

Evaluation of Zucchini (*Cucurbita pepo* L.) Genotypes for Spring Season Production in the Mid-Hills of Nepal

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ISSN : 2382-5359(Online),
1994-1412(Print)

DOI:

<https://doi.org/10.3126/njst.v20i1.43356>

ACCESS THE ARTICLE ONLINE



CONFLICT OF INTEREST: None

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ABSTRACT

Zucchini (*Cucurbita pepo* L.) is one of the most popular and demanded vegetable in Nepal. Seedlings of seven genotypes of squash gourd; Super Squash Ball, Squash Long, Squash Light, Squash Green Ball, Squash Green House Sondo V (check) and Grey Zucchini (check) were transplanted on second week of March in two consecutive years; 2016 and 2017 in field condition at Khumaltar with a spacing of 90 x 90 cm in four replications. The standard recommended dose of fertilizers (240:180:60 NPK kg/ha + 15 ton FYM/ha) and minimum pesticide and fungicide was applied. The main objective of this experiment was to find out suitable high yielding and insect pest and disease tolerant hybrid Zucchini cultivars for commercial production in mid-hills of Nepal. Crops were evaluated for their vegetative, insect pest and disease, and yield attributing parameters. Among the tested genotypes; Squash Long was found highly uniform, vigorous, least virus and insect damage, significantly higher number of fruits (8.6), and yield (3894 g) per plant and yield (46.89 t/ha) followed by Super Squash Ball having highly uniform, less insect and powdery mildew damage, significantly higher number of fruits (8.5) and yield (2565 g) per plant and yield (29.28 t/ha) as compared to check Sondo V and Grey Zucchini where Sondo V had yield (22.50 t/ha and 1703 g/plant), number of fruits (5.6), per plant respectively. Squash Long and Super Squash Ball have been selected and recommended for cultivation during spring season in mid-hills of Nepal.

Keywords: Fruit yield, Mid hills, Spring season, Zucchini genotypes

1. INTRODUCTION

Zucchini (*Cucurbita pepo*) belong to the family *Cucurbitaceae*, and has been regarded as highly polymorphic vegetable grown during summer in tropical and sub-tropical conditions and harvested when the fruits are physiologically immature (Kathiravan *et al.* 2006). It is grown in many temperate and subtropical regions, ranking high in economic importance among vegetable crops worldwide (Parris 1996). It is an annual plant of a big commercial importance. It is characterized by large yield and it is a valuable raw material for a processing industry (Mancini & Calabrese 1999). It is taken as a vegetable, either boiled or fried or stuffed. In Nepal, this crop is relatively new but is increasingly gaining high levels of economic importance both in generation of income and provision of nutritional value.

Zucchini has various health benefits to humans as well as medicinal potentials (Mohammad *et al.* 2011). It is rich in nutrients and bioactive compounds contents such as phenolics, flavonoides, vitamins, aminoacids, carbohydrates and minerals (especially potassium), and it is low in energy content (about 17 kcal/100 g of fresh fruit) and has large amount of fibre (Tamer *et al.* 2010). It has various medical effects comprising antidiabetic, antihypertensive, antitumor, antimutagenic, immune modulating, antibacterial, anti-hyper cholesterolemic, intestinal antiparasitic, antalgic and anti-inflammation effects, and utilization possibilities of various Cucurbitacea species have been reports (Kostalova *et al.* 2009). Production constraints include many pest and disease problems that affect yields (Murphy *et al.* 2009). The total area, production and productivity of Zucchini in Nepal is 1,528ha, 23,906mt and 16mt/ha (MOAD 2016) respectively. The average national productivity is very low due to unavailability of high yielding improved varieties and package of cultivation practices. In Nepal only few varieties are available for growing and there were no more choices for higher yield potentiality and preferred characters. This experiment was carried out to evaluate hybrid Zucchini genotypes for their higher yield, insect pest and disease tolerances.

