

RESPONSE OF CULTIVARS, PLANT GEOMETRY AND METHODS OF FERTILIZER APPLICATION ON PARTHENO-CARPIC CUCUMBER (*CUCUMIS SATIVUS* L.) UNDER ZERO ENERGY POLYHOUSE CONDITION DURING RAINY SEASON.

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Summary

An experiment was conducted in naturally ventilated polyhouse in rainy season during 2007-08 and 2008-09 at Rajasthan College of Agriculture, Udaipur (Raj.) to identify the most suitable cultivar, plant geometry and method of fertilizer application in cucumber. The results revealed that cultivar 'Hilton' was significantly superior to enhance vine length (3.29 m), leaf area (500.99 cm²), days to first harvest (44.40 days), fruit set (51.04 %), number of fruits per vine (30.89), average weight of fruit (105.28 g), fruit length (18.22 cm) and fruit width (3.62 cm) which ultimately gave maximum yield per vine (3.49 kg) during rainy season. Significantly higher yield along with the growth and quality parameters were obtained in spacing 60 x 50 cm. The fruit yield per plant was significantly more at 60 x 50 cm, whereas significantly higher yield per square meter was recorded at 60 x 30 cm and least yield was recorded at 60 x 50 cm. Fertigation practice recorded significantly higher yield (14.49 kg/m²) as compared to conventional method (13.22 kg/m²).

सारांश

खीरे में पालीहाउस के लिए उत्तम प्रजाति, पौधों की संख्या तथा पोषण के चयन के लिए अध्ययन किया गया। हिल्टन प्रजाति वाइन की लम्बाई, पालीश क्षेत्रफल, फल संख्या, फल लम्बाई एवं चौड़ाई तथा उपज में सबसे अच्छी पायी गयी। पोषण विधि एवं 60x50 से.मी. पौध से पौध की दूरी का प्रभाव प्रचलित पद्धति की तुलना में सबसे अच्छा पाया गया।

Introduction

Polyhouse cultivation is still a new and emerging trend for growing vegetables in India. It is mainly grown in summer and rainy season in northern plains of India. Summer season crop is most successful due to lesser incidence of diseases and pests, but rainy season crop is always affected by diseases and pests, resulting into low productivity and poor quality of fruits. Protected cultivation has higher water and nutrient use efficiencies. Both of these factors are of vital importance for healthy and luxuriant growth of crop plants. But protected cultivation requires careful planning and attention including selection of varieties, suitable production technology like spacing, time of planting, water and nutrient management and plant protection to produce economic yield of good quality. In general, zero-energy polyhouse cucumbers are irrigated through drip system and fertilizers are also applied along with irrigation water according to the crop growth and season of cultivation. In view of importance of cucumber, the study was initiated to find out suitable cultivar, plant spacing and method of fertilizer application in cucumber grown under naturally ventilated polyhouse.

Materials and Methods

The experiment was conducted under naturally ventilated polyhouse at Hi-tech Horticulture Unit, Rajasthan College of Agriculture, Udaipur (Rajasthan) during rainy season of 2007-08 and 2008-09. The trial was laid out in Factorial Completely Randomized Design with three replications under zero energy polyhouse. The size of the zero energy polyhouse was 28 x 32 m (896 m²) covered with ultra violet stabilized low density polyethylene sheet having 200 micron thickness. The experiment comprised of three cultivars namely, Hilton (V₁), Isatis (V₂) and Kian (V₃); three spacing 60 x 30 cm (S₁), 60 x 40 cm (S₂) and 60 x 50 cm (S₃) and two methods of fertilizer application viz., conventional method (F₁) with a recommended dose (NPK @ 9:5:4:10.8 kg per 1000 m²) and second Fertigation (F₂). In case of fertigation, same dose of NPK was applied through irrigation water in the ratio of 5:3:6 twice a week with the following concentrations @ 3 liter water per sq. meter area.

