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Evaluation of Green Pepper (*Capsicum annuum* L.) Cultivars for Growth Rate, Biomass Partitioning and Yield Potential

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Abstract: Green pepper (*Capsicum annuum* L.) is one of the exotic vegetable fruits gaining popularity in Lesotho because of its aroma, pungency, sweetness and impressive health benefits. Most of the vegetable farmers dwelling in urban areas produce limited amounts sufficient to meet their household needs and sell small quantities of surplus in the neighborhood. As a result, a low supply always fails to meet market demand. The main objectives of the study were to i) determine the growth rate of six green pepper cultivars during vegetative and reproductive phases, ii) determine biomass partitioning among green pepper cultivars, iii) identify high-yielding green pepper cultivars that can contribute significantly to domestic market, iv) estimate correlation coefficients among characters used for growth rate. The study was conducted at The National University of Lesotho, which is domiciled at Roma Valley in the Maseru district. Treatments consisted of six cultivars of green peppers laid-out using a randomized complete block design with three replications under the shade-net structure. The dimensions of main plot were 19m length x 8m width, while the sub-plot was 3m x 2m length and width, respectively. Total number of sub-plots was 15, each plot had 2 rows, and each row had 8 plants. The inter-row and intra-row spacing was 100 cm and 75 cm, respectively. Data were generated throughout the growing period on growth rate, biomass partitioning, yield and yield components. Parameters measured were plant height, number of branches per plant, number of leaves per plant, leaf length and width per plant, stem girth, number of fruits per plant, fruit length, fruit weight, yield per plant, yield per plot and per cultivar. Results revealed that Citrine and star 6653 outperformed the others in growth rate but produced lower yield. Autry followed with many branches, leaves area and taller stem but still reduced low yield. Jupiter yielded higher with fewer, narrower leaves and a larger number of fruits. California Wonder had a high yield with a larger number of fruits and higher weight. Differences in the performance of green pepper cultivars was solely attributed to unique genetic constitution of each cultivar.

Keywords: *Biomass Partitioning, Capsicum annuum, Growth Rate, Yield, Yield Component.*

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I. INTRODUCTION

Green pepper (*Capsicum annum* L.) originates in Mexico, South America, where it is believed to be its center of origin. There is a wide variability among the species of green pepper, namely, bell pepper, cayenne, friggitello, jalapeno, paprika, serrano, hot red pepper and chill pepper. Basu and De [1] speculated that the original distribution of the species had extended to Columbia from South Mexico, and about 20 *Capsicum* species were distributed worldwide [2]. It was brought to Africa by the Portuguese, after which it was disseminated to different parts of Africa. Over 26 million tons of green pepper fruits are produced worldwide. The leading countries in production are China (34 million metric tons), Mexico (3,23 million mt), Indonesia (2,59 million mt), India (1,74 million mt), Vietman (216, 000 mt), Turkey (153, 800 mt) and Brazil (54 000 mt) [3]. In Africa, the top five producing countries are Madagascar (6 981 mt), Ethiopia (4 511 mt), Ghana (3 767 mt), Rwanda (2 535mt) and Uganda (2 063 mt) [4].

In Lesotho, green pepper is a new fruit crop produced on a small scale for home consumption by households living in the urban areas. Nonetheless, it is increasingly becoming popular grown by a few people under plastic covers or shade nets on a larger scale for niche markets. It has many advantages, which include among others, commanding a higher price compared other fruit crops, can be grown all year

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round, easy to grow under both open and protected cultivation, less perishable compared to tomato which is of the same *Solanaceae* group, and highly prolific suggesting several harvests in a growing season, thus generating a lucrative profit [5].

In Lesotho, many new cultivars of green pepper are introduced into the country by farmers, seed retailers and seed companies from South Africa without evaluating them for growth rate, partitioning of biomass, yield and yield component [6]. These are very important agronomic characters that distinguish cultivars and enhance correct selection for plant breeding programs and farming by breeders and farmers, respectively [5]. There is a great genetic variability among cultivars of green pepper on the afore-mentioned characters which necessitates a proper choice based on the localities, edaphic factors and general cropping management [7]. As a result of genetic variability and varying environmental conditions, some cultivars perform well consistently within and across different environments, while others perform well on specific environment and poorly on others [8]. It is, therefore imperative to evaluate all the new cultivars of green pepper for the above-mentioned agronomic characters, establishing the suitability of a cultivar to a specific area [9]. The specific objectives of this study are three manifolds; i) to determine the growth rate of different green pepper cultivars during vegetative and reproductive phases, ii) to determine partitioning of biomass production in green pepper cultivars, iii) and identify cultivars of green pepper producing high yield and components contributing significantly to yield.

