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Research Article

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Effect of NPK Levels on Growth and Yield of Sweet Pepper *(Capsicum Annum)* under Different Growing Conditions in Arghakhanchi, Nepal

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Abstract

Optimizing fertilization to boost sweet pepper yield is essential for meeting food demands and promoting agricultural sustainability. This field experiment was performed from March to July 2022 in Sandhikharka, Arghankhanchi, to evaluate the effect of NPK levels from inorganic sources on the growth and yield of sweet pepper under different growing conditions. The experiment followed a two-factorial Randomized Complete Block Design (RCBD) with eight treatments: two growing conditions (open field vs. poly-tunnel) and four NPK levels (0 %, 50%, 100%, and 150 % of the recommended dose of NPK), replicated thrice. Results revealed that poly-tunnel had the highest plant height (44 cm), stem base diameter (1.63 cm), number of leaves (169), number of branches (12), number of buds (10), number of flowers (5), number of fruits (6), fruit length (7 cm), fruit diameter (8 cm), average fruit weight (122 g) and yield (8.90 t/ha) as compared to open field conditions. The 50 % more of the recommended NPK had the highest plant height (47 cm), stem diameter (1.67 cm), number of leaves (165), number of branches (12), number of buds (11), number of flowers (6), number of fruits (6), fruit length (7 cm), fruit diameter (8.26 cm), average fruit weight (125 g) and yield (9.68 t/ha). Significant interactions between growing conditions and NPK levels were observed for fruit diameter, average fruit weight, and yield. The study concluded that the recommended NPK dose is optimal for poly-tunnel cultivation, while 150% of the recommended dose is needed for open field conditions.

Keywords : Open field, Capsicum, Nutrients, Protected condition, Poly-tunnel

Introduction:

Sweet pepper (*Capsicum annum)* commonly referred to as capsicum or bell pepper, belongs to the Solanaceae family. It is among the most commonly cultivated vegetable crops globally and is extensively used fresh, in culinary dishes, and as a processed product (Krasnow & Ziv, 2022). Its global popularity is due to its nutritional benefits, delicate taste, pleasant flavor, and vibrant color (Sharma et al., 2019). Sweet peppers are beneficial for a strong and healthy immune system due to their high content of vitamin C and zinc, as well as fatty acids, flavonoids, volatile oil, beta carotene, iron, potassium, calcium, vitamin A and rutin (Agarwal et al., 2007). It has higher levels of complex carbohydrates but with low fat and calories (Kumar et al., 2015). It does not produce capsaicin ($C_{18}H_{27}NO_3$) which is the compound responsible for the burning sensation (Roy et al., 2019).

Nepal's agro-climatic conditions are suitable for growing and producing high-quality sweet peppers (Bhattarai, 2011). In Nepal, sweet pepper is cultivated over an area of 1,931 hectares, yielding 20,002 metric tons with a yield of 10.36 metric tons per hectare. In the Arghakhanchi district, sweet pepper cultivation spans 3 hectares, yielding 27 metric tons with an average production of 9 metric tons per hectare (MoALD, 2023). Sweet pepper cultivation is highly sensitive and responsive to even slight variations in environmental conditions (Cho et al., 2012). Poly-tunnels and plastic mulching play an essential role in successfully cultivating sweet peppers especially in hilly areas by providing essential protection against harsh weather conditions and pests (Singh et al., 2003; Singh et al., 2010). Poly-tunnel cultivation of sweet pepper is considered more profitable among different protected structures (Aruna & Sudagar, 2009). Organic manures alone are insufficient to meet the nutritional needs of the crop (Deore et al., 2010). When organic and chemical fertilizers are applied together, they result in higher yields compared to using either alone (Bokhtiar et al., 2008). Mineral nutrients like nitrogen (N), phosphorus (P), and potassium (K) are recognized to influence the growth and yield of sweet peppers (Alkharpotly, 2018). The optimum NPK fertilizer application rate was found to enhance the increment, advancement, quantity, and quality of capsicum, including its levels of ascorbic acid and capsanthin (Khan et al., 2010).

