



Research Article

Comparative Analysis on the Growth and Yield of Summer Squash (*Cucurbita pepo*) Varieties in the Southern Climate of Nepal

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Abstract | Summer Squash (*Cucurbita pepo* L.) is a globally cultivated horticultural crop. This experiment aimed to assess the growth and yield of five different varieties of summer squash in the southern region of Nepal, characterized by a subtropical climate. The field experiment was conducted from January 2022– June 2022 in Kawasoti, Nawalparasi-East, Nepal. The experiment was conducted in a single factor randomized complete block design with four replications and five treatments: 1: Anna 303, 2: Anna 202, 3: Sunny House, 4: Shlesha, 5: Grey zucchini. The results showed significantly higher plant spreading in Sunny House. The highest number of male flowers plant⁻¹ (29.56) and female flowers plant⁻¹ (13.81) were recorded in Shlesha 1214, while the lowest number of male and female flowers were recorded in grey zucchini, i.e., 24.43 and 11.68, respectively. Similarly, a higher number of days to 50% female flowering (29.56), higher number of pickings plant⁻¹ (5.50), higher average fruit weight plant⁻¹ (915.73g), higher fruit yield plant⁻¹ (5063.062g), higher productivity (81.009Mt/ha) was recorded in Sunny House. Productivity was nearly double in Sunny House than Anna 303, Shlesha 1214, Grey Zucchini, and Anna 202. Among these genotypes, Sunny House demonstrates superiority and exhibits high productivity. In contrast, Shlesha 1214 has the advantage of yielding earlier compared to any other varieties in the study. The results of this experiment thus clearly suggest the benefits of using the Sunny House variety in the southern climate of Nepal. This experiment can benefit several farmers in southern Nepal and elsewhere with similar climates and landscapes globally.

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Introduction

Given the pressing challenges of escalating population growth, food insecurity, and poverty, the scientific community stands at a critical juncture. With the global population projected to be near

9 billion, closing the gap between food production and demand is urgent. Modern advancements are revolutionizing major crops such as rice, wheat, and maize, constituting a significant portion of the global food supply. However, a substantial gap exists between food demand and supply (Amin et

al., 2023). One of the primary constraints affecting growers' productivity and profitability in Nepal is the lack of suitable, improved, high-yielding varieties and hybrids (Kushwah et al., 2016). Addressing this challenge requires exploring easy and economical options to boost production. Vegetable breeding has the potential to contribute significantly to bridging this gap (Amin et al., 2023).

Agriculture is the backbone of Nepal's economy, contributing significantly to its GDP and employing a substantial portion of the population (Singhadurbar, n.d.). In Nepal, vegetable farming is a significant component of agriculture, occupying a substantial area of cultivated agricultural land. For instance, vegetable farming covers 289,839 hectares of land with an annual production of 4,153,157 metric tons (MoALD, 2021/2022). Among the various vegetables grown, summer squash holds a notable rank, covering 1,922 hectares of land with an annual production of 24,509 metric tons and an average productivity of 12.75 metric tons per hectare (MoALD, 2020/21). Despite its potential, the cultivation of summer squash in specific regions, such as Nawalparasi-east, Nawalpur district, remains limited, with only 3 hectares under cultivation and a production of 25 metric tons, resulting in a productivity of 9.62 metric tons per hectare (MoALD, 2021/22) (Statistical Information on Agriculture, 2023). The productivity of vegetables in Nepal lags behind other countries, primarily due to farmers' limited awareness of different management practices. Various strategies can be employed to improve vegetable productivity, including summer squashes such as cultivating modern hybrids and employing correct scientific methods (Alkwaz and Al-Hassani, 2023).

In the lush landscapes of Southern Nepal, agriculture plays a vital role in sustaining livelihoods and nourishing communities. In this context, summer squash (*Cucurbita pepo* L.) emerges as a significant beneficial crop. Belonging to the family Cucurbitaceae, summer squash is a highly polymorphic vegetable cultivated during the summer season and harvested in its immature fruit stage (Sarhan et al., 2011). This family is among the most important plant families supplying humans with edible products and useful fibers (Galal, 2016). Three commonly cultivated species include *C. pepo* (known as summer squash), *Cucurbita maxima* Duch. (winter squash), and *Cucurbita moschata* Duch. (butternut squash) (Martínez-Valdivieso et al., 2015).

Based on archaeological records, *C. pepo* seems to be among the earliest domesticated species, with the oldest remains discovered in Mexico (Aliu et al., n.d.). Also, *Cucurbita* L. (Cucurbitaceae) is one of the most significant genera found in the archaeological record of the New World (Decker, n.d.). Known by different names worldwide, such as Courgette in France, vegetable marrow in the UK, and hariyo farsi in Nepal, summer squash is consumed primarily in its immature stage, contributing to its unique culinary appeal (Paris, n.d.). It stands out as a remarkable global vegetable crop, serving as a valuable commodity for field and greenhouse cultivation (Ebrahim and Ali, 2018). Summer squash is rich in vitamins and minerals, with a low-calorie supply, making it easy to digest and providing health benefits (Rodríguez-Burgos et al., 2015). Its cultivation is attractive to small and marginal vegetable growers due to its ease of cultivation, quick growth, high yield, and off-season nature leading to higher returns per unit area (Bhatt et al., 2016). Moreover, summer squash has the potential to contribute significantly to global food security, making it an important crop for exploitation in different parts of the world (Bello et al., 2022).

