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Effect of Different Plant Training Methods on the Duration of Phenological Stages in Open-Ground Cucumber Cultivated on Wire Trellises

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Abstract: This article analyzes the effect of plant training (shaping) on plant productivity when cultivating cucumbers using the wire trellis method. In the experiment, plants were managed by leaving the main stem, one side shoot, two side shoots, and three side shoots. The results showed that when only the main stem was retained, the first harvest occurred on days 36–38 (1–3 days earlier than the control), the final harvest continued for 105–106 days (20–22 days longer than the control), and the overall fruiting period lasted 67–69 days, which extended the harvest duration by up to 22–24 days compared to the control.

Keywords: Cucumber, hybrids, open ground, cultivation, wire trellis, plant training (shaping), seed germination, fruiting period.

Introduction

Today, the implementation of resource-saving and highly efficient crop cultivation technologies is one of the most pressing tasks in agriculture. In the context of population growth, increasing food demand, limited water resources, and climate change, the application of modern agrotechnologies is of paramount importance for obtaining high and quality yields from vegetable crops.[1][2]

Cucumber (*Cucumis sativus* L.) is one of the most widely distributed vegetable crops in the world and holds significant economic importance. To ensure high productivity of cucumber, alongside

varietal characteristics, cultivation methods, plant density, irrigation and fertilization systems, as well as agrotechnical practices such as plant training (pruning and shaping), play a crucial role.[3][4]

Cultivating cucumbers using the wire trellis method in open ground contributes to the efficient utilization of sunlight, improved air circulation, reduced disease prevalence, and increased labor productivity. However, the high efficiency of this technology largely depends on proper plant training. Training the plants helps maintain a balance between vegetative and generative growth, improves the efficient distribution of nutrients, optimizes the light regime, and extends the fruiting period.[5][6]

In particular, applying scientifically grounded plant training methods for cucumbers grown on wire trellises in hot climate regions is a vital factor for maintaining physiological activity and enhancing product quality. Therefore, a scientifically based evaluation of the advantages of various cucumber plant training methods under open-ground wire trellis systems and recommending them for production are of key significance.[7][8][9]

Methodology

Field experiments were conducted at the Educational and Scientific Field Station of Tashkent State Agrarian University during 2024–2026, where cucumber hybrids Orzu, Samar, and Laser were studied in open ground.[10]

For the wire trellis method, the distance between double rows (ribbons) was 90 cm, row spacing was 50 cm, and plant spacing within the row was 30 cm, providing a plot feeding area of 8.4 m². Each plot contained 40 plants.[11]

In the field experiment, when seedlings developed 4–5 true leaves, a wire trellis was constructed. Wooden posts with a height of 170 cm, installed every 5 m, were used as supports. A 2 mm diameter wire was stretched in a single row along the top of the posts and secured with staples. Each plant was tied at the very base and trained onto the wire trellis.[12][13]

Experimental Results

According to the study results, training plants using different methods had varying effects on the seed germination rate of the hybrids Orzu F₁, Samar F₁, and Laser F₁, the flowering times of their female flowers, the timing of the first and final harvests, as well as the duration of fruiting. For each hybrid, an unpruned (untrained) variant was studied as a control, and the training methods were evaluated relative to this control.[14][15]

In the control variant of the Orzu F₁ hybrid (without plant training), seed germination was 97%. The flowering of 10% of female flowers was observed on day 31, and 75% flowering occurred on day 32. The first harvest began on day 39, and the final harvest was completed on day 85. The fruiting period lasted 46 days.

When training the plant on a single main stem, seed germination was 98%, which was 1% higher than the control. The flowering dates for 10% and 75% of female flowers were identical to the control, occurring at days 31–32. The first harvest was gathered on day 38, which was 1 day earlier than in the control variant. Furthermore, it was established that the final harvest continued until day 105, which was 20 days longer than the control. As a result, the fruiting period lasted 67 days, which was 21 days (or 45.7%) longer compared to the control variant.

