U. Chapagain et al. (2022) Int. J. Appl. Sci. Biotechnol. Vol 10(3): 171-181.
DOI: 10.3126/ijasbt.v10i3.47521

ISSN (Online): 2091-2609
DOI Prefix: 10.3126/ijasbt

International Journal of Applied Sciences and Biotechnology (IJASBT)

Research Article

Effect of Pruning and Fertilizers on Growth, Flowering and Yield of Cucumber (*Cucumis sativus* L.) under Protected Structure in Panchthar, Nepal

Upama Chapagain[1*], Sujan Bhandari[2], Yogendra Man Shrestha[3], Sagar Bista[4], Januka Dahal[1]

[1]Institute of Agriculture and Animal Science (IAAS), Mahendra Ratna Multiple Campus, Ilam, Nepal
[2]Department of Agricultural Botany and Ecology, Institute of Agriculture and Animal Science (IAAS), Tribhuvan University, Kirtipur, Nepal
[3]Ilam Community Agriculture Campus, Ilam, Purbanchal University, Nepal
[4]Agriculture Knowledge Center, Jhapa, Nepal

Article Information

Received: 15 August 2022
Revised version received: 13 September 2022
Accepted: 18 September 2022
Published: 30 September 2022

Cite this article as:
U. Chapagain et al. (2022) Int. J. Appl. Sci. Biotechnol. Vol 10(3): 171-181. DOI: 10.3126/ijasbt.v10i3.47521

***Corresponding author**
Upama Chapagain,
Institute of Agriculture and Animal Science (IAAS), Mahendra Ratna Multiple Campus, Ilam, Nepal
Email: chapagain.upama2055@gmail.com

Peer reviewed under authority of IJASBT

Abstract

A study was conducted to determine the effect of pruning practices and different fertilizer combinations on Bhaktapur local variety of cucumber under protected structure in Panchthar, Nepal during February to June 2021. The experiment was laid out in two factorial Randomized Complete Block Design with three replications. Treatments used were two pruning practices (no pruning and 3G cutting) and four fertilizer doses (no fertilizer (control), 30 Mt/ha FYM+ 100% RDF (140:60:100 kg of NPK), 9.4 Mt/ha Vermicompost+ 100% RDF of NPK and 4.3 Mt/ha Poultry manure+ 100% RDF of NPK). Although 3G cutting practice increased the days required for 50 % flowering, it significantly decreased the male: female flowers ratio (1.69) compared to no pruning (4.38). Similarly, number of fruits per plant, individual fruit weight, fruit diameter and average fruit yield (95.21 Mt/ha) were maximum in 3G cutting. In terms of fertilizers, time requirement for 50% male flowering remained unaffected, however, plants treated with fertilizers 30 Mt/ha FYM+ 100% RDF of NPK showed significantly least days required for 50% female flowering, lowest male: female flowers ratio (2.41), maximum number of fruits per plant, maximum average individual fruit weight and highest average yield (105.78 Mt/ha) which are statistically at par with results of 9.4 Mt/ha vermicompost+ 100% RDF of NPK and 4.3 Mt/ha poultry manure+ 100% RDF of NPK for these parameters. The results concluded that combined application of organic manures and inorganic fertilizers in recommended dose with 3G pruning practices is best for growth and yield of cucumber.

Keywords: Cucumber; Fertilizers; Male: Female flowers ratio; Pruning; Yield

Introduction

Cucumber *Cucumis sativus L.* (2n= 14) is one of the important vegetable crops belonging to the family cucurbitaceous (Bisognin, 2002). It is annual, warm season trailing vine crop, grown throughout the world under tropical and subtropical conditions (Sharma *et al.*, 2018). It is mainly cultivated for its young tender fruits, which are consumed raw as salad, and by making pickles. It is nutritionally rich vegetable as it contains wide range of minerals and vitamins like potassium, magnesium, calcium, iron, thiamine, riboflavin, Vitamin A, C and K. Besides,

fruit contains higher amount of dietary fiber, antioxidants and 90-95 % of water. Its consumption helps to maintain hydration, relieves constipation and helps to reduce the risk of cardio vascular diseases as well as many types of cancer (Mallick, 2022). Along with seasonal production, cucumber are also successfully grown in off season under greenhouse due to its suitability to thrive under high light intensity, high humidity, high soil moisture, temperature and fertilizers condition (Singh *et al.*, 2017). But, the productivity of cucumber is still very limited in Nepal (Khanal *et al.*, 2020). The total area under cucumber cultivation in Nepal is 10,216 ha with production and productivity of 158,688 Mt and 15.53 Mt/ha respectively (MoALD, 2019/20). In Panchthar, cucumber is grown in an area of around 78 ha, with the production and productivity of 951 Mt and 12.19 Mt/ha respectively (MoALD, 2019/20).

Flowering behavior and availability of balanced nutrients in soil are important limiting factors of production of cucumbers. Generally, cucumber is monoecious plant. It bears unisexual flowers in which male flowers appear earlier and also near to the base of the plant compared to female flowers (Pandey *et al.*, 2019). In addition, number of male flowers are highly dominant over female flowers. Male to female flowers ratio may vary from 15:1 to 13:1. Ratio is genetically controlled but it can be altered through chemical practices and some mechanical practices like pruning (Mir *et al*., 2019). Use of chemical plant growth regulators is popular among farmers but, they are unaware of cultural practices like pruning.