Many farmers lack sufficient understanding of how to effectively manage fertilizers for sweet pepper cultivation in protected environments such as greenhouses or poly-tunnels, including the appropriate types and quantities of fertilizers, the timing of applications, and how to balance nutrients to avoid deficiencies or excesses (Sharma et al., 2019). Excessive use of NPK fertilizers leads to groundwater pollution and soil salinity, which undermines sustainable agricultural production (Khan et al., 2018). There have been limited efforts to establish optimal fertilizer schedules for sweet peppers, particularly under both protected and open field conditions indicating a gap that needs to be addressed. With these facts in mind, this study was planned to ascertain the optimum dose of NPK under different growing conditions for exploiting the yield potential of sweet pepper.

Materials and Methods:

Research location

This study took place in Sandhikharka-1, Arghakhanchi, situated in the humid sub-tropical region at an altitude of 960 meters above sea level (masl). Arghakhanchi district from Province 5, is geographically positioned between 28°N to 29°N latitude and 81°E to 83°E longitude, covering an area of 1193 square kilometers. The region receives an average annual rainfall of around 2600 mm. A map depicting the study area is presented in Figure 1.

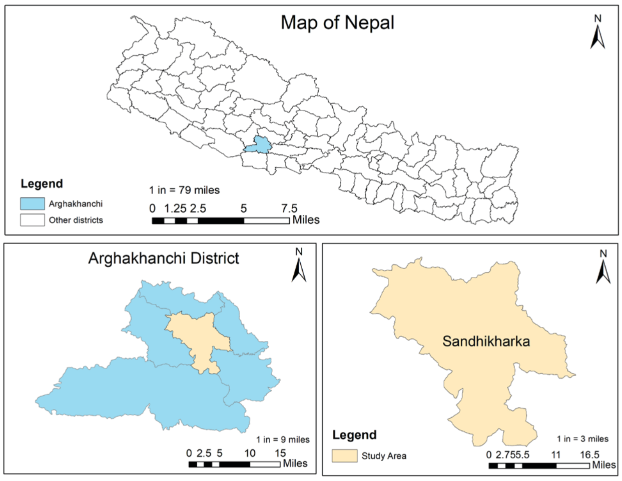
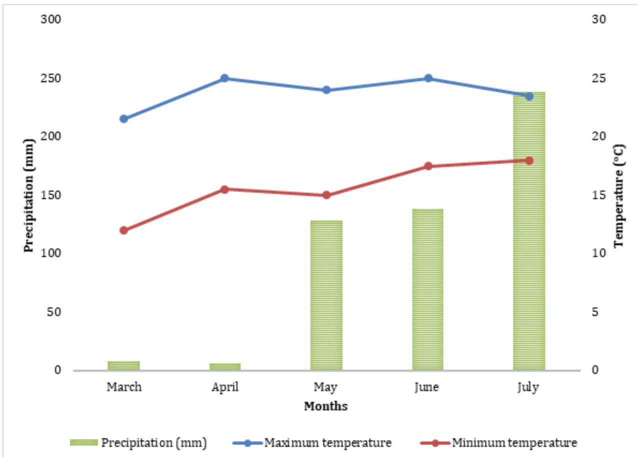


Figure 1. Study area (Source: ArcGIS 10.8)

Climatic condition

The rainfall and temperature data for the experimental period from March to July 2022 in Arghakhanchi were recorded and illustrated in Figure 2.



Source: Department of Hydrology and Meteorology (DHM), 2022

Figure 2. Climatological information during March-July, 2022 at Sandhikharka, Arghakhanchi

Soil condition

A soil test was conducted one week before the initiation of the research using a soil test kit from the Agriculture Knowledge Centre (AKC) of Arghakhanchi. The soil at the experimental site is found to be loamy Alfisols, characterized by a good amount of organic matter making it ideal for sweet pepper cultivation due to its excellent drainage and moisture retention capabilities. The soil pH is neutral to slightly acidic falling between 6.0 and 6.8, which supports optimal nutrient availability. The levels of Nitrogen, Phosphorus, and Potash were found to be low to moderate at the time of testing.

Experimental design

The experiment was conducted using a two factorial Randomized Complete Block Design (RCBD) with 8 treatments, each replicated three times. Each experimental plot was 5 m², totaling 24 plots with 20 plants per plot, accommodating 480 plants in 182.5 square meters. A spacing of 1 meter was maintained between replications and 0.25 meters between treatments.