II. MATERIALS AND METHODS

A. Study Area

The study was conducted at The National University of Lesotho which is domiciled at Roma valley in the Maseru district, the capital town of Lesotho. It is about 34 kilometers south east of Maseru situated at an altitude of 1680.4 meters above sea level. The coordinates are Maseru town 29.3151°S, 27.4869°E and Roma 29.4476°S, 27.7227°E.

B. Site Description

The soil type where the experiment was set-up comprises Berea and Tsiki soils. Berea soil is formed from dust deposits. Tsiki soil constitutes a small proportion of the land. The soil profiles for the two soils are deeper than one meter and horizons are not fully developed. The Berea soil comprises of moderately deep well drained soil. Roma has a temperate highland climate with dry winters. The annual temperature is 18.37°C which is 2.31% higher than Lesotho's average. The lowest annual temperature in winter ranges from -3°C to -10°C with coldest month being July having 9°C, while hottest annual temperatures range between 15°C and 35°C. The warmest month is January with temperatures of up to 35.3°C. The average annual precipitation is 830.47mm with wettest month being December with recordings of 1171.72mm and dry month of August with recordings of 119.29mm rainfall. Average number of rainfall days is 114.87, and 250.13 days without rainfall per annum. Snow depth is 2.50mm while dew point is 6.38°C and relative humidity being 52.97%, all per annum.

C. Experimental Design

Six cultivars of green peppers; Autry, Star 6653, California wonder, Citrine and Jupiter were laid-out using a randomized complete block design with three replications in the shade-net structure. The dimensions of the main plot were 19m length and 8m width, while the sub-plot was 3m x 2m length and width, respectively. The total number of sub-plots were 15, each plot having 2 rows and each row had 8 plants. The inter-row and intra-row spacing was 100 cm and 75 cm, respectively.

D. Agronomic Practices

- *Seedlings Production*

Flat foam trays were used to raise seedlings of six cultivars of green pepper. The cells of trays were filled with vermiculite as soil mixture, after which seeds of culture was sown on distinct rows. Each row was labelled accordingly, to avoid mixing seeds of different cultivars on the same row. The seedlings were allowed to grow in trays until they were 6 weeks old. During seedling stage, plants were fertilized with foliar feeds to grow healthy and strong. Transplanting was performed in mid-November when seedlings were 6 weeks old and true leaves were discernible.

- *Transplanting to the Shade-Nets*

The soil sampling, testing and analysis were performed before transplanting in order to determine soil fertility status and supplement the required amount to meet demand of green pepper. Seed–bed was prepared using a digging spade, after which raised plots were constructed and raked to a fine tilth. Compound fertilizer (6:3:1 +Zn (31) was incorporated into the soil in each plot at the rate of 0.28kg as basal dressing. Two lines were drawn in each raised plot where the holes were dribbled to insert pepper seedlings. Green pepper seedlings were transplanted from the tray to the raised plots, each cultivar planted on distinct three raised plots representing replications. Planting depth was 3cm. Seedlings were all irrigated at the same time on regular basis whenever soil moisture content was in a short supply. Weeding was controlled by hand-hoeing three times during the growing season, which was reliant on on the level of weed infestation. The infestation of aphids was detected at the sixth week from transplanting, mostly on two cultivars; Citrine and Star 6653. Aphicide was applied as treatment few days after recognizing the pests. Diseases observed at four weeks after transplanting were rust which was treated by applying Dithane M45, while black powdery mildew affected green pepper plants at their maturity stage. After the third harvest, no treatment was applied as the plants were already undergoing senescence.

E. Data Collection

Data were generated throughout the growing period on growth rate, partitioning of biomass, yield and yield components. Five plants in each cultivar were selected randomly, after which they were tagged and labelled with a unique number so that all the measurements were taken from them.

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➢ *Parameters for Plant Growth Rate:*

These were plant height, number of branches per plant, number of leaves per plant, leaf length and width (leaf area) per plant, stem girth, number of fruits per plant, fruit length, fruit weight, yield per plant, yield per plot and yield per cultivar.

➢ *Parameters of Fruit Yield:*

Fruit diameters, fruit length, fruits weight, fruit number per plant, total fruit yield per plant, fruit shape and color.

➢ *Parameters for Phenological Characters:*

Days to flowering, days to physiological maturity, days to fruit and harvesting maturity.