Pruning is the act of removing non-productive parts of plant manually, so as to encourage flowering and fruiting. Shoots, branches, twigs are pruned to maintain proper balance between vegetative growth and fruit load (Utobo *et al*., 2010). Pruning of peppers cultivated in greenhouse, improved fruit set and fruit quality (Thakur *et al.*, 2018). Pruning of ridge gourd plants to six primary branches lowered sex ratio, increased total number of fruits and total yield (Arora & Malik, 1989). Different forms of pruning influence different characteristics of plant. Similarly, 3G cutting is a form of pruning technique which enhances femaleness and increases total yield in cucurbits without chemicals. This technique promotes the growth of third generation branches in which greater number of female flowers flushes compared to male flowers, thus lowering male: female flowers ratio in plant (Chaurasiya *et al.*, 2020).

Cucumber is fast growing herbaceous crop, hence requires ample amount of nutrients for proper growth and yield (Umekwe *et al.*, 2015). It is observed that major nutrients required by the crop are Nitrogen (N), Phosphorous (P) and Potassium (K). Inadequate supply of any of these nutrients leads to detrimental effect on growth and yield of the plant. Required amount of nutrients can be applied to soil in the form of organic and inorganic fertilizers to correct the inadequate supply to the crop (Badr *et al.*, 2018). As a result of intensive agriculture, extensive use of chemical fertilizers was practiced by many farmers to increase their production for many years. This led to decreased nutrient uptake, alteration in soil fertility and deterioration of soil health as well as increase in the cost of production (Singh *et al*., 2017). Besides, organic manures are also being applied to supplement nutrient requirements by many famers in Nepal. Organic manures maintain soil organic matter in soil, encourages soil microbial activity and enhances crop growth. Despite of these advantages, risk of low yield of crop is associated due to their low nutrient content and slow releasing nature. Hence considering these problems, the concept of using eco-friendly organic manures with suitable integration of inorganic fertilizers has emerged. Combined application of organic manures and inorganic fertilizers in right dose has been proven to provide balanced nutrients, improve crop yield, fruit quality, soil structure and overall soil health (Bhatt *et al.*, 2020).

Several researches have been conducted on improving the growth and yield of cucumber under protected structure, through various pruning practices and fertilizer applications in world but no such research work has been reported in Nepal. The current study, therefore, was undertaken to evaluate the effect of pruning and different fertilizer combinations on overall growth and yield performance of cucumber under protected structure in Panchthar district, Nepal.

Materials and Methods

Location of the Experiment

The experiment was carried out in the farmer's field of Phidim municipality ward no.11, Panchthar district, Nepal from February 2021 to June 2021. The protected structure used was naturally ventilated polyhouse. The geographical location of the area lies between latitude 27° 08' 32.0" N and longitude 87° 48' 27.7" E with an altitude of 1117 meters above sea level. The area is characterized by a subtropical highland climate with dry winters. Generally, the average maximum temperature in the site is 25-35 ℃, in summer and it falls to 2℃ in winter. Most of the precipitation occurs during the month of June to September. Sky is generally clear and sunny during winter and spring.

Physico-Chemical Characterization of Experimental Soil

Soil samples were taken randomly from different spots of each replication at a depth of 0-20 cm using tube auger to record the initial soil physico-chemical properties of the experimental field. Altogether 15 samples were collected and a composite soil sample of 500 gm was made for further analysis using composite soil sampling method. The sample was then air dried, grounded and sieved through 2 mm sieve and tested in Regional Soil Testing Laboratory at Surunga, Jhapa. The physico-chemical properties of the experimental soil are presented in Table 1.

Experimental Design and Treatment Details

The experiment field was laid out on factorial Randomized Complete Block Design (RCBD) with two factors, three replications and twenty-four treatments in total land area of 208 m^2 (26 m× 8 m). Each replication consists of eight treatment plots each of area 8 m^2 (4m × 2m) which were randomly placed. The distance between replications and between plots was maintained 1 m and 0.5 m respectively. Each plot consists of 8 plants, planted by maintaining row to row distance of 1m and plant to plant distance of 1m. Two pruning practices i.e., no pruning/control (P1) and 3G cutting (P2) were assigned as Factor I. Similarly, four fertilizer combinations i.e., no fertilizer/ control (F1), 30 Mt/ha FYM+ 100% RDF of NPK (F2), 9.4 Mt/ha vermicompost+ 100% RDF of NPK (F3) and 4.3 Mt/ha poultry manure +100% RDF of NPK (F4) were assigned as Factor II (Table 2). Bhaktapur local variety was selected as test crop on the basis of farmer's preference.

Cultivation Practices

Seedlings and land preparation

Seeds were sown in black polybags of size 4×6 inch, having the mixture of soil, FYM and sand with ratio 3:2:1. The field was ploughed thrice and layout of field was done at the time of final land preparation. Plot making, levelling and bed preparation was done thereafter. Pit of 30 cm^3 were dug for fertilizer application and transplanting.

Fertilizer application and Transplanting

Manures and fertilizers were applied in each pit according to treatments assigned. Recommended dose of nitrogen (140 Kg/ha), phosphorous (60 Kg/ha) and potassium (100 Kg/ha) were applied through Urea, Diammonium phosphate and Muriate of potash respectively (NARC, 2020). Recommended dose for FYM is 30 Mt/ha and doses for vermicompost and poultry manure were calculated on the basis of nutrient content available in them with respect to nutrient content of FYM (Table 3). Full dose of Farm Yard Manure (FYM), vermicompost and poultry manure as well as full dose of phosphorous, potassium were applied after pit preparation. Half dose of nitrogen was applied as basal dose, and remaining half dose was applied twice as split dose as side dressing, one during tendrils emergence and another during flower initiation (NARC, 2020). Healthy seedlings were transplanted after 21 DAS and after 7 days of manure application on 26th March, 2021.