Table 1. Effect of different plant training methods on the duration of phenological stages in cucumber cultivated on wire trellises (2024–2026).

Variants	Germination of seeds, %	Flowering 10 % of mother flowers	Blooming of 75 % of mother flowers	Harvest, day		Fruiting period, day
				first	last	
Hybrid Orzu F ₁						
Without shaping (control)	97	31	32	39	85	46
In a single main stem	98	31	32	38	105	67
Leaving the main stem and one side shoot	98	32	33	38	96	58
Leaving the main stem and two side shoots	97	31	32	39	90	51
Leaving the main stem and three lateral shoots	96	31	33	39	88	49
Hybrid Samar F ₁						
Without shaping (control)	95	32	33	39	84	45
In a single main stem	97	31	32	37	106	69
Leaving the main stem and one side shoot	96	32	33	39	97	58
Leaving the main stem and two side shoots	97	33	34	40	89	49
Leaving the main stem and three lateral shoots	96	32	33	39	88	49
Hybrid Laser F ₁						
Without shaping (control)	98	32	33	39	84	45
In a single main stem	99	30	31	36	105	69
Leaving the main stem and one side shoot	98	31	32	38	100	62
Leaving the main stem and two side shoots	97	32	33	39	94	55
Leaving the main stem and three lateral shoots	98	32	33	39	91	52

In the variant where the main stem and one lateral shoot were retained, seed germination was 98%, which was 1% higher than the control. Flowering of 10% and 75% of female flowers was observed on days 32 and 33, respectively, which was 1 day longer than in the control. The first harvest began on day 38, which was 1 day earlier compared to the control. The final harvest was completed on day 96, extending 11 days longer than the control. The fruiting period lasted 58 days, which was 12 days (or 26.1%) longer compared to the control.

In the variant where the main stem and two lateral shoots were retained, seed germination was 97%. Flowering of 10% and 75% of female flowers was observed on days 31 and 32, and the first harvest was gathered on day 39, showing identical results to the control. The final harvest continued until day 90, which was 5 days longer than the control. Consequently, the fruiting period was 51 days, which was 5 days (or 10.9%) longer compared to the control.

In the variant where the main stem and three lateral shoots were retained, seed germination was 96%, which was 1% lower than the control. Flowering of 10% of female flowers coincided with the control on day 31, while 75% flowering occurred on day 33 (1 day later). The first harvest began on day 39. The final harvest concluded on day 88, continuing 3 days longer than the control. The fruiting period lasted 49 days, which was 3 days (or 6.5%) longer compared to the control.

Thus, for the Orzu F₁ hybrid, training the plant on a single main stem allowed harvesting 1 day earlier and extended the fruiting period by 21 days without altering the flowering dates of the female flowers.

In the control variant of the Samar F₁ hybrid (without training), seed germination was 95%. Flowering of 10% of female flowers was observed on day 32, and 75% flowering on day 33. The first harvest began on day 39, and the final harvest concluded on day 84. The fruiting period lasted 45 days.

When training the plants on a single main stem, seed germination was 97%, which was 2% higher than the control. Flowering of 10% and 75% of female flowers was observed on days 31 and 32, respectively, beginning 1 day earlier than the control. The first harvest was gathered on day 37, which was 2 days earlier than the control. The final harvest continued until day 106, which was 22 days longer than the control. The fruiting period lasted 69 days, which was 24 days (or 53.3%) longer compared to the control variant. The Samar F₁ hybrid showed the highest results in phenological indicators.

In the variant where the main stem and one lateral shoot were retained, seed germination was 96%, which was 1% higher than the control. The flowering dates of female flowers and the timing of the first harvest fully coincided with the control variant. The final harvest concluded on day 97, extending 13 days longer than the control. The fruiting period was 58 days, which was 13 days (or 28.9%) longer than the control.