➢ *Partitioning Biomass Production:*

Fruit biomass, leaf biomass, branch Stem biomass, root biomass

F. Data Analysis

Data collected were subjected to analysis of variance using SPSS software package version 21 together with Statistix 10 version to establish significant difference among treatments. The difference between the average values were compared by least significant difference at 5% probability level. Relationship among growth rate parameters and yield components were estimated using correlation analysis.

III. RESULTS AND DISCUSSION

In this study, six cultivars of green pepper were evaluated for their growth rate, biomass partitioning and yield characteristics under the shade-net.

A. Number of Leaves

There was a highly significant difference (P<0.01) among eight cultivars for number of leaves (Table 1). The Autry cultivar had the highest number of leaves recording 134.25, followed by California wonder with 120.06 number of leaves. The lowest number of leaves were observed from Jupiter being 71.98, followed by Citrine with 101.90.

Table 1 Summarized Analysis of Variance Table for Growth Parameters Studied

Sources of variation	Df	Mean square										
		Stem length	Stem girth	Leaf length	Leaf width	Leaf Number	No. of branches	Day of Flowering	Fruit number	Fruit weight	Fruit length	Fruit circumference
Week	7	394922**	18.70**	2.00**	1798.75*	58650.9**	462.67**	211.66*	1.74**	1382.51**	1.73*	2.78*
Treatment	4	176788**	0.31**	3.82**	670.99*	12993.3**	72.22**	35.33*	7.83**	1335.75**	2.94*	0.47*
Error	108	32282**	0.05**	1.33**	382.51*	3400.2**	11.37**	8.95*	3.75**	452.70**	1.35*	0.37*
Total	119											
	** represents highly significant at P<0.01%, * represents significance at P<0.05%, Df= degree of freedom											

Table 2 shows an average number of leaves for each cultivar of green pepper and their variances. All the cultivars had a lag increase in the number of leaves from transplanting date to the first week. The Autry cultivar being the highest in the number of leaves (Table 2) showed an acceleration at a logarithm rate for the number of leaves from week one to week four, after which it showed an exponential increase between week four and week five. Thereafter, the rate at which the number of leaves unfolded started to decline slowly and finally became stationary from week six to week eight. Jupiter had the lowest number of leaves compared to other cultivars initially, and thereafter increased slowly as compared to other cultivars unfolding rate in week. The differences revealed in the number of leaves among the cultivars of green pepper were attributed to genetic variability in the constitution of each cultivar. These cultivars were all exposed to the same environmental conditions affecting the unfolding of leaves in the same rate, but the difference in genetic constitution did not make all cultivars produce equal number of leaves. It could be concluded that there was a variation among the genes controlling the number of leaves in all the cultivars. Ocharo *et al.*, (2017) and Dasgan and Abak (2010) conducted an experiment comparing the number of leaves in 20 cultivars of green peppers and obtained greatly varying number of leaves although some cultivars were comparable.

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Table 2 Table of Means for all Parameters of Green Papper

Cultivar	Stem height	Stem girth	Leaf width	Leaf length	No. of leaves	No. of branches	Days of flowering	No. of fruits	Fruit weight(g)	Fruit length(cm)	Fruit circumference(cm)
Autry	383.75^{a}	4.67^{a}	53.18^{b}	19.91^{a}	134.23^{a}	10.46^{a}	7.79^{a}	2.44^{b}	87.74^{ab}	19.91^{ab}	7.35^{a}
Citrine	369.27^{a}	4.52^{b}	54.51^{ab}	19.26^{ab}	101.90^{a}	8.95^{a}	6.92^{a}	4.30^{a}	84.20^{b}	19.26^{ab}	7.83^{a}
California Wonder	365.15^{a}	4.74^{a}	65.24^{a}	19.07^{ab}	120.06^{a}	9.49^{a}	6.18^{ab}	3.91^{a}	102.33^{a}	19.07^{b}	7.67^{a}
Jupiter	203.25^{b}	4.47^{b}	52.12^{b}	18.75^{b}	7 1.98^{b}	6.13^{b}	4.28^{b}	4.74^{a}	72.96^{b}	19.08^{b}	7.28^{a}
Star 6653	368.34^{a}	4.67^{a}	57.69^{ab}	20.35^{a}	105.76^{a}	10.19^{a}	7.49^{a}	3.93 ^{a}	100.65^{a}	20.35^{a}	7.61^{a}
Grand mean	347.9	4.61	56.55	19.47	106.79	9.04	6.53	3.90	89.58	19.53	7.55
CV	51.64	5.02	34.58	5.93	54.61	37.29	45.82	38.23	23.75	5.95	8.04
LSD	80.11	0.95	11.2	1.33	29.15	1.93	1.98	2.41	15.19	1.34	

Note: Means in rows with different capital letters and means in columns with different lowercase letters are significantly different by Fisher's protected least significant difference (LSD) test ($P < 0.05$) applied after ANOVA.