2. MATERIALS AND METHODS

Seven genotypes namely Super squash ball, Squash long, Squash green house and Squash light, Squash green ball, SondoV and Grey Zucchini were evaluated at NHRC, Khumaltar during summer season. These genotypes were received from Green Seeds Pvt. Ltd. and SondoV and Grey Zucchini were used as check. Genotypes; Super Squash Ball and Squash Green Ball are round fruit bearing genotypes, and the rest were oblong fruit bearing genotypes. Seeds were sown on February and transplanted after 21 days in an open field at a distance of 90 cm and 90 cm with four replications in RCBD design. Plot size was 15 plants per plot where 3 rows planted with 5 plants per row. The standard recommended doses of fertilizers (240:180:60 NPK kg/ha + 15-ton FYM/ha) was applied. The data were analyzed using GenStat software and means were separated by DMRT test. The fruits were harvested in the month of April-May.

The research field of National Horticulture Research Center is located at an altitude of 1275 m, latitude of 27° 40' N and longitude of 85° 20' E (NHRC 2019). Soil type of the experimental plot was black and sandy loam in texture, slightly acidic and medium in organic matter (NHRC 2019).

The meteorological data for cropping season was recorded from the meteorological station of Khumaltar, Lalitpur. The average maximum and minimum daily temperature was 25°C and 12°C, respectively in 2016 and 25.8°C and 12.2°C respectively in 2017. Similarly, average relative humidity was 63%, and 62.2 % in 2016 and 2017, and mean rainfall was 698 mm and 777 mm during the growing period in 2016 and 2017 respectively.

Plant uniformity was taken on the basis of homogeneity of crop whereas vigor was on the basis of size of the plant and its growth habit. Plant vigor was observed at its full growth and flowering stage. Plant uniformity and vigor were taken as a hedonic scale such as 1 for very poor whereas 5 for excellent. Days to flowering was recorded when 50 % of plants had set flowers. The number of leaves and nodes per plant and lobes per leaf were recorded by visual observations. Plant uniformity and vigor was recorded twice by visual observation as a

combination of active growth, plants appearing to be healthy and strong at full emergence and flowering stage by a team of scientists using hedonic grades of 1:very poor, 2:poor, 3:acceptable/medium, 4:good and 5:very good. The scale rating of very poor was defined as inactive growth with weak and unhealthy plants, whereas very good was defined as active growth with healthy and strong plants. Single fruit weight, Fruit length and its width in centimeters were measured on the largest, fully expanded, mature fruit. All samples measurements were averaged from 10 randomly selected plants. The insect and disease severity were scored by using 1-5 scale where 1 is less affected and 5 is highly susceptible.

3. RESULTS AND DISCUSSION

3.1 Plant Uniformity and Vigor

Plant uniformity and plant vigor directly effect on productivity of crop yield. The plant uniformity difference among the genotypes was non-significant. However, combined average mean of plant uniformity of all the tested genotypes had 4.7 score except Squash Green Ball and Squash Green House (4.0) (Fig. 1). Similarly, plant vigor showed statistically non-significant among the genotypes but there was variation from 3.0 (Squash Green Ball) to 3.7 (Squash Long, Squash Light & Grey Zucchini) (Fig. 2).

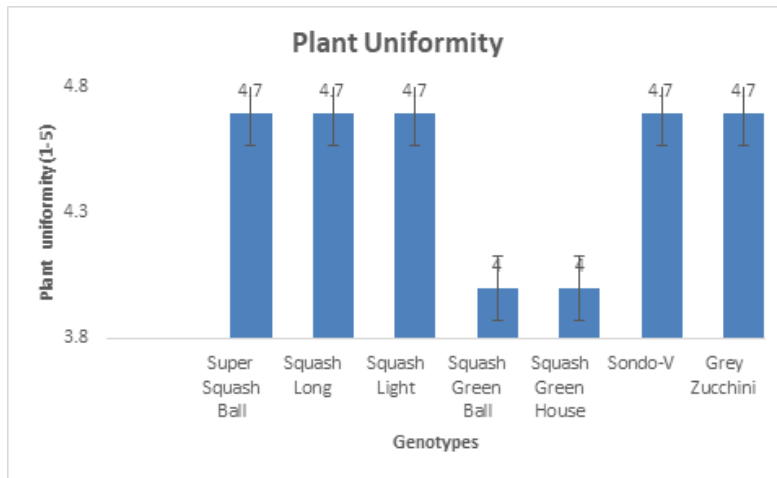


Fig. 1: Plant uniformity of different genotypes of Zucchini tested at NHRC, Khumaltar in the years 2016 and 2017