In the variant where the main stem and two lateral shoots were retained, seed germination was 97%, which was 2% higher than the control. However, 10% and 75% female flowering occurred on days 33 and 34, respectively, which was delayed by 1 day compared to the control. The first harvest was gathered on day 40 (1 day later than the control). The final harvest finished on day 89, continuing 5 days longer than the control. The fruiting period lasted 49 days, which was 4 days (or 8.9%) longer than the control.

In the variant where the main stem and three lateral shoots were retained, seed germination was 96%, which was 1% higher than the control. The timing of female flowering and the start of the first harvest coincided with the control. The final harvest concluded on day 88, lasting 4 days longer than the control. The fruiting period was 49 days, which was 4 days (or 8.9%) longer compared to the control.

Thus, for the Samar F₁ hybrid, training the plant on a single main stem contributed to accelerating female flowering by 1 day, the first harvest by 2 days, and extending the fruiting period by 24 days compared to the control.

In the control variant of the Laser F₁ hybrid (without training), seed germination was 98%. Flowering of 10% and 75% of female flowers was observed on days 32 and 33, respectively. The first harvest was gathered on day 39, and the final harvest was completed on day 84. The fruiting period lasted 45 days.

When training the plants on a single main stem, seed germination reached 99%, which was 1% higher than the control. Flowering of 10% of female flowers was recorded on day 30, and 75% flowering on day 31 (2 days earlier than the control). The first harvest began on day 36, which was 3 days earlier compared to the control. The final harvest was gathered on day 105, lasting 21 days longer than the control. As a result, the fruiting period lasted 69 days, which was 24 days (or 53.3%) longer than the control variant.

In the variant where the main stem and one lateral shoot were retained, seed germination was identical to the control at 98%. Flowering of 10% and 75% of female flowers occurred on days 31 and 32, respectively (1 day earlier than the control). The first harvest also began 1 day earlier than the control, on day 38. The final harvest continued until day 100, which was 16 days longer than the control. The fruiting period lasted 62 days, which was 17 days (or 37.8%) longer than the control.

In the variant where the main stem and two lateral shoots were retained, seed germination was 97%, which was 1% lower than the control. Flowering dates and the start of the first harvest coincided with the control. The final harvest finished on day 94, lasting 10 days longer than the control. The fruiting period was 55 days, which was 10 days (or 22.2%) longer than the control.

In the variant where the main stem and three lateral shoots were retained, seed germination, female flowering dates, and the beginning of the first harvest showed identical results to the control.

The final harvest concluded on day 91, extending 7 days longer than the control. The fruiting period, lasting 52 days, was 7 days (or 15.6%) longer than the control.

Thus, for the Laser F₁ hybrid, training the plant on a single main stem accelerated female flowering by 2 days, the start of harvesting by 3 days, and extended the fruiting period by 24 days. In the variant where the main stem and one lateral shoot were retained, it was also observed that the fruiting period was 17 days longer compared to the control.

A comparative evaluation of the hybrids revealed that training plants on a single main stem provided the most optimal phenological results across all hybrids. The fruiting period in this variant was 67 days for the Orzu F₁ hybrid, and 69 days for the Samar F₁ and Laser F₁ hybrids.

Single main stem training contributed to extending the fruiting period compared to the control by 21 days (or 45.7%) in the Orzu F₁ hybrid, and by 24 days (or 53.3%) in the Samar F₁ and Laser F₁ hybrids.

Conclusion

In the Orzu F₁ hybrid, when trained on a single main stem, the first harvest was gathered 1 day earlier than in the control, and the final harvest extended 20 days longer. The fruiting period lasted 67 days, which was 21 days (or 45.7%) longer compared to the control.

In the Samar F₁ hybrid, single main stem training accelerated female flowering by 1 day and the first harvest by 2 days. Compared to the control, the final harvest extended 22 days longer, and the fruiting period was 24 days (or 53.3%) longer.

In the Laser F₁ hybrid, single main stem training accelerated female flowering by 2 days and the first harvest by 3 days. The fruiting period lasted 69 days, which was 24 days (or 53.3%) longer compared to the control.

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