Table 1: Physico-chemical characterization of the soil at the Experimental field

Properties	Content	Scale
Physical properties		
Soil texture	Sandy loam	-
Chemical properties		
Soil pH	6.2	Slightly acidic
Soil organic matter (%)	2.15	Low
Total nitrogen (%)	0.08	Low
Available phosphorous (Kg/ha)	36.59	Low
Available potassium (Kg/ha)	108.33	Low

Table 2: Treatment details

Factor II (Fertilizers)	**Factor I (Pruning)**	
	No pruning (P1)	**3G cutting (P2)**
No fertilizer/ control (F1)	P1F1	P2F1
30 Mt/ha FYM+ 100% RDF of NPK (F2)	P1F2	P2F2
9.4 Mt/ha vermicompost+ 100% RDF of NPK (F3)	P1F3	P2F3
4.3 Mt/ha Poultry manure+ 100% RDF of NPK (F4)	P1F4	P2F4

Note: RDF means Recommended Dose of Fertilizer

Table 3. Nutrient content of FYM, Vermicompost and Poultry manure

Nutrient content	**FYM (Bhatt *et al*., 2020)**	**Vermicompost (Subbaiah, 2019)**	**Poultry manure (Bhatt *et al*., 2020)**
Nitrogen (%)	0.95	1.9	3.5
Phosphorous (%)	1	1.23	4.19
Potassium (%)	0.62	1.6	4.35

Pruning

3G cutting was performed following the procedure mentioned by Chaurasiya *et al.* (2020). The main branch (1st generation branch) growing from transplanted seedling was allowed to grow with proper care. All the side branches were cut off until 5 leaved stage height from main branch. When the main branch reached the height of 5-6 feet, the tip portion of about 4-5 inches was cut off on 21st April to promote the growth of secondary branches (2nd generation branches). The tip portion of secondary branches was removed as previous one on 5th May, when they reached the height of 2-3 feet. Then, tertiary or third generation (3G) branches were allowed to grow with proper fertilization and soil moisture.

Intercultural Operations

Staking was done with plastic net and bamboo stakes after 20 DAT. Irrigation was provided through drip irrigation system as per required. Manual weeding was done twice at 25 DAT and 45 DAT. Plant protection measures were undertaken as per required. Manual harvesting was done from 40 DAT until 10th June for twelve times.

Data Observation and Statistical Analysis

Four plants were selected randomly considering the border effects for measurement of parameters. Growth parameters like plant height and flowering parameters like nodal position for male and female flower, days to 50% flowering per plot, number of male and female flowers and male: female flowers ratio were recorded by observing field regularly. Further, yield parameters like days to first harvest, number of fruits per plant, fruit length, fruit diameter, fruit weight and fruit yield were recorded as well. The data thus collected were statistically analyzed using MS Excel 2013 and R studio version 4.0.2. Data were subjected to two way analysis of variance (ANNOVA) and means comparison was done using Least Significant Difference (LSD) test at 5% level of significance (Gomez & Gomez, 1984).

Result and Discussions

Plant Height

Data presented in (Table 4) revealed that different pruning practices had a significant effect on plant height of cucumber at 30, 45 and 60 Days after Transplanting (DAT) whereas non-significant effect at 15 DAT. At 30 DAT, the highest plant height (190.39 cm) was recorded from no pruning (control) treatment, whereas lowest plant height (147.71 cm) was observed in 3G cutting treatment. Similar results were obtained at 45 and 60 DAT where no pruning treatment recorded statistically superior and higher plant height compared to 3G cutting treatment. Our results are in line with the findings given by Mir *et al.* (2019) who observed that pruning to five primary branches resulted lowest stem length compared to control. The decrease in plant height due to 3G cutting can be attributed to the fact that pruning of main shoot caused pruning stress which might have hampered the normal growth of plant and plant took longer recovery period to overcome the stress.

Among fertilizers, all three fertilizer combinations (30 Mt/ ha FYM +100 % RDF of NPK, 9.4 Mt/ha vermicompost+ 100% RDF of NPK and 4.3 Mt/ha Poultry manure + 100% RDF of NPK) resulted statistically similar and significantly superior result i.e., highest plant height at 30, 45 and 60 DAT whereas non-significant effect was recorded at 15 DAT (Table 4). The lowest plant height was recorded from no fertilizer (control) treatment at 30, 45 and 60 DAT. Similar results are given by Shah *et al.* (2020) in sponge gourd. Integration of organic manures with recommended dose of chemical fertilizers might have provided all the nutrients in balanced form required by plants for their proper growth and development. Besides, the interaction effect of pruning and different fertilizers on plant height of cucumber was found to be non-significant at 15, 30, 45 and 60 DAT.

Table 4. Effect of Pruning and Different Fertilizers on Plant height of cucumber in different time interval under protected structure at Panchthar during 2021

Treatments	Plant Height (cm) ± SEM			
	15 DAT	30 DAT	45 DAT	60 DAT
Pruning				
No pruning (control)	31.54±1.32	190.39±16.0^{a}	279.79±15.4^{a}	381.69±19.3^{a}
3G cutting	29.96±2.33	147.71±5.48^{b}	177.33±5.59^{b}	203.15±6.57^{b}
LSD (0.05)	5.53^{ns}	29.47**	23.59***	30.26***
Fertilizers				
No fertilizer (control)	26.54±2.89	126.50±10.4^{b}	181.58±17.4^{b}	238.70±31.1^{b}
30 Mt/ ha FYM +100 % RDF of NPK	33.66±2.93	184.67±10.7^{a}	241.21±23.9^{a}	317.75±44.0^{a}

9.4 Mt/ha Vermicompost+ 100% RDF of NPK	30.87±1.66	173.52±12.7[a]	241.71±26.2[a]	297.12±42.6[a]
4.3 Mt/ha Poultry manure + 100% RDF of NPK	31.92±2.60	191.50±26.9[a]	249.75±33.5[a]	316.08±51.7[a]
LSD (0.05)	7.83[ns]	41.68*	33.36**	42.79**
Mean	30.75	169.05	228.56	292.42
CV%	20.56	19.91	11.78	11.81
Interaction (Pruning X Fertilizers)				
LSD (0.05)	11.07[ns]	58.54[ns]	50.98[ns]	60.51[ns]
CV %	20.56	19.91	11.78	11.81