Despite its potential, summer squash's growth, yield, and quality are hindered by a lack of knowledge about best management practices. For example, factors such as water stress during critical periods like flowering and fruiting can significantly reduce yield (Regmi et al., 2021). Summer squash, characterized by its shallow root system, is highly responsive to soil moisture levels (Kuslu et al., 2014). However, hybrid varieties have shown higher yields and earliness than open-pollinated varieties, indicating the potential to improve productivity through appropriate variety selection (Yoldaş, 2014). Given the importance of summer squash and the challenges it faces, there is a need for comprehensive research to evaluate the growth and yield of different varieties in the southern climate of Nepal. Many efforts have been made for yield and its quality assessment and improvement by breeding programs to produce new hybrids with high productivity and tolerance to diseases and insects (El-Gazzar et al., 2020). The main objective of a variety evaluation program is to assess new vegetable crop varieties for growers, alongside a selection of older varieties used as benchmarks (Swingle et al., n.d.). Trials conducted by Kushwah et al. (2016) revealed that the primary reason for low yields among farmers is the impact of insect pests, diseases, and the

continued use of traditional cultivars. So, it is crucial to showcase high-yielding vegetable crop cultivars resistant to biotic stress, along with improved cultivation practices, which farmers are typically hesitant to adopt. Thus, this study aims to address this gap by assessing various growth parameters, including plant height, number of leaves and plant spreading, as well as yield parameters, such as fruit weight, number of fruits plant⁻¹, and total yield, to determine the most suitable varieties for commercial cultivation in the region.

Materials and Methods

Study area descriptions

The field experiment was conducted at Kawasoti municipality -13, Tangri, Nawalparasi-east district (Figure 1A, B). The study was carried out from January 2022 to June 2022. The area is located at 27° 65' N latitude and 84° 13' E longitude with an elevation of 357.81m above mean sea level. The experimental materials used for the investigation comprise varieties of Summer squash. The five varieties were Anna 303, Anna 202, Sunny House, Shlesha 1214 and Grey Zucchini. Summer squash was selected for experiment purposes because it does not need staking and because of its' quick growing nature and early yielding (Regmi *et al.*, 2021). According to Shrestha *et al.* (2021), Squash long and super Squash ball have been chosen and advised for cultivation during the spring season in the mid-hills of Nepal. Based on previous studies, among the varieties Arpit, Surya, Pratap, and Desi, the "Surya" variety is best suited for commercial summer squash cultivation when grown under black plastic mulch (Kumar and Sharma, 2018). The treatment consisted of five varieties, and there were four replications. The plot design was laid out in a Randomized Complete Block Design (RCBD) with four replications. The soil of the research site was silt loam and slightly acidic to basic in soil reaction (pH 6.2-7.4). The recommended agronomic management practices were followed to accomplish the experimentation. The experimental plot was divided into four plots of five in each block. Thus, there were 20 (4×5) unit plots. For the facilitation of different intercultural operations, the distance between blocks and plots was kept at 1m and 0.5 m, respectively. The size of each plot was 4m×4m. Each plot contains four rows of plants, and each row contains four plants. Four plants were randomly taken as sample plants. The single plot size was 16

m²- (4m×4m). There were 16 plants in the plot. Row to row and plant-to-plant spacing were 1 m and 1 m, respectively.

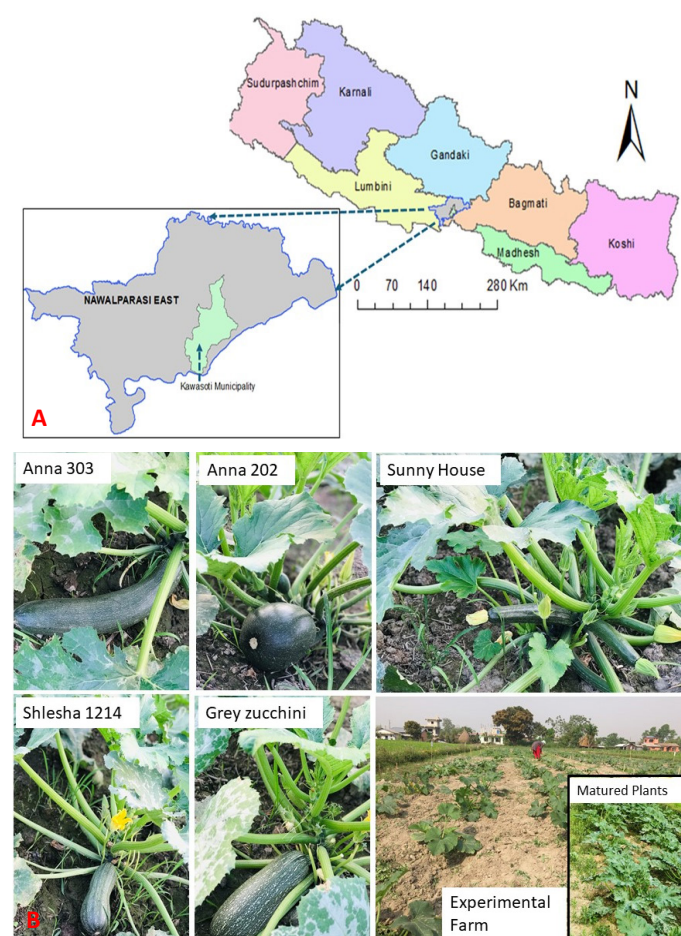


Figure 1: (A) Study area-Kawasoti Municipality; (B) Field experiment with selected five varieties of summer squash at Kawasoti Municipality.

