/ha) and five quality parameters namely *i.e.*, standard germination (%), seedling length (cm), seedling dry weight (mg), vigour index-I and vigour index-II (7). The experimental data recorded from various observation were analysed in split plot design with four replications for analysis of variance in OPSTAT (http://14.139.232.166/opstat/default.asp) statistical software developed by Chaudhary Charan Singh, Haryana Agricultural University, Hisar, Haryana, India (8).

Results and Discussion

Seed yield parameters : Pruning and growth regulators significantly influenced the seed yield parameters of bottle gourd. Among the different levels of pruning, when the vine was pruned at 1.5 m vine length, it recorded the mean maximum seed yield per plot (0.168 kg) and seed yield (201.43 kg/ha). However, the minimum seed yield per plot (0.151 kg) and seed yield (181.22 kg/ha) was recorded with no pruning (table 1). Pruning has the effect of increasing the ratio of female flowers to male flowers. Since female flowers are the ones that develop into fruit and subsequently produce seeds, an increase in their proportion can potentially lead to higher seed yield. More fruits with better characteristics will have more quality seeds. Additionally, pruning can enhance seed yield in cucurbits by improving the size and weight of the seeds. More fruits with better characteristics will have more quality seeds.

Among different levels of growth regulators, ethrel @ 125 ppm recorded the mean maximum seed yield per plot (0.174 kg) and seed yield (209.10 kg/ha), whereas the minimum seed yield per plot (0.149 kg) and seed yield (178.46 kg/ha) was recorded with control (table 1). This can be attributed to the effect of ethrel in stimulating the production of abscisic acid (ABA), a plant hormone that plays a role in seed development and maturation. By applying ethrel to cucurbits, it triggers an increased production of ABA, which can contribute to a higher seed yield. Furthermore, ethrel can also promote the development of more flowers and fruit, which can further enhance the overall seed yield. The findings are consistent with the works of (9) in bitter gourd and (10) with respect to seed yield in bottle gourd.

Seed quality parameters : Pruning and growth regulators significantly influenced the standard germination of bottle gourd. Similarly, among the different pruning levels, pruning at 1.5 m vine length recorded the mean maximum standard germination (84.64 %), seedling length (36.91 cm), seedling dry weight (81.89 mg), vigour index-I (3,128.80) and vigour index-II (6,938.04). However, the minimum standard germination (78.49%), seedling length (34.45 cm), seedling dry weight (78.70 mg), vigour index-I (2,710.81) and vigour index-II (6,185.23) was recorded with no pruning (Table-2). It is attributed to the fact that pruning promotes better air circulation and humidity around the plants, resulting in improved standard germination in cucurbits. Pruning also enhances plant health and seed quality, as more resources are directed towards fruit development, leading to larger and more uniform fruits that contain viable seeds. pruning stimulates the development of fresh shoots and leaves, contributing to an overall boost in plant biomass. This, in turn, provides a greater quantity of dry matter, which is vital for supporting seedling growth.

Among different levels of growth regulators, GA_3 @ 75 ppm recorded the mean maximum standard germination (86.48 %) seedling length (38.52 cm), seedling dry weight (86.29 mg), vigour index-I (3,332.54) and vigour index-II (7,464.71), whereas the minimum standard germination (77.83 %), seedling length (32.59 cm), seedling dry weight (75.08 mg), vigour index-I (2,538.97) and vigour index- II (5,847.69) was observed with control (table-2). In standard germination, the presence of hard seed coats acts as a barrier, inhibiting the entry of water and oxygen into the seed and thus hindering germination. However, the application of GA_3 can break seed dormancy by stimulating the production of enzymes that soften the seed coat, facilitating water uptake and promoting improved germination of high-quality seeds. These observations align with the findings of Sandra *et al*. (2015) in bitter gourd. Regarding seedling length, the application of GA_3 may have contributed to increased elongation and cell division in the embryonic axis of the seed. This stimulation of growth processes could result in longer and more robust seedlings. These observations are similar to those reported by (10) in bottle gourd. In terms of seedling dry weight and vigor indices, GA_3 plays a significant role in the germination process, leading to faster and more uniform germination rates. This, in turn, promotes the development of stronger and more vigorous seedlings, which can exhibit greater dry weight. Furthermore, GA_3 can enhance nutrient and water uptake by the seedlings, facilitating increased growth and dry weight. These findings are consistent with the studies conducted by (11) in bitter gourd and (10) in bottle gourd.

Conclusions

From the present study, it was concluded that different levels of pruning and growth regulators had significant effect on the seed yield and seed quality parameters of bottle gourd crop. Among all the treatments of growth regulators, when ethrel @ 125 ppm and GA_3 @ 75 ppm was applied at 2-4 true leaves stage, it recorded the maximum seed yield (222.64 q/ha) and seed quality parameters respectively in bottle gourd. Among the different levels of pruning, when the vine was pruned at 1.5 m vine length, it recorded the maximum seed yield (201.43 q/ha) and seed quality parameters in bottle gourd under semi-arid, subtropical condition of sandy loam soil in Haryana.

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