Note: Means followed by common letter(s) in the superscript within a column are not significantly different at 5% by LSD, DAT = Days after transplanting, RDF= Recommended dose of fertilizer, FYM= Farm Yard Manure, CV = Coefficient of variation, LSD = Least significant difference, SEM (±) = Standard error of mean difference, * significant at 5%, ** significant at 1%, *** significant at 0.1%, NS = non-significant

Nodal Position for First Male and First Female Flower

Statistical analysis of data showed that different pruning practices had non-significant effect on nodal position for first male flower of cucumber (Table 5). Similarly, nodal position for first male flower was also non-significantly affected by different fertilizer combinations. Statistical analysis of data showed significant variation in nodal position for first female flower as affected by different pruning practices whereas different fertilizer combinations had non-significant effect on nodal position for first female flower (Table 5). The lowest node (4.14) for first female flower was recorded from no pruning (control) treatment and highest node (8.56) for first female flower was recorded from 3G cutting treatment. The results revealed that without any pruning practice, plant produced first female flower earlier in lower nodal position. Our results are in accordance with the findings of Mir (2007) who reported that pruning might cause stress period for plant which might have resulted in shift of female flower to upper node and delay in flowering.

The interaction effect of pruning and different fertilizers on nodal position for first male and nodal position for first female flower was found to be non-significant (Table 5).

Days Required To 50% Male Flowering And 50% Female Flowering Per Plot

Statistical analysis of data revealed that days to 50% male flowering was significantly affected by different pruning practices whereas different fertilizer combinations had non-significant effect on this parameter (Table 5). The results revealed that minimum days (25.17) to 50% male flowering was recorded from no pruning (control) treatment and maximum days (26.83) was recorded from 3G cutting treatment. Utobo *et al.* (2010) reported the similar results where they observed unpruned cucumber plants took shorter days (26 days) to 50% male flowering as compared to lateral stem pruning from 4th node down (29 days). Similarly, data presented in (Table 5) showed that days to 50% female flowering was significantly affected by pruning practices and different fertilizer combinations. The result revealed that no pruning took minimum days (30.42) to 50% female flowering whereas 3G cutting took maximum days (32.83) for 50% female flowering per plot. Our results are in line with the findings given by Mir *et al.* (2019). Pruning of main shoot and branches might cause the modulation of hormone levels and assimilates translocation in plants, which might affect and change the days required for 50% flowering of both male as well as female flower.

Table 5. Effect of Pruning and Different Fertilizers on nodal position for first male flower, nodal position for first female flower, days to 50% male flowering per plot and days to 50% female flowering per plot under protected structure at Panchthar during 2021.

Treatment	**Parameters ± SEM**			
	Nodal position for first male flower	**Nodal position for first female flower**	**Days to 50% male flowering**	**Days to 50% female flowering**
Pruning				
No pruning (control)	3.27±0.14[a]	4.14±0.34[b]	25.17±0.60[b]	30.42±0.98[b]

3G cutting	3.39±0.13[a]	8.56±0.28[a]	26.83±0.44[a]	32.83±0.79[a]
LSD (0.05)	0.45[ns]	0.98***	1.66*	1.49**
Fertilizers				
No fertilizer (control)	3.58±0.22[a]	7.04±1.03[a]	27.16±0.60[a]	36.00±0.93[a]
30 Mt/ha FYM +100% RDF of NPK	3.12±0.19[a]	5.71±1.19[a]	24.83±1.11[a]	29.50±0.99[b]
9.4 Mt/ha Vermicompost+ 100% RDF of NPK	3.21±0.1[a]	6.67±1.09[a]	25.83±0.87[a]	30.33±0.96[b]
4.3 Mt/ha Poultry manure + 100% RDF of NPK	3.42±0.24[a]	6.00±0.95[a]	26.17±0.31[a]	30.67±0.33[b]
LSD (0.05)	0.64[ns]	1.39[ns]	2.34[ns]	2.12***
Mean	3.33	6.35	26.00	31.62
CV%	15.49	17.73	7.29	5.40
Interaction (Pruning X Fertilizers)				
LSD (0.05)	0.90[ns]	1.97[ns]	3.32[ns]	2.99[ns]
CV %	15.49	17.73	7.29	5.40

Note: Means followed by common letter(s) in the superscript within a column are not significantly different at 5% by LSD, DAT = Days after transplanting, RDF= Recommended dose of fertilizer, FYM= Farm Yard Manure, CV = Coefficient of variation, LSD = Least significant difference, SEM (±) = Standard error of mean difference, * significant at 5%, ** significant at 1%, *** significant at 0.1%, NS = non-significant

All three fertilizer combinations (30 Mt/ ha FYM +100 % RDF of NPK, 9.4 Mt/ha vermicompost+ 100% RDF of NPK and 4.3 Mt/ha Poultry manure + 100% RDF of NPK) recorded statistically similar results i.e minimum days to 50% female flowering whereas no fertilizer (control) treatment recorded maximum days (36.00) to 50% female flowering. Shah *et al.* (2020) reported similar results in sponge gourd who observed that female flowering requires ample amount of nutrients and combined application of organic manure and inorganic fertilizer in recommended dose improved the translocation of nutrients to the aerial parts and provided all nutrients in required amount. Besides, there was non-significant interaction between pruning and different fertilizers on days to 50% male and female flowering.