The experimental field was deep plowed with the help of a power tiller one month before transplanting, followed by two light plows one week before transplanting. All the stubbles and weeds were removed from the field, and the land was correctly leveled. The field layout was done as per random-block design. Pit digging and incorporation of the recommended dose of urea, DAP, MOP, and FYM (according to Krishi's diary) was applied five days before transplanting. The summer squash seed (var. Anna 303; Anna 202, Sunny house, Grey zucchini, and Shlesha 1214 (Figure 1B) was collected from NARC Khumaltar, Lalitpur, and the seed was sown in poly bag having growing media of sand, farm soil, FYM in the ratio of 2:1:1. The sown poly bag was placed in gumose on February 18, and was irrigated as per requirement. The seedling was transplanted 20 days after sowing, i.e., on March 10, 2022, in the pits of the experimental field (One seedling pit⁻¹ and

16 pits plot⁻¹). The poly bag was removed carefully during transplanting to prevent damage to the root ball. The seedlings were watered regularly until their establishment. After transplanting, watering, and other intercultural operations such as replacing dead and damaged seedlings with healthy ones, tagging, weeding, and fertilization were carried out. Plant tagging was done in every plot to recognize the treatments during the research period for data collection. Tagging was carried out on March 20, 2022. Four sample plants from each plot were tagged using a red-colored rope. Two hand weeding was done at 20DAT and 35DAT to remove the weeds from the research field. The remaining half-split dose of urea was applied after the first weeding. The farm plot was irrigated as per the requirement. Summer squash fruits were harvested when they were small, soft, and shiny. Fruits became ready to harvest on April 10, 2022, and continued till May 5, 2022. Harvesting was carried out regularly at intervals of 2-3 days. Harvesting was done manually, and yield was measured before the storage.

Precipitation and temperature distributions

The graph illustrates the precipitation and temperature data from 2020 to 2023 at the study region, highlighting distinct seasonal patterns (Figure 2). Precipitation is low from November to April, then rises significantly during the monsoon season, peaking in July and August before tapering off by October. Temperature, gradually increases from January, reaching its highest point in May or June. During the monsoon months (July to September), temperatures slightly decrease due to rainfall, with a minor increase post-monsoon in October before declining again towards the end of the year. This seasonal cycle reflects the typical climatic conditions of Nepal's southern region, characterized by a hot and dry period followed by a wet and slightly cooler monsoon season in all three years. Typically, late spring to summer is a favorable climatic condition for growing summer squash in southern Nepal.

Measurements/Observations

The measurements were taken from randomly selected four plants in each experimental plot. The following parameters were measured during the data collection.

Biometric parameters

Four plants from each treatment plot were selected at random and tagged to record the observations on the

following parameters. The observations were recorded at 15 DAT, 30 DAT, and 45 DAT.

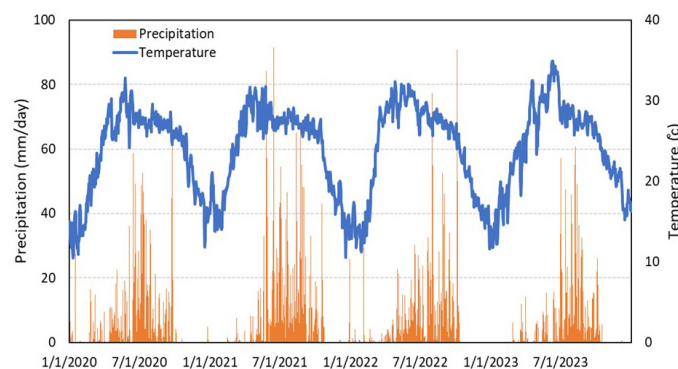


Figure 2: Average daily precipitation and temperature records for three years (2021- 2023) at Kawasoti-13, Nawalparasi-east (Source: NASA/POWER CERES/MERRA2 Native Resolution Daily Data).

Plant height (cm): Plant height was measured from the ground level to the growing point in four randomly tagged plants at the tallest part and expressed in centimeters.

Number of leaves per plant: The number of leaves attached to the plant during data collection was counted from sample plants. Dried and senescence leaves were excluded from counting in each observation.

Plant spreading: Plant spreading was recorded by measuring the length covered by the plant at the broadest side of the ground in criss- cross, and then averages from two values were recorded in centimeters as plant spreading.

Reproductive parameters

Days to 50% plant flowering: Four sample plants from each experimental plot were considered 100%, and the day when 2 out of 4 plants flowered was recorded as days to 50% plant flowering. Days to 50% male and female flowering were recorded separately.

Number of staminate and pistillate flowers per plant: Several staminate and pistillate flowers were recorded daily from the start of flowering till the end of harvesting.

Sex ratio: The number of staminate (male) and pistillate (female) flowers per plant were counted all over the flowering and fruiting period, and the sex ratio was recorded by dividing the number of staminate flowers by pistillate flowers.