➢ *Number of Branches*

A highly significant difference ($P<0.01$) was observed among the cultivars for number of branches (Table 1). Autry possessed highest number of branches (10.46), followed by Star 6653 with 10.19. Autry accelerated exponentially in the number of branches from the first week to the fifth week, after which it increased constantly to week seven. This was followed by sharp increase at week eight where it became stationary. Autry was followed by Star 6653 with 10.19 branches. Autry had a lagged increase in the number of branches for the first three weeks, after which it increased exponentially from week three to week six. From week six, it increased at a decreasing rate until week seven. Thereafter, number of leaves remained unchanged. Table 2 showed that Autry and Star 6653 cultivars were significantly difference ($P<0.05$) from the other cultivars, as they had more branches ranging between 10.19-10.46, while Jupiter had the lowest number of branches (6.13) than all the cultivars. The difference in the number of branches among these cultivars were ascribed to the genetic variability in their make-up. Autry possessed the genes conferring the trait of fast increase in the number of branches. Conversely, Jupiter was constituted by genes conferring slow increase in the number of branches. The fact that all the cultivars of green pepper were subjected to similar environment including crop management and only cultivars differed. It confirmed that genetic constitution of cultivars was different. The results of this study resonated well with the previous studies [12; 11]. They both concurred with this current study that where many cultivars were grown under the same growing conditions but results (number of branches) were different, it was due to differing genetic constitution of the cultivars.

➢ *Leaf Length and Width*

There was a significant difference ($P<0.05$) in the leaf length among the cultivars of green pepper (Table 1). Star 6653 recorded the longest leaf length of 20.35cm, followed by Autry with leaf length of 19.91cm. The cultivar with the shortest leaf length was Jupiter measuring 18.75cm, followed by California wonder with 19.07cm. The lengths of other cultivars were between Autry and Jupiter (Table 2). The type of trend curve in the lengthening of leaves in all cultivars was almost similar, although some cultivars appeared to have increased lengths more than others. The difference in the length of leaves was associated with genetic variation among the genes within each cultivar conferring the trait of leaf lengthening. All other factors contributing towards growth remained the same for six cultivars of green pepper, except cultivars.

California Wonder cultivar had the widest leaf width of 65.24mm, followed by Star 6653 with 57.69 mm and then Citrine with 54.51. The cultivars with the narrowest leaf were Jupiter measuring 52.12mm followed by Autry with 53.18mm. All measurements are depicted in table 2. This confirmed that some cultivars had wide leaves, while others narrow. The results resonated well with those of Shamil and Merga (2022) who found that different cultivars of green pepper differed greatly in both leaf length and width grown subjected to the same conditions. These differences were caused by genetic variation among the cultivars which determine the rate of elongation of leaves.

➢ *Stem Girth*

There was a highly significant difference ($P<0.01$) in stem girth among cultivars of green pepper (Table 1). California wonder, Autry and Star 6653 expressed the largest stem girth of 4.74, 4.67 and 4.67mm, respectively. The stem girth of three afore-mentioned cultivars increased at a logarithmic rate from week one to week four, after which they increased exponentially to week six, then slowed down and stopped at week eight. Jupiter revealed the smallest stem girth of 4.47mm, followed by Citrine with 4.52mm (Table 2). These results were consistent with those of Adekaldu (2021) [13] and Merga (2022) [12], who reported that there was a highly significant difference among green pepper cultivars on stem

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girth during green pepper growth. They further elaborated that California Wonder had a thicker stem girth of 5.0cm and Jupiter had a thinner stem of 4.23cm.

➢ *Days to Flowering*

The number of days to 50% flowering was significantly different at ($p<0.05$) among cultivars (Table 1). The earliest number of days to reach 50% flowering was observed from cultivars of Jupiter (42.8 days), while the cultivars with the longest days to flowering were Autry (77.9 days), followed by Star 6653 (74.9days) and California (61.8 days) (Table 2). Shamil and Merga (2022) [12] observed that days to 50% flowering days was the same among different cultivars indicating that they share similar genes for flowering. Merga (2022) [12] and Quartey *et al* (2014) [14] reiterated that since different cultivars of the same crop were compared, most traits were expected to be the same to a certain extent like flowering in the case of this study.