Table 1: Levels of two factorial RCBD

	Factor A: Different growing conditions		Factor B: Different NPK levels from an inorganic source
1	Poly-tunnel	1	Control (No NPK from inorganic sources)
2	Open field	2	50% of the recommended NPK dose
		3	100 % of the recommended NPK dose
		4	150% of the recommended NPK dose

Table 2: Treatment details of the Experiment

Treatments	Treatments Combinations	Composition
T1	P1F1	Poly-tunnel + Control
T2	P1F2	Poly-tunnel + 50% of recommended NPK
T3	P1F3	Poly-tunnel + 100 % of recommended NPK
T4	P1F4	Poly-tunnel + 150% of recommended NPK
T5	P2F1	Open field + Control
T6	P2F2	Open field + 50% of recommended NPK
T7	P2F3	Open field + 100 % of recommended NPK
T8	P2F4	Open field + 150% recommended NPK

Management practices

In the second week of Falgun, sweet pepper seeds were sown in a nursery bed, and by the third week of Chaitra, the seedlings were transplanted. Seedlings were raised in trays using a mixture of cocopeat and peat moss with seeds sown at a depth of 2 cm and placed in a gummose house. The seedlings were transplanted into the main field 40 days after sowing (DAS) at a spacing of 50 cm between plants and 50 cm between rows. As a source of organic manure, 2 tons per hectare of farmyard manure (FYM) was evenly applied to all experimental plots while preparing the land. Inorganic fertilizers, namely Urea, DAP, and MOP, were applied to meet the experimental levels of NPK. The recommended dose of NPK for capsicum is 110:45:60 N: P_2O_5:K_2Okg/ha. Desired experimental levels of NPK were calculated and applied in the field according to the area of the experiment. Half of the nitrogen dose was incorporated as a basal dose with ¼ part being top-dressed at 30 days after transplanting (DAT) and the rest ¼ at 45 days after transplanting (DAT).

Data collection and analysis

Plant growth parameters like plant height (cm), stem base diameter (cm), and number of leaves, and branches were observed along with yield parameters like number of buds, flowers, fruits per plant, fruit length (cm), fruit diameter (cm), weight of fruit per plant (g) and fruit yield per hectare (tha^{-1}).

MS Excel software was used to tabulate the data collected from the field for different parameters. The analysis of the data was performed using R-Studio (v 4.2), and treatment means were assessed using Analysis of Variance (ANOVA) and separated using Duncan's Multiple Range Test (DMRT) at a 5% level of significance.

Results and Discussion:

Effect of growing conditions and NPK levels on growth parameters

Plant height

The plant height was significantly greater in poly-tunnel than in open field at all growth stages (Table 3). At 60 DAT, the recorded plant height was significantly higher in poly-tunnel (44 cm) than in the open field (42 cm). The result was in accordance with Nkansah et al. (2017) who observed the maximum number of plants in a protected house which provides optimal conditions for growth. Effects of NPK on plant height were significant at all growth stages of the plant (Table 3). At 30 and 45 DAT, 50 % of recommended NPK was statistically similar to 100 % of recommended NPK. There was a notable increase in plant height from 50% to 150 % of recommended doses of NPK at 60 DAT. A similar result was obtained with 50% more of the recommended dose of NPK treatment, as reported by Sharma (2016). The increased plant height may be attributed to a plentiful supply of nitrogen and phosphorus which enhanced photosynthesis and contributed to plants' overall vigor (Razaq et al., 2017). The interaction effect of growing conditions and NPK levels was statistically similar for plant height at all stages.