Yield and yield attributing parameters

Days to first harvest: The number of days taken from transplanting to the first harvest was recorded and averaged for each sample plant.

Picking per plant: This comprises the total number of harvests from the first to the last from the randomly selected sample plants.

Fruit yield per plant (g): The weight of individual fruit at every picking from the sample plant was measured and then summed.

Average fruit weight per plant (g): The weight of individual fruit at every picking from the sample plant was measured and then averaged.

Productivity (Mt ha⁻¹): The average fruit yield per plant was converted to yield in Mt ha⁻¹ to determine the productivity of the production.

Statistical analysis

The measured data was systematically arranged on the basis of various observed parameters. Statistical package R programming was used to analyze data of different parameters collected during the experiment. Means were compared at 95% probability using Fishers protected LSD test.

Results and Discussion

The results and discussion part consists of three sections: (i) Evaluation of biometric parameters, (ii) Evaluation of reproductive parameters, and (iii) Evaluation of yield and yield attributing parameters. Results are presented and discussed with the help of graphs and tables wherever applicable.

Evaluation of biometric parameters

Plant height (cm): The analyzed data revealed that the plant height of summer squash was significant at 15 DAT and found non-significant at 30 DAT and 45 DAT. At 15 DAT, the highest plant height was recorded in Anna 202 (19.09 cm), which was statistically similar to Sunny House, i.e., 17 cm, followed by Anna 303 and Shlesha 1214, i.e., 15.25 cm and 15.25 cm, respectively. At the same time, the lowest plant height was recorded in Grey Zucchini (13.25 cm) (Table 1, Figure 3).

According to (Evaluation of Summer Squash

Cucurbita Pepo, n.d.) Sunny House and Grey Zucchini produce similar plant heights. However, the result of this study showed that a Sunny house is taller than Grey zucchini.

Table 1: Evaluation of Plant height at 15DAT, 30DAT and 45DAT.

Treatment	Plant height (cm)		
	15DAT	30DAT	45DAT
Anna 303	15.25 ^{bc}	46.56 ^b	31.56 ^a
Anna 202	19.09 ^a	47.50 ^b	32.12 ^a
Sunny House	17.0 ^{ab}	53.37 ^{ab}	34.75 ^a
Shlesha 1214	15.25 ^{bc}	57.93 ^a	37.25 ^a
Grey zucchini	13.25 ^c	45.06 ^b	35.62 ^a
SEm(±)	1.09	3.033	2.18
LSD _{0.05}	3.35*	9.35ns	6.72ns
CV%	13.60	12.11	12.73
Grand mean	16.01	50.09	34.26

Note: Means followed by common letter(s) within the column indicate non-significant difference based on Fishers Protected LSD at 0.05 level of significance, * significant at 5% level of significance, ** significant at 1% level of significance, ns: non-significant. SEm: Standard Error of mean, CV: Coefficient of Variation, LSD: Least Significance Difference.

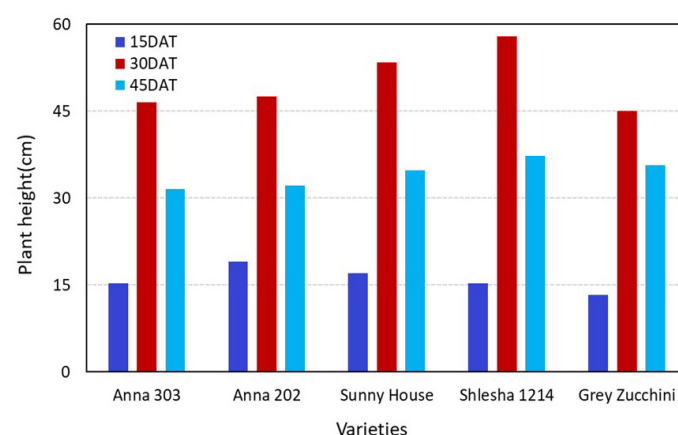


Figure 3: Evaluation of plant height of summer squash.

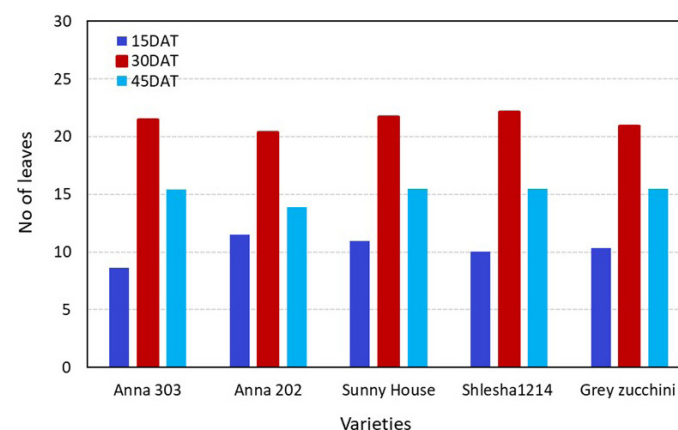


Figure 4: Evaluation of the number of leaves per plant of Summer squash.

Number of leaves plant⁻¹

It is observed that the number of leaves plant⁻¹ of summer squash was significant at 15DAT and found non-significant at 30DAT and 45DAT. At 15 DAT, the highest number of leaves plant⁻¹ was recorded in Anna 202 (11.50), which was statistically similar (at par) with Sunny House, followed by Control and Shlesha 1214. The minimum number of leaves plant⁻¹ was recorded in Anna 303 (8.63) (Table 2, Figure 4).