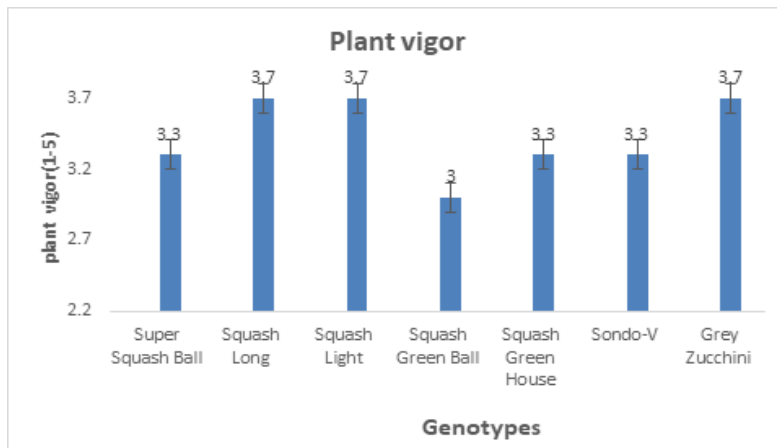


Fig. 2: Plant vigor of different genotypes of Zucchini tested at NHRC, Khumaltar in the year's 2016 and 2017

3.2 Insect, Pest Infection and Disease Servertiy

Intensity of insect and disease was significant among the genotypes where major insect damage was by red pumpkin beetle. Squash Green Ball (3.0) and Grey Zucchini (3.0) were highly damaged by insect while Squash Green House (1.0) genotype was least damaged by insects followed by Squash Long (1.1) respectively. Insect damage at all the tested genotypes was at par to the check Sondo V (1.7) except Squash Green Ball (3.0). Though powdery mildew and virus

susceptible, they were non-significant Squash Green Ball (3.3) was highly infected by powdery mildew and infection of powdery mildew was seen low in Super Squash Ball, Squash light and Sondo V (1.7) as shown in Table 1. Squash Green Ball (7.0) was found highly susceptible to the virus followed by Super Squash Ball and Sondo V check (6.3). The genotype Squash long was found to be highly resistant to the virus and was seen on the scale of 1.3 out of 9 (Table 1). The Squash Green House was least damaged by insect and this might be due to varietal effect.

Table 1: Insect and Disease Parameter of Different genotypes of Zucchini in 2016 and 2017 at Khumaltar

Genotypes	Insect Damage (1-5 scale)	Powdery Mildew (1-9 scale)	Virus Suspect (1-9)
Super Squash Ball	1.7b	1.7b	6.3a
Squash Long	1.3b	2.0b	1.3c
Squash light	1.3b	1.3b	4.7ab
Squash Green Ball	3.0a	3.3a	7.0a
Squash Green House	1.0b	2.0b	3.7b
SandoV(Check)	1.7b	1.7b	6.3a
Grey Zucchini(check)	3.0a	2.0b	5.3ab
GM	1.85	2	4.93
F -test	*	*	*
LSD	0.954	0.73	2.3
CV %	25.38	33.92	30.73

Note: NS,* and ** indicate non-significant and significant at $p < 0.01$, respectively. Means followed by the same letter(s) in the column are not significantly different at 5% by DMRT.

3.3 Days of 50% Flowering

The two years pooled analysis data showed that days to 50% flowering, number of leaves/plant and number of nodes per plant were significant among the genotypes. The 50% flowering period, number of leaves per plant and number of nodes per plant were significant among the genotypes. Early 50% flowering was observed in Grey Zucchini (30.7 days) followed by Sondo V, Squash Green Ball and Super Squash Ball (31.7 days) while late flowering was observed by Squash Long (34.3 days) followed by Squash Green House. Among the hybrid genotypes; Squash Long (34.3 days), Green House (34.0 days) and Squash Light (33.7 days) showed significantly longer period to flowering as compared to Sondo

V (31.7 days) but Super Squash Ball and Squash Green Ball were not having any difference with Sondo V on days to flowering.