- (1) Nitrogen – 0.300g N/3 liter water/ m²
- (2) Phosphorus- 0.180g P₂O₅/3 liter water/m²
- (3) Potassium – 0.360 g K₂O/3 liter water / m²

In case of conventional method of fertilizer application, $\frac{1}{2}$ dose of nitrogen and full dose of Phosphorus and Potassium were applied before stansplanting . Remaining hald dose of N was applied in two split i.e. at 30 and 60 DAT . In the is way, total 18 treatments were used in the present study. For green house cultivation of cucumber, the seedlins were raised on soil-less media in plastic protrays having cells of 1.5" in size. The seedlings were ready for transplanting within 15- 18 days. Three weeks old seedling at 2- 3 true leaf stage were transplanted at 60 x 30, 60 x 40, 60 x 50 cm according to the different treatment combinations. Data on vegetative growth characteristics, yield and yield attributing characteristics and quality characteristics were recorded from randomly selected five plants of each treatment and further analyzed. The economics of cucumber production under indigenously designed naturally ventilated polyhouse was worked out by taking the depreciation cost of the structure and by taking the life of the basic steel structure as 20 years, whereas the life of UV plastic film and insect proof net was considered as three years. Indigenously designed naturally ventilated polyhouse, which can be fabricated with the cost of Rs. 500 / m², is technically suitable and economically feasible for round the year cucumber cultivation. The cost of cultivation per 500 square meters was calculated treatment wise.

Results and Discussion

Vegetable Growth Characters: Interaction effect of cultivars, spacing and method of fertilizer application significantly influenced the vegetative growth characters like vine length, internodal distance and leaf area of parthenocarpic cucumber under zero-energy polyhouse condition during rainy season (Table 1). The maximum vine length (3.71m), leaf area (53.43 cm²) and minimum internodal distance (7.97 cm) were recorded in treatment $V_1S_3F_2$ (Hilton + 60 x 50 cm + Fertigation) . This might be due to the combined effect of cultivars , wider spacing and timely and uniformly availability of all the macro – nutrients through fertilization. The present results are supported by the findings of Arora *et al.*, (2006) and Singh *et al.*, (2002). In greenhouse grown tomato; Ban *et al.*, (2006) and Maynard and Scott (1998) in melons . Drip fertigation of cucumber adequately sustain favourable vegetative and reproductive growth

as compare to conventional method of fertilizer application. These results are in accordance with the findings of Al- Jaloud *et al.*, (1999) and Choudhari and More (2002) in gynoecious cucumber hybrids.

Flowering Characteristics : Data clearly showed that effect of cultivars, spacing, method of fertilizer application along with their interaction effects had significantly influenced the various flowering characteristics as number of flowers per vine, days to flower bud initiation and nodal position of first flower . The pooled minimum days (32.94) required to flower bud initiation was reported in $V_1S_3F_2$ (Hilton + 60 x 50 cm + Fertigation) . The findings of the present investigation are in close conformity with the findings of Gulam ud din *et al.* (2006) in cucumber.

Yield and Yield Attributing Characteristics : In present inverstigation, all the yield and yield attributing characteristics as given in Table 1 clearly exhibited significant influence by interaction effect of cultiars, spacing and method of fertilizer application. Maximum fruit set (55.14%) with minimum fruit drop (4.09%) was recorded in combined treatment $V_1S_3F_2$ (Hilton + 60 x 50 cm + Fertigation). These findings are quite analogous with that of Fonseca *et al.* (2003) and Hanna and Adams (1991) in cucumber.

The pooled maximum number of fruits per vine (36.00) and average fruit weight (115.23 g) were observed in same treatment i.e. $V_1S_3F_2$ (Hilton + 60 x 50 cm + Fertigation). The similar findings of increase in average fruit weight and number of fruits per vine with wider spacing was reported by Mantur and Patil (2008) in tomato. Choudhari and More (2002) reported maximum number of fruits per vine and fruit weight at 1.80 m x 0.45 m spacing with fertilization experimentation in tropical gynoecious cucumber hybrid namely Phule Prachi.