Table 2: Evaluation of number of leaves per plant at 15DAT, 30DAT and 45DAT.

Treatment	Number of leaves per plant		
	15DAT	30DAT	45DAT
Varieties			
Anna 303	8.62 ^b	21.44 ^a	15.44 ^a
Anna 202	11.50 ^a	20.38 ^a	13.88 ^a
Sunny House	10.94 ^a	21.69 ^a	15.50 ^a
Shlesha1214	10.07 ^{ab}	22.13 ^a	14.69 ^a
Grey zucchini	10.38 ^{ab}	20.94 ^a	14.44 ^a
SEm(±)	0.58	1.18	0.65
LSD _{0.05}	1.78*	3.644ns	2.02ns
CV%	11.22	11.07	8.85
Grand mean	10.3	21.31	14.79

Note: Means followed by common letter(s) within the column indicate non-significant difference based on Fishers Protected LSD at 0.05 level of significance, * significant at 5% level of significance, ** significant at 1% level of significance, ns: non-significant. Sem: Standard Error of mean, CV: Coefficient of Variation, LSD: Least Significance Difference.

Table 3: Evaluation of Plant Spreading at 15DAT, 30DAT and 45DAT.

Treatment	Plant spreading (cm)		
	15DAT	30DAT	45DAT
Varieties			
Anna 303	46.44 ^{ab}	115.88 ^{ab}	80.72 ^a
Anna 202	48.28 ^{ab}	91.13 ^c	65.28 ^b
Sunny House	53.22 ^a	123.94 ^a	88.72 ^a
Shlesha 1214	54.66 ^a	123.47 ^a	83.47 ^a
Grey zucchini	42.25 ^b	104.03 ^{bc}	89.00 ^a
SEm(±)	2.52	5.51	3.80
LSD _{0.05}	7.78*	16.96**	11.72**
CV%	10.31	9.86	9.34
Grand mean	48.97	111.70	81.44

Note: Means followed by common letter(s) within the column indicate non-significant difference based on Fishers Protected LSD at 0.05 level of significance, * significant at 5% level of significance, ** significant at 1% level of significance, ns: non-significant. Sem: Standard Error of mean, CV: Coefficient of Variation, LSD: Least Significance Difference.

Plant spreading

The analyzed data revealed that plant spreading of summer squash was significant at 15DAT, 30DAT, and 45DAT. At 15DAT, the highest plant spreading was recorded in Shlesha 1214 (54.65 cm), statistically similar to Sunny House, followed by Anna 202 and Anna 303, i.e., 48.28 cm and 46.44 cm. The lowest plant spreading was recorded in Grey zucchini control (42.25 cm) (Table 3, Figure 5).

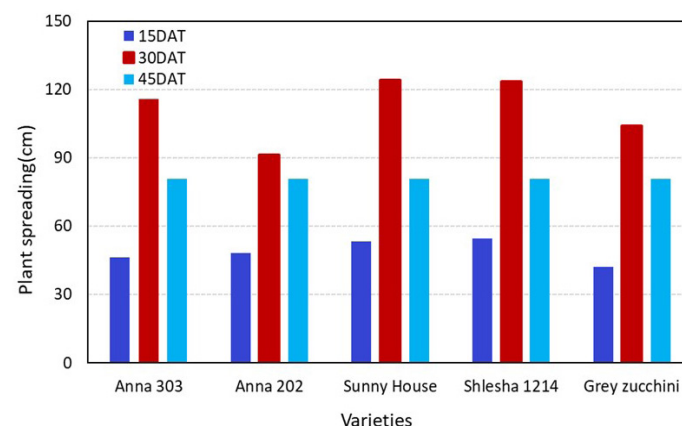


Figure 5: Evaluation of plant spreading of summer squash.

At 30DAT, the highest plant spreading was recorded in Sunny House (123.93 cm), which was statistically similar to Shlesha 1214 (123.46 cm). It was followed by Anna 202 and Anna 303. The lowest plant spreading was recorded in control (42.25 cm).

At 45DAT, the highest plant spreading was recorded in Grey zucchini control (89.00 cm), which was statistically similar to Sunny House (88.72 cm). It was followed by Shlesha 1214 and Anna 303, i.e., 83.47 cm and 80.72 cm, respectively. The lowest plant spreading was recorded in Anna 202 (65.28 cm).

Evaluation of reproductive parameters

Number of staminate flowers: The data presented in Table 4 and Figure 6 revealed that the number of staminate flowers plant⁻¹ was significant. The highest number of staminate flowers plant⁻¹ (29.56) was recorded in Shlesha 1214, which was statistically similar (at par) with Anna 202 (26.13), followed by Sunny House and Anna 303, i.e., 25.75 and 25.13, respectively, while the lowest number of staminate flower plant was recorded in control (24.44) (Table 4, Figure 6).

Number of pistillate flowers

The analyzed data revealed many pistillate flowers plant⁻¹. The highest number of pistillate flowers plant⁻¹ (13.81) was recorded in Shlesha 1214, which was

statistically similar (at par) with Sunny House, while the lowest in Anna 303 (11.25) being statistically similar (at par) with Anna 202 and control, i.e., 11.81 and 11.69, respectively (Table 4, Figure 6).