Table 3: Effect of growing conditions and NPK on plant height at different growth stages

Treatments	Plant height (cm)		
	30 DAT	45 DAT	60 DAT
Growing Conditions (Fa)			
Poly-tunnel	12.83[a]	24.80[a]	43.69[a]
Open field	12.02[b]	23.68[b]	42.13[b]
SE (±) d	0.22	0.41	0.44
F-value	0.74**	0.16**	0.20**
NPK(Fb)			
Control	11.11[c]	20.79[c]	41.69[b]
50% of recommended NPK	11.69[bc]	23.89[b]	42.13[b]
100% of recommended NPK	12.75[b]	24.96[b]	43.69[a]
150% of recommended NPK	14.15[a]	27.32[a]	43.13[ab]
SE (±) d	0.31	0.49	0.63
F-value	0.74*	0.16*	0.20**
CV %	4.37	4.20	2.55
Grand Mean	12.42	24.24	42.91

Treatment mean followed by common letter (s) are not significantly different from each other based on DMRT 5% level of significance, * and ** represent significance at p<0.05 and p<0.01 respectively, DAT= Days after transplanting, SE (±) d = Standard error of difference between two means, CV= Coefficient of variation, F-value = F-test value.

Stem diameter

At 60 DAT, the highest diameter was recorded under the poly-tunnel (1.63 cm), significantly higher than the open field (1.39 cm). There were no significant effects at 30 and 45 DAT (Table 4). The effect of NPK levels on stem diameter was non-significant at 30 DAT while significantly higher at 45 and 60 DAT (Table 4). At 45 DAT, 50 % (1.11 cm), 100 % (1.16 cm), and 150 % (1.14 cm) of recommended NPK levels provide statistically similar results while control (1.01 cm) is the lowest. At 60 DAT, the highest diameter (1.67 cm) is from 150% followed by 100 % and 50 % recommended dose of NPK levels. Interaction effects of growing conditions and NPK levels on stem diameter were non-significant at all growth stages of the plant.

Table 4: Effect of growing conditions and NPK on stem diameter(cm) at different growth stages

Treatments	Stem diameter (cm)		
	30 DAT	45 DAT	60 DAT
Growing Conditions (Fa)			
Poly-tunnel	0.63	1.10	1.63[a]
Open field	0.57	1.11	1.39[b]
SE (±) d	0.03	0.03	0.05
F-value	2.68[ns]	0.45[ns]	14.03**
NPK(Fb)			
Control	0.56	1.01[b]	1.34[c]
50% of recommended NPK	0.62	1.11[a]	1.46[bc]
100% of recommended NPK	0.61	1.16[a]	1.56[ab]
150% of recommended NPK	0.61	1.14[a]	1.67[a]
SE (±) d	0.05	0.03	0.07
F-value	0.64[ns]	6.99*	8.03**
CV %	15.05	5.73	7.88
Grand Mean	0.60	1.10	1.51

Treatment mean followed by common letter (s) are not significantly different from each other based on DMRT 5% level of significance, * and ** represent significance at p<0.05 and p<0.01 respectively, DAT= Days after Transplanting, ns = non-significant, SE (±) d = Standard error of difference between two means, CV= Coefficient of variation, F-value = F-test value.

Number of leaves per plant

The effect of growing conditions on the number of leaves per plant was non-significant at 30 DAT but significantly higher at 45 and 60 DAT (Table 5). At 45 DAT, the highest number of leaves per plant was recorded in the poly-tunnel (81) and the lowest in the open field (76). At

60 DAT, the number of leaves per plant was significantly higher in the poly-tunnel (169) compared to the open field (121). The microclimate created by the poly-tunnel favors greater leaf production. This result contradicts the study of Ima-obong et al. (2017) where open fields had the highest number of leaves.

branches than the open field (9.49).

The effects of NPK on the number of branches were significant at all growth stages (Table 6). At 30 DAT, the highest number of branches was recorded at 150% (0.76) and 100% (0.63) of the recommended NPK dose, while the lowest was at 50% (0.73) and control (0.52). At 45 DAT, the highest number of branches was at 150% (6.40) and 100% (6.06) NPK, with the lowest in the control (4.73) and 50% (4.80). At 60 DAT, the highest number of branches was at 150% (12.30) and 100% (11.56) NPK, with the lowest in the control (8.73). Altaf et al. (2019) also noted that the number of branches increased as the NPK rate rose.