Number of Male and Female Flowers

The effect of pruning practices and different fertilizer combinations was found to be significant on number of male flowers and number of female flowers, whereas effect of interaction of pruning and fertilizers was non- significant on both of these parameters (Table 6). The results revealed that no pruning (control) recorded highest number of male flower (236.08) and 3G cutting recorded lowest number of male flower (119.64). In contrast to this, 3G cutting recorded highest number of female flower (72.97) and no pruning (control) recorded lowest number of female flower (65.08). Our results are supported by the research of Chaurasiya *et al*. (2020). Authors observed that 3G cutting promoted the growth of third generation branches that are responsible for production of high number of female flowers compared to male flowers, as a result of modulation in hormonal level in plants.

Regarding fertilizers, all three fertilizer combinations (30 Mt/ ha FYM +100 % RDF of NPK, 9.4 Mt/ha vermicompost+ 100% RDF of NPK and 4.3 Mt/ha Poultry manure + 100% RDF of NPK) recorded statistically similar and superior results i.e., maximum number of male and female flowers, as compared to no fertilizer (control) treatment (Table 6). Minimum number of male flowers (123.58) and female flowers (30.20) was noted from no fertilizer (control) treatment. Use of organic manures such as Farmyard manure (FYM) with suitable integration with inorganic fertilizers helps in continuous supply of all essential plant nutrients throughout the growth period of crop which resulted in earlier and proper development of reproductive parts (Bhatt *et al.*, 2020).

Male to Female Flowers Ratio

Data presented in (Table 6) showed that pruning practices and different fertilizer combinations had highly significant effect on male: female flowers ratio of cucumber. The results revealed that maximum ratio (4.38) was recorded from no pruning whereas minimum ratio (1.69) was recorded from 3G cutting treatment. Our results are in accordance with Thakur *et al.* (2018). All three fertilizer

combinations (30 Mt/ ha FYM +100 % RDF of NPK, 9.4 Mt/ha vermicompost+ 100% RDF of NPK and 4.3 Mt/ha Poultry manure + 100% RDF of NPK) recorded statistically similar and lowest male to female flowers ratio in comparison with no fertilizer (control) which gave highest ratio 4.74. The interaction effect of pruning and different fertilizers was found to be highly significant on male to female flowers ratio (Table 7). The results revealed that 3G cutting and all four fertilizer combinations showed statistically similar and lowest male to female flowers ratio whereas no pruning and no fertilizer treatment recorded highest (7.64) male to female flowers ratio (Table 7)

Table 6. Effect of Pruning and different fertilizers on number of male flowers, number of female flowers and male to female flowers ratio under protected structure in Panchthar during 2021.

Treatment	Parameters ± SEM		
	Total number of male flowers	Total number of female flowers	Male: female flower ratio
Pruning			
No pruning (control)	236.08±11.6^{a}	65.08±7.57^{b}	4.38±0.61^{a}
3G cutting	119.64±11.5^{b}	72.97±6.80^{a}	1.69±0.12^{b}
LSD (0.05)	23.23***	7.83*	0.59***
Fertilizers			
No fertilizer (control)	123.58±27.8^{b}	30.20±3.96^{b}	4.74±1.34^{a}
30 Mt/ha FYM +100 % RDF of NPK	200.87±26.1^{a}	83.70±2.22^{a}	2.41±0.31^{b}
9.4 Mt/ha Vermicompost+ 100% RDF of NPK	188.20±26.3^{a}	80.20±4.16^{a}	2.43±0.44^{b}
4.3 Mt/ha Poultry manure + 100% RDF of NPK	198.79±30.6^{a}	82.00±5.24^{a}	2.58±0.55^{b}
LSD (0.05)	32.85***	11.07***	0.84***
Mean	177.86	69.03	3.04
CV%	14.91	12.95	22.30
Interaction (Pruning X Fertilizers)			
LSD (0.05)	46.46^{ns}	15.66^{ns}	1.19***
CV %	14.91	12.95	22.30

Note: Means followed by common letter(s) in the superscript within a column are not significantly different at 5% by LSD, RDF= Recommended dose of fertilizer, FYM= Farm Yard Manure, CV = Coefficient of variation, LSD = Least significant difference, SEM (±) = Standard error of mean difference, * significant at 5%, ** significant at 1%, *** significant at 0.1%, NS = non-significant

Table 7. Interaction effect of pruning and different fertilizers on male: female flowers ratio of cucumber under protected structure in Panchthar during 2021.

Treatments	Male:Female flowers ratio ± SEM	
	No Pruning	3G cutting
No fertilizer (control)	7.64±0.69^{a}	1.84±0.32^{c}
30 Mt/ha FYM+100% RDF of NPK	3.05±0.07^{b}	1.76±0.23^{c}
9.4 Mt/ha Vermicompost+100% RDF of NPK	3.18±0.56^{b}	1.68±0.28^{c}
4.3 Mt/ha Poultry manure+100% RDF of NPK	3.65±0.55^{b}	1.49±0.18^{c}
Mean	3.04	
LSD0.05	1.18***	
CV (%)	22.30	

Note: Means followed by common letter(s) in the superscript within a column are not significantly different at 5% by LSD, RDF= Recommended dose of fertilizer, FYM= Farm Yard Manure, CV = Coefficient of variation, LSD = Least significant difference, SEM (±) = Standard error of mean difference, *** significant at 0.1%

Days to First Harvest

Statistical analysis of data revealed that different pruning practices had non-significant effect on days required to first harvest whereas different fertilizer combinations had a significant effect on this parameter (Table 8). Pruning had no effect on fruit harvesting time because pruning might not accelerate physiological maturity in fruit (Mir *et al*., 2019). The results revealed that all three fertilizer combinations (30 Mt/ ha FYM +100 % RDF of NPK, 9.4 Mt/ha vermicompost + 100% RDF of NPK and 4.3 Mt/ha Poultry manure + 100% RDF of NPK) recorded statistically similar result i.e., minimum days required to first harvest, as compared to no fertilizer (control) treatment which required maximum (52.29) days to first harvest (Table 8). Shah *et al.* (2020) also reported similar results in which they observed that combined application of organic manure with inorganic fertilizers improved vegetative growth and development of plant, translocated all macro and micro nutrients required by plant for earlier fruiting and harvesting. There was non-significant interaction between pruning and fertilizers on days required to first harvest.