Table 4: Evaluation on number of staminate flower, pistillate flower and sex ratio.

Treatment	Number of staminate flower per plant	Number of pistillate flower per plant	Sex Ratio (M:F)
Anna 303	25.12 ^b	11.25 ^b	2.23 ^a
Anna 202	26.12 ^b	11.81 ^b	2.20 ^a
Sunny House	25.75 ^b	13.31 ^a	1.89 ^a
Shlesha 1214	29.56 ^a	13.81 ^a	2.13 ^a
Grey Zucchini	24.44 ^b	11.69 ^b	2.05 ^a
SEm	0.95	0.35	0.12
LSD _{0.05}	2.94*	1.08***	0.36ns
CV%	7.29	5.68	10.98
Grand mean	26.2	12.38	2.1

Note: Means followed by common letter(s) within the column indicate non-significant difference based on Fishers Protected LSD at 0.05 level of significance, * significant at 5% level of significance, ** significant at 1% level of significance, ns: non-significant. Sem: Standard Error of mean, CV: Coefficient of Variation, LSD: Least Significance Difference.

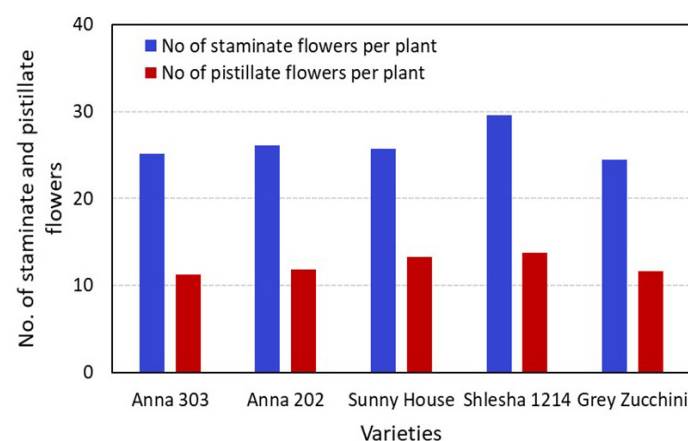


Figure 6: Evaluation of the number of staminate flowers, pistillate flowers, and sex ratio.

Sex ratio

No significant differences were observed in the sex ratio of summer squash. However, the highest sex ratio was recorded in Anna 303 (2.23) and the lowest in Sunny House (1.90) (Table 4, Figure 6).

According to Piya (2007), the male and female flowers are usually 3:1 or higher during the primary growing season. This report matches Green Beret and Sunny House varieties in the first year and Rondo B

in the second year. This study showed that the highest sex ratio was observed in Anna 303 and the lowest in Sunny House.

Days to 50% female and male flowering

Days to 50% female flowering was significant, and Days to 50% male flowering was three significant. However, an early 50% female flower was recorded in Shlesha 1214, followed by Anna 202, and an early 50% male flowering was recorded in Anna 202, followed by Sunny House. At the same time, late 50% of female flowering was recorded in Sunny House and late 50% of male flowering in grey zucchini (Table 5, Figure 7).

Table 5: Evaluation on days to 50% female and male flowering.

Treatment	Days to 50% female flowering	Days to 50% male flowering
Anna 303	28.75 ^{ab}	19.38 ^a
Anna 202	19.75 ^c	19.00 ^a
Sunny House	29.36 ^a	19.25 ^a
Shlesha 1214	18.75 ^c	19.88 ^a
Grey zucchini	24.88 ^b	20.38 ^a
SEm	1.28	0.88
LSD _{0.05}	3.95**	2.72 ^{ns}
CV%	10.55	9.00
Grand mean	24.3	19.58

Note: Means followed by common letter(s) within the column indicate non-significant difference based on Fishers Protected LSD at 0.05 level of significance, * significant at 5% level of significance, ** significant at 1% level of significance, ns: non-significant. Sem: Standard Error of mean, CV: Coefficient of Variation, LSD: Least Significance Difference.

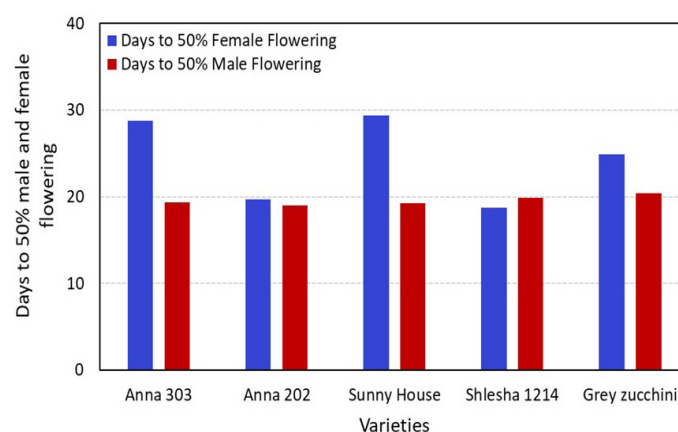


Figure 7: Evaluation on days to 50% female and male flowering.

Evaluation of yield and yield attributing parameters

Days to first harvest: The analyzed data revealed no significant difference was recorded in the days to first picking. However, earlier picking was recorded in

Shlesha 1214 and Anna 202 (34.25 days), and late picking in Grey zucchini (38.19 days). According to Piya (2007) earlier picking was recorded in Grey zucchini, Rondo B, and True green. This study report showed earlier picking in Shlesha 1214 and Anna 202 (Table 6, Figure 8).