3.4 Number of Leaves and Nodes per Plant

Number of leaves per plant was ranged from 19.1 in Squash Long to 25.1 in Squash Green Ball. Squash Long and Squash Light had significantly lower number of leaves per plant as compared to Sondo V (23.7) and Grey Zucchini (24.4) but Super Squash Ball and Green House had number of leaves per plant at par to Sondo V. Similarly, Squash Green Ball had significantly higher number of nodes (18.1) per plant as compared to all the rest genotypes. As far as leaf characteristics was concerned, Sondo V had higher number of lobes per leaf (12.0) (Table 2).

Table 2: Days to 50% flowering after transplanting, No. of leaves/plant, No. of nodes per plant and No. of lobes/leaf of different genotypes of Zucchini in 2016 and 2017 at khumaltar

Genotypes	Days to 50%flowering after transplanting	No of leaves/plant	No of nodes per Plant	No of lobes per leaf
Super Squash Ball	31.7a	23.9b	10.3b	6.4
Squash Long	34.3a	19.1c	9.7b	6.6
Squash Light	33.7a	19.2c	9.4b	6.2
Squash Green Ball	31.7b	25.1a	18.1a	6.1
Squash Green House	34.0a	21.4bc	10.3b	6.9
SondoV (Check)	31.7b	23.7ab	9.3b	12
Grey Zucchini (check)	30.7b	24.4ab	9.6b	8
GM	32.4	12.41	10.96	7.46
F –test	*	*	*	NS
LSD	1.67	2.93	3.73	-
CV %	9.84	10.95	25.1	51.67

Note: NS,* and ** indicate non-significant and significant at $p<0.01$, respectively. Means followed by the same letter(s) in the column are not significantly different at 5% by DMRT.

3.3 Yield Parameter

The average fruit weight, its length and width all were significant on both years. Average fruit weight was significantly higher in Super Squash Ball (820.8 g) followed by Green House (723.7 g) as compared to SondoV (539.1 g) which had the smallest fruit among the tested genotypes. Fruit size of Sondo V was followed by Squash Light (561.8 g) and Squash Long (591.4 g) respectively. Similar result was obtained by Salata and Stepaniuk (2013) in their study where average 1.5 kg fruit from plants cultivated in optimal conditions of soil and

favorable weather conditions during flowering, setting and development of fruits. Longest fruit was measured in Grey Zucchini (25.5 cm) followed by Green House (24.6 cm) and Squash Light (21.7 cm) respectively whereas the shortest length was in Squash Green Ball (9.6 cm) and followed by Super Squash Ball (9.8 cm). It had been reflected in fruit width where widest fruit was measured in Squash Green Ball (22.9 cm) followed by Super Squash Ball (17 cm). Hence, all the genotypes had oblong fruit shape except Super Squash Ball and Squash Green Ball (Table 3).

Table 3: Average fruit weight, Average fruit length and Average fruit diameter of different genotypes of Zucchini in 2016 and 2017 at NHRC, Khumaltar

Genotypes	Average fruit weight (g)	Average fruit length (cm)	Average fruit diameter (cm)
Super Squash Ball	820.8a	9.8c	17ab
Squash Long	591.4c	21.1ab	8.3c
Squash Light	561.8c	21.7ab	7.5c
Squash Green Ball	621.1bc	9.6c	22.9a
Green House	723.7ab	24.6ab	9.3c
Sondo V (F1, check)	539.1c	16.3bc	10.2bc
Grey Zucchini (Local check)	627.9bc	25.5a	6.5c
GM	640.8	18.4	11.8
F –test	*	*	*
LSD	116.8	7.79	7.1
CV %	16.45	12.4	15.1

Note: NS,* and ** indicate non-significant and significant at $p<0.01$, respectively. Means followed by the same letter(s) in the column are not significantly different at 5% by DMRT.