B. Biomass accumulation

Biomass allocation was compared among five cultivars of green pepper. All parameters (plant parts) showed a significant difference ($P<0.05$) among cultivars for partitioning of biomass. The difference in fruit weight, root weight and leaf weight were highly significant ($P<0.001$) as depicted Table 4. The mean difference on table 4 indicated that most of the assimilates on all the cultivars were stored in the branches as they had the highest mean difference of weight (133.7g), followed by the fruit weight (93.27g) and leaves weight (89.96g). The roots had the lowest mean weight difference (9.69g) compared to other parts of the green pepper plants from all the cultivars. Differentiation and growth of cells and tissues are changed by expression of genes and altering morphology in biomass partitioning by the plant hormones, like responding to the environmental stimuli [15]. Besides, there are enzymatic actions responsible for enhancing, redirecting or impeding the movement of the biomass to certain plant parts such as leaves, roots, fruit and branches [16]. Therefore, in this case, both hormonal and enzymatic action directed the biomass mostly to the branches. Poorter *et al.* (2011) [17] reiterated that hormones and environmental conditions also influence biomass partitioning by allowing plants to maximize growth and reproductive success controlled by their specific conditions. This finding concurred with the current study, which showed that stems grew higher than the competitors to get sunlight. The partitioning focused most on the plant part with limited resources, therefore stems had to grow higher as were shaded and provided limited sunlight. Partition in biomass was influenced by the limits or excesses in resources like sunlight, carbon dioxide, mineral nutrients and water-plant growth controlled by the constant balance among the partitioning of biomass and plant parts.

Table 3 Anova for the Biomass Partition Among Different Green Papper Cultivars

Source of Variances	DF	Mean Difference (%)	Std Error	P Value
Fruit weight	4	93.27 (28.56)	1.42	0.000
Leaf weight	4	89.96 (27.54)	22.49	0.026
Branch weight	4	133.7 (40.93)	12.22	0.001
Root weight	4	9.69 (2.97)	0.75	0.000

C. Yield and Yield Components

Fruit yield is significantly ($P>0.05$) influenced by many different yield components, including the number of fruits per plant, fruit weight and dry matter production (Table 1). The contributions of each component towards the yield differ greatly [18]. Ocharo et al. (2017) [10] also found that the differences in yield among the cultivars were highly credited to their genetic makeup and the growing environment. The fruit yield is a complex inherited feature influenced by many attributes of the plant [19].

Jupiter outperformed all cultivars recording the greater number of fruits (4.74 fruits) per plant which was highly significant ($P>0.01$), followed by Citrine with 4.3 fruits. Autry had fewer number of fruits (2.44 fruits) (Table 2). The difference in the number of fruits per plant were attributed to the genetic make-up of each cultivar. Each cultivar had a unique gene for determining the number of fruits to be borne by a plant. Nonetheless, the environment could also modify it positively or negatively, though in this study environment was the same, thus effect was non-existent. Difference was solely on genetic make-up. Shamil and Merga (2022) [12] conducted research on performance of eight different cultivars green pepper focusing on fruit number per plant and obtained different fruit number from each cultivar which the attributed to genetic constitution.

Likewise, there was a highly significant difference among cultivars of green pepper for fruit weight. The cultivar with highest weight was California wonder (102.33kg), followed by Star 6653 weighing (100.65 kg). Citrine and Autry measured lowest weight of 84.20 kg and 87.7kg, respectively. Considering the same environment that all the cultivars were exposed to, the variation in the fruit weight could be attributed to the unique combination of genes that make-up individual cultivar, with special reference to the genes conferring fruit weight character and synergistic effect of related genes. Dasgan and Abak (2010) [11] explicitly explained influence of genes in determining fruit weight and modifying effect of different environmental conditions.

Similarly, there was a significant difference among cultivars of green pepper cultivars for fruit circumferences. Citrine cultivars had the highest circumference of 7.83cm, followed by California wonder with 7.67cm. The lowest circumference was obtained from Jupiter and Autry measuring 7.28 and 7.35cm, respectively. All the same, genetic constitution of different cultivars contributed towards the difference observed in circumferences and environmental

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influence was the same. A significant difference among 15 different cultivars of green pepper for fruit circumference was derived due to their genetic constitution, while environmental conditions were maintained the same in one locality [20].