Table 6: Evaluation of days to first harvest and no of picking/plant.

Treatment	Days to first harvest	No of picking/plant
Anna 303	35.69 ^{ab}	2.88 ^c
Anna 202	34.25 ^b	3.69 ^b
Sunny House	35.63 ^{ab}	5.50 ^a
Shlesha 1214	34.25 ^b	4.19 ^b
Grey zucchini	38.19 ^a	3.00 ^c
SEm	1.10	0.16
LSD _{0.05}	3.37 ^{ns}	0.50 ^{***}
CV%	6.15	8.49
Grand mean	35.6	3.85

Note: Means followed by common letter(s) within the column indicate non-significant difference based on Fishers Protected LSD at 0.05 level of significance, * significant at 5% level of significance, ** significant at 1% level of significance, ns: non-significant. Sem: Standard Error of mean, CV: Coefficient of Variation, LSD: Least Significance Difference.

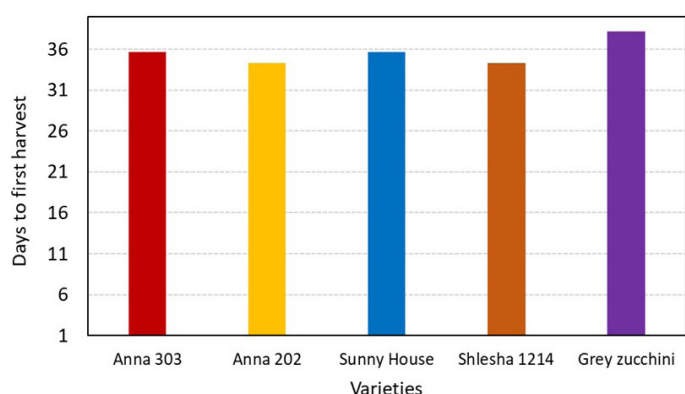


Figure 8: Days to first harvest.

No of picking per plant

The analyzed data revealed a significant number of pickings plant⁻¹. The highest number of picking plant⁻¹ was recorded in Sunny House (5.50), statistically similar to Shlesha 1214 (4.19), followed by Anna 202 and Grey zucchini, i.e., 3.69 and 3.0, respectively. The lowest number of pickings was recorded in Anna 303 (2.88) (Table 6, Figure 9).

Average fruit weight plant⁻¹

The average fruit weight plant⁻¹ was significant. The highest average fruit weight plant⁻¹ was recorded in Sunny House (915.74 g), which was statistically

similar (at par) with Grey Zucchini (858.46 g), followed by Anna 303 and Shlesha 1214 i.e., 826.70 g and 709.41 g, respectively. The lowest average fruit weight plant⁻¹ was recorded in Anna 202 (674.84 g) (Table 7, Figure 10).

Table 7: Evaluation of average fruit weight per plant, fruit yield per plant, and productivity of summer squash.

Treatment	Average fruit weight per plant (g)	Fruit yield per plant (g)	Productivity (Mt/ha)
Anna 303	826.70 ^{ab}	2384.13 ^b	46.88 ^b
Anna 202	674.83 ^c	2571.63 ^b	41.17 ^b
Sunny House	915.74 ^a	5063.06 ^a	81.01 ^a
Shlesha 1214	709.41 ^{bc}	2949.13 ^b	47.19 ^b
Grey zucchini	858.46 ^a	2593.81 ^b	41.50 ^b
SEm	43.29	235.71	5.84
LSD _{0.05}	133.38 ^{**}	726.30 ^{***}	18.00 ^{**}
CV%	10.86	15.147	22.67
Grand mean	797.03	3112.35	51.54

Note: Means followed by common letter(s) within the column indicate non-significant difference based on Fishers Protected LSD at 0.05 level of significance, * significant at 5% level of significance, ** significant at 1% level of significance, ns: non-significant. Sem: Standard Error of mean, CV: Coefficient of Variation, LSD: Least Significance Difference.

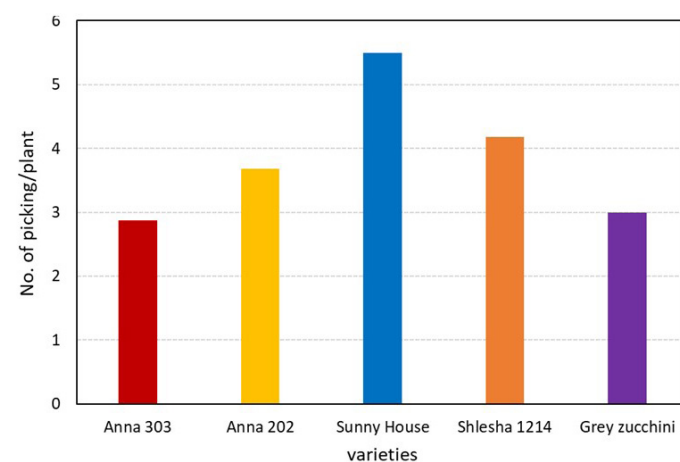


Figure 9: Number of picking per plant.