3.6 Fruit Number per Plant

The two years data showed that highest number of fruits were obtained by genotype Squash Long

(8.6) followed by Super Squash Ball(8.5) and least fruit number was obtained by Grey Zucchini (3.8).

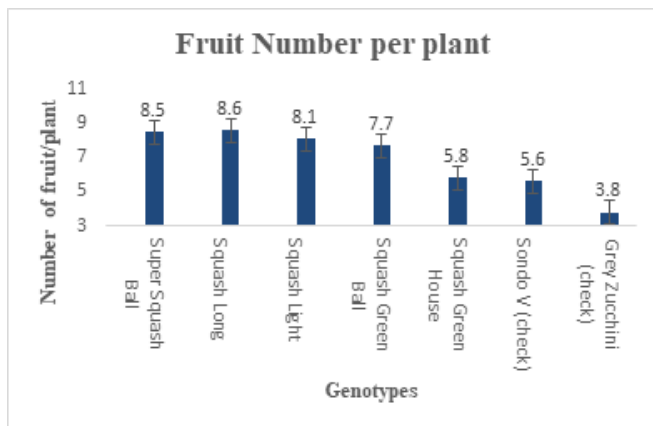


Fig. 3: Fruit number per plant of different genotypes of Zucchini tested at NHRC, Khumaltar in the years 2016 and 2017

3.7 Fresh Fruit Yield

Yield of fruits in number per plant was ranged from 3.8 in Zucchini to 8.6 in Squash Long followed by Super Squash Ball (8.5) and Squash Light (8.1) respectively. All the tested genotypes had given higher number of fruits per plant. Squash Long had also produced higher yield of fruit per plant (3894 g). All the tested genotypes had given significantly higher yield of fruit per plant in both the years as compared to check genotype; Sondo V (1703 g) and Grey Zucchini (1384 g). In both the years, Squash Long had highest yield per plant that was 5108 g in first year and 2680 g in second year. It was followed by Super Squash Ball which had

yield stability and gave 2572 g in 2017 (Table 4).

As far as total yield of the fruit is concerned, all the tested genotypes gave superior yield as compared to check Sondo V where Squash Long (46.89 t/ha) and Squash Light (36.94 t/ha) gave significantly higher yield than check Sondo V (22.5 t/ha) (Table 4). Among the oblate/ball fruit type of genotypes; Super Squash Ball became superior to Squash Green Ball because of higher yield, less virus infection, less powdery mildew disease, and also less insect damages. The yield performance is comparatively lower in 2017 because of scarcity of timely raining and damages by fruit flies.

Table 4: Fresh fruit yield and Total yield of different genotypes of Zucchini in 2016 and 2017 at NHRC, Khumaltar

Genotypes	Fresh fruit yield (gm/plant)			Total yield (t/ha)		
	2016	2017	C Mean	2016	2017	C Mean
Super Squash Ball	2558bcd	2572a	2565bc	30.6bc	27.96ab	29.28bc
Squash Long	5108a	2680a	3894a	63a	30.79a	46.89a
Squash Light	3719b	1697bc	2708b	45.9b	27.98ab	36.94ab
Squash Green Ball	2697bcd	1584c	2140cd	33.2bc	23.24bc	28.22bcd
Squash Green House	3443bc	2368ab	2905b	36.4bc	22.93bc	29.66bc
Sondo V(check)	2071cd	1335c	1703de	25.5c	19.50cd	22.50cd
Grey Zucchini(check)	1660d	1109c	1384e	19.5c	14.19d	16.84d
GM	3159	1907	2471	36.3	23.8	30.04

F Value	**	**	**	**	**	**
LSD	1338	687.2	467.5	17	6.72	11.45
CV %	16.2	6.1	10.2	21.47	9	7.6

Note: NS,* and ** indicate non-significant and significant at $p < 0.01$, respectively. Means followed by the same letter(s) in the column are not significantly different at 5% by DMRT.