Table 5: Effect of growing conditions and NPK on the number of leaves per plant at different growth stages

Treatments	Number of leaves per plant		
	30 DAT	45 DAT	60 DAT
Growing Conditions (Fa)			
Poly-tunnel	16	81[a]	169[a]
Open field	15	76[b]	121[b]
SE (±) d	0.99	1.74	4.61
F-value	0.27[ns]	9.39**	7.44**
NPK(Fb)			
Control	14	60[c]	122[c]
50% of recommended NPK	16	64[c]	137[b]
100% of recommended NPK	14	92[b]	155[a]
150% of recommended NPK	17	99[a]	165[a]
SE (±) d	1.39	2.46	6.52
F-value	2.04[ns]	6.62*	9.08**
CV %	15.87	5.41	7.80
Grand Mean	15.25	78.76	144.95

Treatment mean followed by a common letter (s) are not significantly different from each other based on DMRT 5% level of significance, * and ** represent significance at $p<0.05$ and $p<0.01$ respectively, DAT= Days after Transplanting, ns= non-significant, SE (±) d = Standard error of the difference between two means, CV= Coefficient of variation, F-value = F-test value.

The effect of NPK on the number of leaves per plant was non-significant at 30 DAT but significantly higher at 45 and 60 DAT (Table 5). At 45 DAT, the highest number of leaves per plant was recorded at 150% of the recommended NPK dose (99), followed by 100% (92). At 60 DAT, the highest number of leaves per plant was again recorded at 150% of the recommended NPK dose (165), at par with 100% (155.03). The lowest number of leaves was recorded in the control group (122). It is because NPK is associated with photosynthetic activity and vigorous vegetative growth (Prativa & Bhattarai, 2011). NPK fertilization increased the number of leaves agreed to the findings of Aminifard et al. (2012). An interaction effect was not significant at all stages.

Number of branches

The effect of growing conditions on the number of branches was non-significant at 30 DAT but significantly higher at 45 and 60 DAT (Table 6). At 45 DAT, the highest number of branches was recorded in the poly-tunnel (6) and the lowest in the open field (5.1). At 60 DAT, the poly-tunnel (12) produced significantly more

Effect of growing conditions and NPK on yield attributing parameters

Number of buds, flowers, and fruits per plant

There was a significant difference in the number of buds, flowers, and fruits per plant between the growing conditions (Table 7). The highest (10) number of buds was from poly-tunnel and the lowest (9) number of buds from open field. The highest (5) number of flowers was from poly-tunnel and the lowest (4) number of flowers from open field. The highest (6) number of fruits was from poly-tunnel and the lowest (5) number of fruits from open field. Rathore and Bahadur (2024) recorded similar findings. This could be attributed to the favorable climatic conditions, rapid growth, increased number of

Table 6: Effect of growing conditions and NPK on the number of branches at different growth stages

Treatments	Number of branches		
	30 DAT	45 DAT	60 DAT
Growing Conditions (Fa)			
Poly-tunnel	0.58	6[a]	12[a]
Open field	0.63	5[b]	9[b]
SE (±) d	0.06	0.31	0.44
F-value	0.63[ns]	6.46*	9.78**
NPK(Fb)			
Control	0.53[b]	5[b]	9[c]
50% of recommended NPK	0.50[b]	5[b]	10[b]
100% of recommended NPK	0.63[ab]	6[a]	12[ab]
150% of recommended NPK	0.76[a]	6[a]	12[a]
SE (±) d	0.09	0.44	0.63
F-value	3.61*	7.44*	12.57**
CV %	25.36	14.00	10.13
Grand Mean	0.60	5.5	10.70

Treatment mean followed by a common letter (s) are not significantly different from each other based on DMRT 5% level of significance, * and ** represent significance at $p<0.05$ and $p<0.01$ respectively, DAT= Days after Transplanting, ns= non-significant, SE (±) d = Standard error of the difference between two means, CV= Coefficient of variation, F-value = F-test value.

branches, ample accumulation of photosynthates, and reduced flower drop in sweet pepper (Omar et al., 2018).

The effect of NPK on the number of buds, flowers, and fruits per plant was significant (Table 7). The highest number of buds (11) and flowers (6) was recorded at 150% of the recommended NPK dose, with the control showing the lowest bud count (7). Similarly, the highest number of fruits (6) was at 150% NPK, with the control having the lowest (5). The 100% and 50% NPK doses had similar effects on the number of flowers and fruits. These results follow the study of Sharma et al (2023) who reported that increasing the rate of NPK fertilizers increased the number of fruits. An interaction effect was not significant at all the stages.