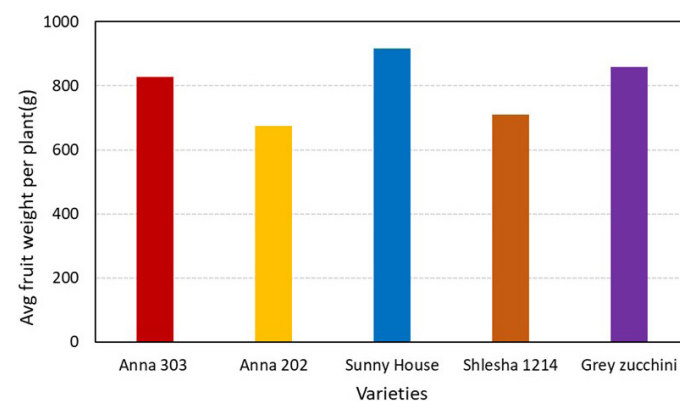


Figure 10: Evaluation of average fruit weight per plant.

Fruit yield per plant

The analyzed data revealed significant fruit yield plant⁻¹. The highest fruit yield plant⁻¹ was recorded in Sunny House (5063.06 g), followed by Shlesha1214, Grey zucchini, and Anna 202. The lowest fruit yield plant⁻¹ was recorded in Anna 303 (2384.13 g) (Table 7, Figure 11).

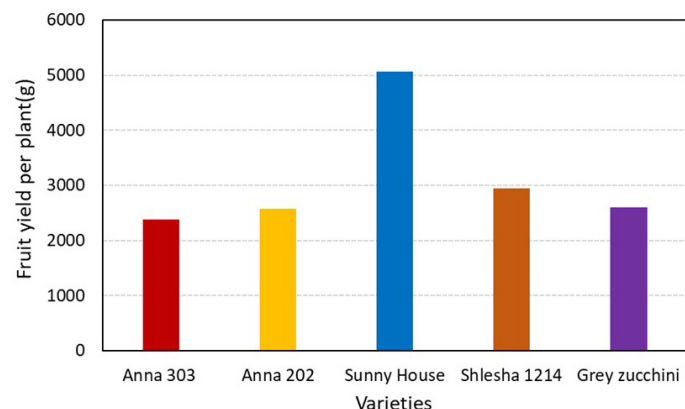


Figure 11: Evaluation of fruit yield per plant.

Productivity

The analyzed data revealed that productivity was significant. The highest productivity was recorded in Sunny House (81.01 mt/ha), followed by Shlesha 1214, Anna 303, and Grey zucchini, i.e., 47.19, 46.88, and 41.50 mt/ha, respectively. The lowest productivity was recorded in Anna 202 (41.146 mt/ha) (Table 7, Figure 12). According to (Ghosh *et al.*, 2017) productivity can be enhanced by managing various factors such as the environment, soil, production techniques, and protection from pests and diseases.

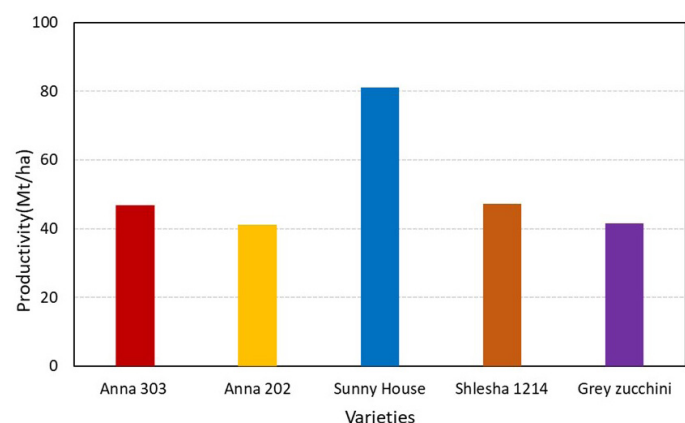


Figure 12: Evaluation of productivity of summer squash.

Conclusions and Recommendations

The study was conducted in the southern climate of Nepal. This study evaluated the growth and yield of different summer squash varieties. Five varieties were tested, and various parameters were observed,

including plant height, number of leaves, plant spreading, flowering time, fruit yield, and productivity. The results showed that variety selection significantly influenced the growth and yield of summer squash. Sunny House exhibited the best performance in terms of plant spreading, days to female flowering, number of pickings plant⁻¹, average fruit weight, fruit yield, and productivity, outperforming other varieties like Anna 303, Shlesha 1214, Grey Zucchini, and Anna 202. The study suggests that varietal selection is crucial in increasing summer squash production, and farmers can benefit from adopting high-performing varieties like Sunny House.

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Novelty Statement

This research stands out by offering a comparative analysis of different summer squash varieties tailored to the southern Nepalese climate, providing valuable insights into how local environmental factors influence crop performance. By investigating the adaptability, growth patterns, and yield variations of various summer squash varieties, this study aims to fill a critical gap in knowledge and offer practical recommendations for local farmers seeking to optimize their production.

Author's Contribution

Sanjita Gurau: Conceptualization, methodology, validation, formal analysis, investigation, resources, data curation, writing original draft preparation, writing review and editing.

Ram L Ray: Visualization, supervision, and editing. Both authors have read and agreed to the published version of the manuscript.

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Data availability statement

Data available upon request.

Conflicts of interest

The authors have declared no conflict of interest.

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