Significant differences were obtained among green pepper cultivars for fruit length. Star 6653 measured the highest fruit length of 20.35 cm, followed by Autry with 19.91cm. California and Jupiter revealed a short fruit length of 19.07 and 19.08, respectively. The difference in fruit length was attributed to genetic constitution of each green pepper cultivars. There were genes in some cultivars which expressed long fruit length, while others conferred short leaf length. The fruit length in between the two extreme afore-mentioned length were determined by another different gene. The environment does not play an important part in fruit length because it was the same across all cultivars. Adekaldu (2021) [13] and Merge (2022) [12] carried an investigation on green pepper cultivars observing yield components including amongst others fruit length and found the fruit length to differ greatly irrespective of the same environmental conditions in which they were subjected to.

D. Correlation Coefficient Analysis

Correlation analysis was conducted to establish a relationship among crop growth parameters, fruit characteristics and yield components (Table 3). There was a high correlation (r=0.984) between number of leaves, stem length and stem girth (r=0.900). Number of fruits were moderately correlated to stem length (r=0.659) and number of leaves (r=0.655). Moderate correlation was found between stem girth to leaf length (r = 0.537), stem girth to leaf width (r=0.584) and fruit circumference to fruit weight (r=0.530). All these confirmed that the increase in the number or size of one parameter contributed to the increase in another parameter. The correlation between fruit length to leaf width was 0.023, fruit length and number of leaves (r=0.089) and number of fruits to fruit length (r=0.091), which suggested that all these parameters measured were unrelated. This implied that as one parameter was increased, the other would remain unchanged, thus each was independent from the other. Findings of Shango et al. (2021) [21] investigated correlation among some crop growth characters, fruit characteristics and yield components, and deduced that some characters were correlated positively, negatively or no correlation be in existence. They further suggested that correlation should be determined among characters when improving any character as one character affect the other/s. Farhad et al. (2008), Amit et al. (2014) and Cankaya et al. (2010) discovered that fruit length, stem girth and plant height of green pepper plants were highly correlated and were good factors used to predict fruit numbers per plant. They also found that fruit width, plant height and number of fruits per plant were traits moderately correlated. They emphasized the characteristics of improving yield per plant on green pepper to be plant height, leaf length, leaf width, stem girth and number of leaves. One study found a correlated relationship between fresh pepper fruits with the number of fruits, fruit weight and volume [21].

Table 4 Correlations Martic Among Growth Rate Parameters and Yield Components

	Stem length	Leaf length	Leaf width	Number of leaves	Stem girth	Fruit weight	Fruit length	Fruit circumference	Number of fruits
Stem length	1								
Leaf length	0.451	1							
Leaf width	0.390	0.888	1						
Number of leaves	0.900**	0.397	0.379	1					
Stem girth	0.443	0.537*	0.584*	0.647**	1				
Fruit weight	0.084	0.385	0.194	0.062	0.018	1			
Fruit length	0.007	0.233	-0.023	-0.089	0.098	0.506	1		
Fruit circumference	0.413	0.269	0.107	0.311	0.115	0.530*	0.103	1	
Number of fruits	0.659**	0.127	0.081	0.655**	0.164	0.120	-0.091	0.507	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

c. Cannot be computed because at least one of the variables is constant.

d. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

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IV. CONCLUSION

This study concluded that determining yield by their plant morphological traits may mislead a farmer as the Autry had shown the best performance during the growing period on a number of branches, leaf area and height but produced less yield. Jupiter was the shortest with fewer and narrow leaves but had yielded higher number of fruits. California Wonder also showed its best performance in weight at Roma climate condition and environment. This means the farmer can gain more profit with fewer number of fruits but bigger when taken to the market. Citrine and Star 6653 outperformed in growth rate and other morphological traits, but they seemed to be the most susceptible cultivars among them all to pests (aphids) and diseases (rust and black powdery mildew), which lowered their yield. With these results, it is recommended that California wonder be encouraged to the farmers to be grown generally, but there is a need to conduct a similar study in different agro-ecological zone to identify cultivars specific to a particular locality.

RECOMMENDATIONS FOR FUTURE RESEARCH

There is little if any research work performed on green peppers in Lesotho as well as in neighboring countries. This means that more research is required, mostly on soil, climate, and environmental conditions that are best for each specific cultivar. The research should also focus agro-ecological zones such as Highlands, Foothills. Senqu river value and Lowlands proved that the yield is based mostly on the cultivar and environment where green pepper plants are grown.

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