Maximum yield (3.99 / vine) was noticed in $V_1S_3F_2$ (Hilton + 60 x 50 cm + Fertigation) ; whereas , maximum yield (19.22 kg per sq.m.) was obtained in $V_1S_3F_2$ (Hilton + 60 x 50 cm + Fertigation) . It is concluded that the main factors responsible for the increase in fruit yield per unit area at narrowspacing were due to grater crop biomass. These results indicated that maximum yields are function of greater number of plants per nuit area. The present findings are in accordance with the results of Papadopoulous and Prararajasingham (1997). The increased in yield

Table 1: Interaction effect of cultivars, spacing and method of fertilizer application on growth, yield and quality characteristics of parthenocarpic cucumber under zero energy polyhouse condition during rainy season.

| S.No. | Treatment | Vine length (m) | Internodal distance (cm) | Leaf area (cm ²) | Days to flower bud initiation | Fruit set (%) | Fruit drop (%) | Number of fruits per vine | Number of fruits weight (g) | Yield per vine (kg) | Yield per sq. m. (kg) | Fruit length (cm) | Fruit width (cm) | TSS (%) | Total chlorophyll content (mg g ⁻¹ fresh weight) |
|-------|--|-----------------|--------------------------|------------------------------|-------------------------------|---------------|----------------|---------------------------|-----------------------------|---------------------|-----------------------|-------------------|------------------|---------|---|
| 1. | V ₁ S ₁ F ₁ | 2.95 | 8.80 | 481.86 | 34.61 | 47.79 | 8.18 | 26.93 | 98.07 | 3.15 | 17.47 | 17.01 | 3.38 | 3.36 | 1.17 |
| 2. | V ₁ S ₁ F ₂ | 3.36 | 8.44 | 502.43 | 33.40 | 50.30 | 6.88 | 31.60 | 103.36 | 3.46 | 19.22 | 18.25 | 3.62 | 3.37 | 1.26 |
| 3. | V ₁ S ₂ F ₁ | 3.09 | 8.55 | 485.68 | 34.37 | 51.52 | 8.89 | 27.27 | 98.11 | 3.20 | 13.31 | 17.05 | 3.39 | 3.33 | 1.24 |
| 4. | V ₁ S ₂ F ₂ | 3.46 | 8.19 | 507.74 | 34.33 | 51.57 | 4.90 | 33.60 | 112.77 | 3.72 | 15.49 | 19.53 | 3.88 | 3.49 | 1.30 |
| 5. | V ₁ S ₃ F ₁ | 3.15 | 8.65 | 497.80 | 36.47 | 49.92 | 6.74 | 29.93 | 104.16 | 3.39 | 11.30 | 17.36 | 3.50 | 3.37 | 1.36 |
| 6. | V ₁ S ₃ F ₂ | 3.71 | 7.97 | 530.43 | 32.94 | 55.14 | 4.09 | 36.00 | 115.23 | 3.99 | 13.30 | 19.84 | 3.94 | 3.45 | 1.35 |
| 7. | V ₂ S ₁ F ₁ | 2.74 | 8.84 | 429.79 | 37.40 | 45.38 | 9.75 | 28.40 | 97.64 | 3.02 | 16.76 | 16.43 | 3.26 | 3.79 | 1.23 |
| 8. | V ₂ S ₁ F ₂ | 2.85 | 9.02 | 452.59 | 36.18 | 45.09 | 7.45 | 30.13 | 91.26 | 3.09 | 17.15 | 17.36 | 3.45 | 3.75 | 1.34 |
| 9. | V ₂ S ₂ F ₁ | 2.84 | 9.42 | 428.62 | 38.12 | 43.38 | 8.55 | 27.13 | 93.26 | 2.85 | 11.85 | 17.28 | 3.43 | 3.68 | 1.26 |