3.8 Morphological Variation

Super Squash Ball had the longest (24.5 cm) leaf length followed by Squash Light (22.3 cm) whereas the shortest leaf length (18 cm) was recorded in Squash Long. Likewise, Squash Green House had the widest leaf (29 cm) followed by Super Squash Ball (27.7 cm) and

the shortest (17.3 cm) petiole was recorded in Squash Light. Similarly, fruit shape is varied from round (Super Squash Ball to elongated oblong (Squash Long) and color from light green (Super Squash Ball) to dark green (Grey Zucchini) (Table 5). Kenneth (2016) had also mentioned about much variation in shape, texture and color in squash gourd.

Table 5: Distinct observation on the morphology of different genotypes of Zucchini in 2016 and 2017 at NHRC, Khumaltar

Parameters	Squash Long	Super Squash Ball	Squash Light	Squash Green Ball	Squash Green House	Sondo V	Grey Zucchini
Leaf Length (cm)	18±3.2	24.5±3.3	22.3±3.1	18.8±6.4	21.9±7.1	20.4±2.1	20.6±1.4
Leaf Width (cm)	23.2±2.6	27.7±5.4	25.1±2.1	22.4±1.8	29±1.1	20.1±7.1	24.4±2.6
Petiole Length (cm)	14.9±7.8	20.1±3.2	17.3±7.5	25.1±8.8	29.2±3.1	17.9±6.6	22.9±1.0
Fruit Shape	Shiny elongated oblong type	Round shape	Elongated rod shape	Spherical	Spherical	Oblong obovate	Elongated
Fruit color	Shiny light Green	Light Green	Shiny Light Green	Dark Green and Shiny	Green	Dark Green	Dark Green
Days to 50% flowering (Days)	33-36	30-32	30-35	30-33	32-36	30-33	30-32
No. of nodes/plant	10-Sep	11-Oct	10-Sep	10-Sep	11-Oct	10-Sep	10-Sep

4. CONCLUSION

The study revealed that among the tested genotypes; Squash Long was found highly uniform, vigorous, least virus and insect damage, significantly higher number of fruits (8.6), and yield (3894 g) per plant and yield (46.89 t/ha) followed by Super Squash Ball having highly uniform, less insect and powdery mildew damage, significantly higher number of fruits (8.5) and yield (2565 g) per plant and yield (29.28 t/ha) as compared to check Sondo V and Grey Zucchini which are widely grown cultivars in mid-hills of Nepal where Sondo V

had only yield (22.50 t/ha) and 1703 g/plant), number of fruits (5.6), per plant respectively. Hence, Squash long and Super Squash Ball have been selected and recommended for cultivation during spring season in mid-hills of Nepal. There is no any variety having round type of fruits registered/released in Nepal. Consumer's preferred round shape fruit as compared to oblong type because it resembles to local pumpkin fruits. Super Squash Ball had good yield stability and registered in Nepal. Squash long was higher yielder but its yield varied greatly from one year to the next year.

Some Photographs of different genotypes of Zucchini during Research Programin 2016 and 2017 at NHRC, Khumaltar



Super Squash Ball



SondoV



Squash Long

Fig .Plant characteristics of three hybrid genotypes of zucchini



Super Squash Ball



SondoV

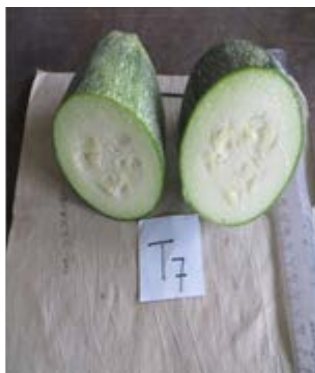


Squash Long

Fig .Plant characteristics of three hybrid genotypes of zucchini



Super Squash Ball



Grey Zucchini



Squash Long

Fig. Fruit characteristics of three hybrid genotypes of zucchini in its transverse section

ACKNOWLEDGEMENT

We are extremely grateful to Nepal Agricultural Research Council for providing financial support through National Horticulture Research Center (NHRC), Khumaltar. All the supporting staffs of NHRC are thankfully appreciated for timely providing necessary facilities, logistic supports and physical assistance for the accomplishment of this experiment. We would also like to thank Green Seed Pvt. Company for providing us seed.

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