Number of Fruits Per Plant

The effect of pruning practices and different fertilizer combinations was found to be highly significant on number of fruits per plant, whereas effect of interaction of pruning and fertilizers was non-significant on this parameter (Table 8). The data presented in (Table 8) showed that maximum number of fruits (12.81) was noted from 3G cutting treatment whereas minimum number of fruits (8.89) was noted from no pruning (control) treatment. The results are in close similarity with results of Mir *et al.* (2019) who reported that increase in number of female flower due to pruning might have increased the number of fruits in each plant. Besides, all three fertilizer combinations (30 Mt/ ha FYM +100 % RDF of NPK, 9.4 Mt/ha vermicompost + 100% RDF of NPK and 4.3 Mt/ha Poultry manure + 100% RDF of NPK) recorded statistically similar and superior result i.e., maximum number of fruits per plant as compared to no fertilizer (control) treatment which gave minimum (6.87) number of fruits per plant (Table 8). Similar results are obtained by Shah *et al.* (2020) who observed that application of full dose of FYM and full dose of NPK in sponge gourd produced maximum number (9.25) of fruits per plant while minimum (5.50) number was noted on control treatment.

Fruit Diameter (cm) and Fruit Length (cm)

Statistical analysis of data revealed that fruit diameter was significantly affected by different pruning and fertilizer combinations whereas interaction effect of pruning and fertilizers was observed to be non- significant on fruit diameter (Table 8). The results revealed that maximum fruit diameter (7.43 cm) was noted on 3G cutting treatment and minimum fruit diameter (7.25 cm) was recorded on no pruning (control) treatment. According to Mir *et al.* (2019), pruning helped to distribute the assimilates of the photosynthesis process which further resulted in cell enlargement and improved the fruit characters. Similarly, all three fertilizer combinations (30 Mt/ ha FYM +100 % RDF of NPK, 9.4 Mt/ha vermicompost + 100% RDF of NPK and 4.3 Mt/ha Poultry manure + 100% RDF of NPK) recorded statistically similar and superior result i.e. maximum fruit diameter as compared to no fertilizer (control) treatment which gave minimum (6.85 cm) fruit diameter (Table 8). The results are in accordance with Shah *et al.* (2020) who reported that combined application of FYM and NPK in sponge gourd produced maximum fruit volume of (218.87 cm^3) while minimum fruit volume (163.32 cm^3) was noted on control treatment.

Different pruning practices and interaction between pruning and different fertilizers showed non-significant variation on fruit length (cm) (Table 8). Thakur et al. (2018) also reported that pruning had no effect on length of fruits. Whereas, fruit length (cm) was significantly varied by different fertilizer combinations (Table 8). Similar results are reported by Shah *et al.* (2020).

Table 8. Effect of Pruning and different fertilizers on days to first harvest, number of fruits per plant, fruit diameter (cm) and fruit length (cm) under protected structure at Panchthar during 2021.

Treatment	Parameters ± SEM			
	Days to first harvest	Number of fruits per plant	Fruit diameter (cm)	Fruit length (cm)
Pruning				
No pruning (control)	49.17±0.80^a	8.89±0.71^b	7.25±0.13^b	28.91±0.57^a
3G cutting	50.14±0.63^a	12.81±1.00^a	7.43±0.08^a	29.47±0.43^a
LSD (0.05)	1.89^{ns}	1.48***	0.16*	0.84^{ns}
Fertilizers				
No fertilizer (control)	52.29±0.40^a	6.87±0.44^b	6.85±0.17^b	26.79±0.72^b
30 Mt/ha FYM +100% RDF of NPK	49.41±0.51^b	12.91±0.97^a	7.53±0.07^a	30.17±0.32^a
9.4 Mt/ha Vermicompost+ 100% RDF of NPK	48.08±1.16^b	11.54±1.69^a	7.47±0.03^a	29.88±0.32^a

4.3 Mt/ha Poultry manure + 100% RDF of NPK	48.83±0.98^{b}	12.08±1.14^{a}	7.53±0.06^{a}	29.92±0.21^{a}
LSD (0.05)	2.68*	2.10***	0.22***	1.18***
Mean	49.65	10.85	7.34	29.19
CV%	4.36	15.66	2.46	3.27
Interaction (Pruning X Fertilizers)				
LSD (0.05)	3.79^{ns}	2.98^{ns}	0.32^{ns}	1.67^{ns}
CV %	4.36	15.66	2.46	3.27

Note: Means followed by common letter(s) in the superscript within a column are not significantly different at 5% by LSD, RDF= Recommended dose of fertilizer, FYM= Farm Yard Manure, CV = Coefficient of variation, LSD = Least significant difference, SEM (±) = Standard error of mean difference, * significant at 5%, ** significant at 1%, *** significant at 0.1%, NS = non-significant

Fruit weight (gm)

Fruit weight (gm) varied significantly due to the effect of pruning and different fertilizer combinations, whereas interaction effect between pruning and different fertilizers was found to be non-significant on fruit weight (gm) (Table 9). The results showed that 3G cutting treatment produced maximum fruit weight (827.24 gm) and no pruning (control) treatment produced minimum fruit weight (775.65 gm). Our results are in conformity with the findings of Mardhiana *et al*. (2017) who reported that pruning reduced unproductive parts which resulted in wide allocation of assimilate of photosynthesis process to enhance cell enlargement. Similarly, all three fertilizer combinations (30 Mt/ ha FYM +100 % RDF of NPK, 9.4 Mt/ha vermicompost + 100% RDF of NPK and 4.3 Mt/ha Poultry manure + 100% RDF of NPK) recorded statistically similar and superior result i.e. maximum fruit weight as compared to no fertilizer (control) treatment which produced minimum (637.75 gm) fruit weight of cucumber (Table 9). According to Kharga *et al.* (2019), the reason for greater fruit weight might be due to the easy accessibility of nutrients to plants through inorganic fertilizers along with better solublization of organic manures in the soil, ultimately resulting to the production and translocation of adequate amount of photosynthates from leaves to the reproductive organs.