Fruit length (cm), diameter (cm), average weight(g), and yield (tha^{-1})

There was a significant difference in fruit length, diameter, average weight, and yield between growing conditions (Table 8). The highest values for fruit length (7.23 cm), diameter (8.16 cm), average weight (122 g), and yield (8.14 t/ha) were recorded in the poly-tunnel, while the lowest values were in the open field. The poly-tunnel provided higher yields and reduced disease due to its protection against abiotic stresses and controlled environment (Kumar et al., 2019).

The effect of NPK levels on fruit length, diameter, average fruit weight, and yield per hectare was significant (Table 8). The highest fruit length (7.38 cm) and diameter (8.26 cm) were recorded at 150% of the recommended NPK dose, with the lowest fruit length (6.98 cm) recorded in the control, which was similar to the 50% and 100% NPK levels. Higher vegetative growth likely facilitated the synthesis of more fruit material, which was subsequently translocated into developing fruits, leading to increased fruit length and diameter (Kaur et al., 2017). The highest average fruit weight (125 g) and yield (9.68 t/ha) were recorded at 150% of the recommended NPK dose, followed by 100% and 50%. The lowest average fruit weight (113 g) and yield (7.62 t/ha) were from the control, similar to the 50% NPK level. These findings conform with the results reported by Aminifard et al (2012) and (Yasuor et al., 2013). This could be due to plants efficiently utilizing the continuous availability of higher nutrient levels (Chetri et al., 2012).

The interaction between growing conditions and NPK levels was significant for fruit diameter, average fruit weight, and yield per hectare, while it had a non-significant effect on fruit length (cm).

Table 7: Effect of growing conditions and NPK on the number of buds, flowers, and fruits per plant

Treatments	Parameters		
	Buds/plant	Flowers/plant	Fruits/plant
Growing Conditions (Fa)			
Poly-tunnel	10[a]	5[a]	6[a]
Open field	9[b]	4[b]	5[b]
SE (±) d	0.22	0.19	0.17
F-value	10.28**	14.10**	13.80**
Levels of NPK(Fb)			
Control	7[d]	5[b]	5[c]
50% of recommended NPK	8[c]	5[b]	5[bc]
100% of recommended NPK	10[b]	5[ab]	5[b]
150% of recommended NPK	11[a]	6[a]	6[a]
SE (±) d	0.32	0.27	0.24
F-value	15.28**	4.54*	10.58**
CV %	6.10	9.69	8.14
Grand Mean	9.12	4.92	5.25

Treatment mean followed by common letter (s) are not significantly different from each other based on DMRT 5% level of significance, * and ** represent significance at p<0.05 and p<0.01 respectively, DAT= Days after Transplanting, SE (±) d = Standard error of difference between two means, CV= Coefficient of variation, F-value = F-test value

Table 8. Effect of growing conditions and NPK on fruit length, diameter, average weight, and yield

Treatments	Fruit Parameters			Yield(t/ha)
	Length (cm)	Diameter (cm)	Weight (g)	
Growing Conditions (Fa)				
Poly-tunnel	7.23[a]	8.16[a]	122[a]	8.90[a]
Open field	7.05[b]	7.95[b]	117[b]	8.14[b]
SE (±) d	0.07	0.06	0.96	0.15
F-value	5.92*	11.63**	14.95**	13.71**
Levels of NPK(Fb)				
Control	6.98[b]	7.98[b]	113[d]	7.62[c]
50% of recommended NPK	7.05[b]	7.89[b]	116[c]	7.90[c]
100% of recommended NPK	7.15[b]	8.09[ab]	122[b]	8.88[b]
150% of recommended NPK	7.38[a]	8.26[a]	125[a]	9.68[a]
SE (±) d	0.10	0.08	1.36	0.22
F-value	5.85*	6.43**	10.27**	15.72**
CV %	2.48	1.90	1.98	4.52
Grand Mean	7.14	8.05	119.12	8.52

Treatment mean followed by common letter (s) are not significantly different from each other based on DMRT 5% level of significance, * and ** represent significance at p<0.05 and p<0.01 respectively, DAT= Days after transplanting, SE (±) d = Standard error of difference between two means, CV= Coefficient of variation, F-value = F-test value.