| 10. | V ₂ S ₂ F ₂ | 3.04 | 8.84 | 469.71 | 36.07 | 49.51 | 5.48 | 28.80 | 94.84 | 3.12 | 12.96 | 17.51 | 3.48 | 3.81 | 1.39 |
| 11. | V ₂ S ₃ F ₁ | 3.18 | 8.68 | 453.53 | 33.85 | 47.83 | 7.59 | 28.00 | 102.90 | 3.04 | 10.11 | 17.52 | 3.48 | 3.70 | 1.32 |
| 12. | V ₂ S ₃ F ₂ | 3.27 | 8.80 | 475.57 | 33.90 | 48.33 | 5.14 | 31.33 | 105.29 | 3.19 | 10.61 | 18.55 | 3.68 | 3.86 | 1.39 |
| 13. | V ₃ S ₁ F ₁ | 2.85 | 9.18 | 428.36 | 34.07 | 44.54 | 10.48 | 23.80 | 99.53 | 2.87 | 15.92 | 16.89 | 3.35 | 3.47 | 1.32 |
| 14. | V ₃ S ₁ F ₂ | 3.17 | 9.06 | 453.52 | 36.82 | 46.61 | 7.76 | 31.87 | 100.58 | 3.15 | 17.51 | 18.08 | 3.59 | 3.48 | 1.42 |
| 15. | V ₃ S ₂ F ₁ | 3.02 | 9.00 | 441.39 | 37.40 | 42.80 | 9.12 | 28.87 | 102.44 | 2.92 | 12.16 | 17.51 | 3.48 | 3.46 | 1.41 |
| 16. | V ₃ S ₂ F ₂ | 3.09 | 8.76 | 456.86 | 37.77 | 44.31 | 6.00 | 30.87 | 96.77 | 3.15 | 13.11 | 18.67 | 3.71 | 3.60 | 1.49 |
| 17. | V ₃ S ₃ F ₁ | 3.19 | 9.04 | 458.58 | 34.13 | 47.32 | 8.56 | 27.33 | 104.56 | 3.02 | 10.07 | 18.16 | 3.61 | 3.52 | 1.36 |
| 18. | V ₃ S ₃ F ₂ | 3.29 | 8.64 | 500.76 | 33.87 | 48.98 | 6.42 | 31.60 | 102.86 | 3.32 | 11.06 | 18.70 | 3.71 | 3.56 | 1.41 |
| | SEm± | 0.024 | 0.065 | 3.133 | 0.259 | 1.217 | 0.256 | 0.698 | 1.177 | 0.019 | 0.081 | 0.242 | 0.051 | 0.055 | 0.028 |
| | CDat 5 % | 0.064 | 0.182 | 8.813 | 0.731 | 3.431 | 0.720 | 1.967 | 3.319 | 0.053 | 0.229 | 0.683 | 0.144 | NS | NS |

V₁, Hilton; V₂, Isatis and V₃, Kian; S₁, 60cmx30cm; S₂, 60cmx40cm; S₃, 60cmx50cm; F₁, Conventional method; F₂, Fertigation.

attributes under fertigation in tomato may be attributed to better water utilization and higher uptake of nutrients (Bafna et al., 1993).

Fruit Quality Characteristics : Fruit length and fruit width of cucumber were found to be significantly influenced by interaction effect of cultivars, spacing and method of fertilizer application. The pooled maximum fruit length (19.84 cm) and fruit width (3.94 cm) were observed in V₁S₃F₂ (Hilton + 60 x 50 cm + Fertigation) treatment. Pandey et al. (2005) reported the significant differences for fruit length and fruit width of glass house grown capsicum. Maximum fruit diameter was recorded by Choudhari and More (2002) in cucumber through fertigation. Economic analysis indicated that treatment V₁S₃F₂ (Hilton + 60 x 50 cm + Fertigation) had gross return (Rs. 133000 per 500 sq. m.) and net return of Rs. 91539.39 per 500 sq. m. area. The cost-benefit ratio of cucumber cultivation under zero – energy polyhouse was worked out as 1: 2.21 under Udaipur conditions of India.

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