Fruit Yield (Kg/plant) and Fruit Yield (Mt/ha)

Data presented in (Table 9) showed that different pruning and different fertilizer combinations had significant effect on both fruit yield (Kg/plant) and fruit yield (Mt/ha). Interaction effect of pruning and different fertilizers was non-significant on both of these parameters. The results revealed that 3G cutting produced maximum fruit yield (9.52 Kg/plant and 95.21 Mt/ha) and no pruning produced minimum fruit yield (7.93 Kg/plant and 79.34 Mt/ha). Pruning helps to control the unessential vegetative growth of plant which helps to increase interception of sunlight to whole plant canopy, increase air circulation and CO_2 level thereby resulting in increase of photosynthesis rate ultimately leading to higher yield (Mardhiana *et al.*, 2017). Similarly, all three fertilizer combinations (30 Mt/ ha FYM +100 % RDF of NPK, 9.4 Mt/ha vermicompost + 100% RDF of NPK and 4.3 Mt/ha Poultry manure + 100% RDF of NPK) recorded statistically similar and superior result i.e. maximum fruit yield (Kg/plant and Mt/ha) as compared to no fertilizer (control) treatment which produced minimum fruit yield (3.93 Kg/plant and 39.38 Mt/ha) (Table 9). Shah *et al.* (2020) reported similar results in which application of full dose of FYM and full dose of NPK recorded highest fruit yield compared to control in sponge gourd plant. Inorganic source of nutrients with the addition of organic source such farmyard manure, poultry manure or vermicompost increased the plant growth due to the synthesis of more carbohydrates which caused maximum fruit yield of the crop (Shah *et al.*, 2020).

Table 9. Effect of Pruning and different fertilizers on fruit weight (gm), fruit yield (Kg/plant) and fruit yield (Mt/ha) under protected structure at Panchthar during 2021.

Treatment	**Parameters ± SEM**		
	Fruit weight (gm)	**Fruit yield (Kg/plant)**	**Fruit yield (Mt/ha)**
Pruning			
No pruning (control)	775.65±38.1^{b}	7.93±0.86^{b}	79.34±8.60^{b}
3G cutting	827.24±26.9^{a}	9.52±1.01^{a}	95.21±10.1^{a}
LSD (0.05)	44.96*	1.18*	11.78*
Fertilizers			
No fertilizer (control)	637.75±45.7^{b}	3.93±0.45^{b}	39.38±4.51^{b}
30 Mt/ha FYM +100 % RDF of NPK	859.21±23.4^{a}	10.58±0.45^{a}	105.78±4.53^{a}
9.4 Mt/ha Vermicompost+ 100% RDF of NPK	860.63±14.6^{a}	10.08±1.05^{a}	100.79±10.5^{a}
4.3 Mt/ha Poultry manure + 100% RDF of NPK	848.19±10.1^{a}	10.32±0.78^{a}	103.16±7.80^{a}
LSD (0.05)	63.59***	1.67***	16.66***

Mean	801.45	8.72	87.28
CV%	6.41	15.41	15.41
Interaction (Pruning X Fertilizers)			
LSD (0.05)	63.59^{ns}	2.36^{ns}	23.56^{ns}
CV %	6.41	15.41	15.41

Note: Means followed by common letter(s) in the superscript within a column are not significantly different at 5% by LSD, RDF= Recommended dose of fertilizer, FYM= Farm Yard Manure, CV = Coefficient of variation, LSD = Least significant difference, SEM (±) = Standard error of mean difference, * significant at 5%, ** significant at 1%, *** significant at 0.1%, NS = non-significant

Conclusion and Recommendations

The experimental findings revealed that 3G cutting was found better among the pruning practices as it recorded the shortest plant height at 30,45 and 60 DAT, lowest male to female flower ratio, highest number of fruits per plant, maximum fruit diameter and highest fruit yield (95.21 Mt/ha). In terms of fertilizers, all three fertilizer combinations (30 Mt/ ha FYM +100 % RDF of NPK, 9.4 Mt/ha vermicompost + 100% RDF of NPK and 4.3 Mt/ha poultry manure + 100% RDF of NPK) found equally effective for enhancing all the growth parameters, flowering parameters, yield attributing characters and ultimately the yield of cucumber due to the statistically similar results. Hence, farmers can use any fertilizer combinations among three of them as per their feasibility and availability in the locality.

Author's Contribution

All of the authors contributed equally in the manuscript. Final form of manuscript was approved by all authors.

Conflict of Interest

The authors declare that there is no conflict of interest with present publication.

Acknowledgements

The author would like to acknowledge Mahendra Ratna Multiple Campus Ilam and Prime Minister Agriculture Modernization Project, Government of Nepal for providing the platform for research and funding as well. The supervising committee of the author is acknowledged for providing the author with appropriate guidelines and the farmers of Sejepa, Phidim are acknowledged for providing field and other necessary resources to conduct research.

References

Arora SK & Malik IJ (1989) Effect of pruning and spacing levels on growth, flowering, earliness and fruit yield in ridge gourd. *Haryana Journal of Horticulture Science* **18**(1-2): 99-105.