Table 9: Interaction effect of growing conditions and NPK on fruit length, diameter, average weight, and yield

Treatments	Fruit Parameters			Yield(t/ha)
Growing Conditions × NPK levels	Length(cm)	Diameter (cm)	Weight (g)	
P1F1	7.04	7.91^{cd}	112^{e}	7.62^{c}
P1F2	7.01	8.10^{abc}	119^{bc}	8.63^{b}
P1F3	7.35	8.26^{ab}	127^{a}	9.40^{a}
P1F4	7.51	8.38^{a}	129^{a}	9.97^{a}
P2F1	6.95	8.06^{bc}	115^{cde}	7.63^{c}
P2F2	7.08	7.68^{d}	114^{de}	7.18^{c}
P2F3	6.95	7.92^{cd}	117^{cd}	8.35^{b}
P2F4	7.25	8.15^{abc}	121^{b}	8.79^{b}
SE (±) d	0.14	0.12	1.92	0.31
$LSD_{0.05}$	0.31	0.26	4.13	0.67
F-value	1.96^{ns}	4.01^{*}	9.35^{*}	4.04^{*}
CV %	2.48	1.90	1.98	4.52
Grand Mean	7.14	8.05	119.12	8.52

Note: P1- Poly-tunnel, P2- Open field

F1 (Control), F2 (50% of recommended NPK, F3 (100% of recommended NPK), F4 (150% of recommended NPK)

Treatment mean followed by common letter (s) are not significantly different from each other based on DMRT 5% level of significance, * and ** represent significance at p<0.05 and p<0.01 respectively, DAT= Days after transplanting, ns = non-significant, SE (±) d = Standard error of difference between two means, CV= Coefficient of variation, F-value = F-test value.

The highest fruit diameter (8.38 cm) was observed at 150% NPK which was similar to 100% and 50% NPK under poly-tunnel and 100% NPK under open field, while the lowest (7.68 cm) was at 50% NPK under open field. The highest fruit weight (129 g) was at 150% NPK, similar to 100% NPK under poly-tunnel, with 50% NPK under poly-tunnel (119 g) comparable to 100% NPK under open field (121 g). The lowest fruit weight (112 g) was at control under poly-tunnel, similar to control, and 50% NPK under an open field. The highest fruit yield (9.97 t/ha) was achieved with 150% NPK, similar to 100% NPK under poly-tunnel. Under poly-tunnel, 50% NPK (8.63 t/ha) showed similar yields to those of 100% (8.35 t/ha) and 150% (8.79 t/ha) NPK under open field. The lowest yield (7.62 t/ha) was recorded with control under poly-tunnel, matching yields of control and 50% NPK under open field. Chapagain et al. (2014) revealed that higher NPK levels have a positive effect in improving fruit parameters which results in higher yield per unit area under poly-tunnel. These findings are in line with the study done by Shil et al. (2015) and Ameta et al. (2021).

Conclusion:

Poly-tunnel cultivation is preferable over open field conditions to achieve optimal yields of the California Wonder variety of sweet pepper in conditions like those in Sandhikharka, Arghakhanchi. Under poly-tunnel conditions, the recommended NPK (Nitrogen, Phosphorus, Potassium) dosage is sufficient for maximum yield. Conversely, open-field cultivation exposes plants to environmental stressors, necessitating a 50% increase in the recommended NPK dosage to meet the higher nutrient demands and enhance productivity. Thus, poly-tunnel methods offer more efficient nutrient use and higher yields compared to open-field cultivation.

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Declaration of conflict of interest and ethical approval:

P.B. Kunwar designed the experiment, conducted fieldwork, recorded data, performed data analysis, and wrote the manuscript. S. Khatri assisted with data recording and manuscript preparation. T.N. Bhusal provided direct supervision throughout the research process. All authors have reviewed the manuscript before submission to Nepalese Horticulture and declare no competing interests. This article does not involve any human participants or animals.

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