Badr LAA, EL-Nagar MM, Aly SM & Saad MA (2018) Effect of nutrition and pruning methods on productivity and quality of cucumber hybrids in greenhouse. *Annals of Agricultural Science, Moshtohor* **56**(3): 697-708. DOI: 10.21608/assjm.2018.50326

Bhatt KR, Bhattachan BK, Marahatta S & Adhikari JB (2020) Growth and profitability of maize (*Zea mays* L.) under sole and combined applications of different organic and inorganic nutrient management at Rampur, Chitwan, Nepal. *Journal of Biology and Today's World* **9**(2): 1-7. DOI: 10.15412/J.JBTW.01070214

Bisognin DA (2002) Origin and evolution of cultivated cucurbits. *Ciência Rural* **32**(5): 715-723. DOI: 10.1590/S0103-84782002000400028

Chaurasiya DK, Kumar M, Sahni S & Singh S (2020) 3G cutting: A wonderful technique to redouble the production of cucurbits. *Biotica Research Today* **2**(12): 1308-1310.

Gomez KA & Gomez AA (1984) Statistical procedure for agricultural research (second edition): A wiley interscience publication.

Khanal S, Shrestha J & Lamichhane J (2020) Economics of production and marketing of cucumber in Nawalpur district of Nepal. *Azarian Journal of Agriculture* **7**(3): 93-101. DOI: 10.29252/azarinj.034

Kharga S, Sarma P, Warade SD, Debnath P, Wangchu L, Singh AK & G.Simray A (2019) Effect of integrated nutrient management on growth and yield attributing parameters of cucumber (*Cucumis sativus* L.) under protected condition. *International Journal of Current Microbiology and Applied Sciences* **8**(08): 1862-1871. DOI: 10.20546/ijcmas.2019.808.219

Mallick PK (2022) Evaluating potential importance of cucumber (*Cucumis sativus* L. - Cucurbitaceae): A Brief Review. *International Journal of Applied Sciences and Biotechnology* **10**(1): 12-15. DOI: 10.3126/ijasbt.v10i1.44152

Mardhiana, Pradana AP, Adiwena M, Kartina, Santoso D, Wijaya R & Maliki A (2017) Effects of pruning on growth and yield of cucumber (*Cucumis sativus*) mercy variety in the acid soil of North Kalimantan, Indonesia. *Cell Biology and Development* **1**(1): 13–17. DOI: 10.13057/cellbioldev/v010103

Mir AA (2007) Effect of pruning and plant growth regulators on growth, flowering, fruiting and yield of cucumber. *M. Sc. Thesis: Sher-E-Bangla Agricultural University*, Dhaka, Bangladesh.

Mir AA, Sadat MA, Amin MR & Islam MN (2019) Pruning: A mechanical stress inducing method to improve growth and yield of bangaldeshi local cucumber variety "Baromashi". *International Journal of Business, Social and Scientific Research* **7**(4): 31-35.

MoALD (2019/20) *Statistical Information on Nepalese Agriculture*. Singhadurbar, Kathmandu, Nepal: Planning and Development Cooperation Coordination Division.

NARC (2020) *Package of Practices for Vegetable crops*. Khumaltar, Lalitpur, Nepal: National Outreach research center, Nepal Agriculture Research Council.

Pandey P, Jha RK & Shrestha AK (2019) Influence of ethephon on vegetative character, flowering behaviour and sex expression of cucumber in Pokhara Lekhnath, Kaski. *North American Academic Research* **2**(5): 1-13.

Shah PS, Nabi G, Khan M, Hussain S & Jan JA (2020) Performance of sponge gourd cultivars under organic and inorganic fertilizer regimes. *Sarhad Journal of Agriculture* **36**(2): 478-488. DOI: 10.17582/journal.sja/2020/36.2.478.488

Sharma D, Sharma VK & Kumari A (2018) Effect of spacing and training on growth and yield of polyhouse grown hybrid cucumber (*Cucumis sativus* L.). *International Journal of Current Microbiology and Applied Sciences* **7**(05): 1844-1852. DOI: 10.20546/ijcmas.2018.705.217

Singh MC, Singh JP, Pandey SK, Mahay D & Shrivastva V (2017) Factors affecting the performance of greenhouse cucumber cultivation-A Review. *International Journal of Current Microbiology and Applied Sciences* **6**(10): 2304-2323. DOI: 10.20546/ijcmas.2017.610.273

Singh V, Prasad V, Kasera S, Singh BP & Mishra S (2017) Influence of different organic and inorganic fertilizer combinations on growth, yield and quality of cucumber (*Cucumis sativus* L.) under protected cultivation. *Journal of Pharmacognosy and Phytochemistry* **6**(4): 1079-1082.

Subbaiah, PV (2019) Review on vermicompost, poultry manure, farmyard manure, biogas digest, biochar, urban compost and biofertilizers as potential alternate nutrient sources for sustainable agriculture. *International Journal of Chemical Studies* **7**(4): 255-258.

Thakur O, Kumar V & Singh J (2018) A review on advances in pruning to vegetable crops. *International Journal of Current Microbiology and Applied Sciences* **7**(2): 3556-3565. DOI: 10.20546/ijcmas.2018.702.422

Umekwe PN, Okpani FM & Okocha IO (2015) Effects of different rates of NPK 15:15:15 and pruning methods on the growth and yield of cucumber (*Cucumis Sativus* L.) in Unwana-Afikpo. *International Journal of Science and Research* **4**(10): 4.

Utobo EB, Ekwu LG, Ogah EO & Nwokwu GN (2010) Growth and Yield of Cucumber Varieties as Influenced by Pruning at Abakaliki Agricultural Area, Southeastern Nigeria. *Continental Journal of Agronomy* **4**: 23–27.