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Masoom Mohanty
Department of Horticulture, Assam Agricultural University, Jorhat, Assam, India

Manisha Kachari
College of Horticulture and FSR, Assam Agricultural University, Jorhat, Assam, India

Deepa Borbora Phookan
Department of Horticulture, Assam Agricultural University, Jorhat, Assam, India

Nilay Borah
Department of Soil Science, Assam Agricultural University, Jorhat, Assam, India

Corresponding Author:
Manisha Kachari
College of Horticulture and FSR, Assam Agricultural University, Jorhat, Assam, India

Quality of zucchini (*Cucurbita pepo*) influence by planting time and fertilizers

Masoom Mohanty, Manisha Kachari, Deepa Borbora Phookan and Nilay Borah

Abstract
The zucchini or baby marrow (*Cucurbita pepo*) is a vining herbaceous plant belongs to the family Cucurbitaceae. An experiment was conducted in split-plot design with three planting time and four fertilizer treatments during 2019-20 in the Experimental Farm, Department of Horticulture, AAU, Jorhat. The fertilizer treatment T3 (75: 80: 80: NPK Kg/ha) showed maximum result for parameters fiber (0.88%), ash (0.61%), protein (6.28%), fat (0.67%) and minimum result for moisture content (95.41%). However, β-carotene content (7.69 mg/100g) was found maximum in T0(Control). Among the planting time P1 (1st December) noticed significantly highest value in parameters such as fiber, ash and β-carotene content. However, moisture content was found maximum in P3(1st January). From these findings it can be concluded that treatment combination T3 P1 recorded best treatment in terms of fiber, ash, fat except for β-carotene which gave best result in T1P1 treatment combination.

Keywords: fertilizer, planting time, quality, zucchini

Introduction
Zucchini, is an exotic crop belongs to the *Cucurbita pepo* species, which also includes other squashes and pumpkins. The fruits come in green and golden colour, cultivated in low as well as high temperature condition. Zucchini is rich in nutrition and possess medicinal properties (Mohammad *et al*., 2011) [4]. Zucchini, unlike cucumber, is generally served cooked, steamed, boiled, grilled, baked, barbecued, and fried. Its flowers may be stuffed and deep fried, making them a delicacy. A zucchini with the flowers still attached is an indication of a genuinely fresh and young fruit with sweeter taste. Zucchini in diet provides several health benefits. It has bioactive compounds which reduces the risk of cardiovascular and degenerative diseases. Zucchini is low calory vegetable (14 kcal/100 g), rich in antioxidants, minerals, fibre, vitamins especially vitamin C and potassium, and highest in water content (96.5%).) which prevents body from dehydration (Tejada *et al*., 2020) [8]. Due to its emollient properties, it helps in digestion of food suitable for those with digestive problems. The planting dates has a prime importance in growth, development, and yield for sustainable production of the crop nonetheless, of identical management practices. The other factor fertilizers have a great influence on growth and quality of horticultural crops, Poor and inconsistent supply of nutrients leads to nutritional disorders in horticulture crops (Shaheen *et al*., 2010) [7]. Consequently, use of sufficient amount of the fertilizers leads to increase the crop yield and improve the quality of the fruit. Upper zone of Assam is well known for cucurbits cultivation. Zucchini being a member of gourd family is much, suitable for cultivation under agroclimatic conditions of Assam. However, there is a dearth of knowledge on growing techniques for its cultivation, Therefore, the objective of this trial was to find the best planting time and conducive fertilizer dose to get quality harvest from its cultivation.

Materials and Methods
An experiment on "Quality of zucchini (*Cucurbita pepo*) influence by planting time and fertilizer rates in upper zone of Assam" was conducted during the year 2019-20 in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat. The experimental plot was uniform in topography, located at 26° 47' North latitude, 94°12' East longitude at an altitude of 86.6 m above MSL. The climate of Jorhat is sub-tropical where maximum temperature goes around 34.36 °C during summer and minimum is around 7 °C during winter.

The experiment was designed in split plot with three replications in which zucchini variety 'Priyanka' was planted in three different dates 1st December, 15th December, 1st January with fertilizers treatments as T0 (control); T1 (45:48:48: NPK Kg/ha); T2 (60: 64: 64: NPK Kg/ha); and T3 (75:80:80: NPK Kg/ha) in plot size 1.8m x 1.8m at a spacing of 60cm x 60cm. The data on quality parameters recorded during the field experiment were fibre percentage, ash percentage, β-carotene, moisture content, protein percentage, fat percentage. The significance of difference between mean values of the parameters of the treatments was tested by computing critical difference (CD).

Fiber percentage (%)

Fiber content was estimated from fat free sample of dried fruits as per method suggested by Ranganna (1977) [6]. 2g of ground material with petroleum ether was extracted. 2g dried material was boil with 200 ml H_2SO_4 for 30 minutes with bumping chips. Then it was filtered through muslin cloth and washed with boiling water to remove the acid. Then boiled with NaOH solution for 30 minutes in the beaker. Again, it was filtered through the muslin cloth and washed with 25 ml boiling 1.25% H_2SO_4, then 50 ml portions of water and 25 ml alcohol. Then the residue was removed and transferred to the crucible. The residue was dried for 24 hours at 130 ^{0}C. The crucible in the desiccator was cooled and weighed. Then was ignited in muffle furnace for 30 minutes. Desiccator was again cooled and reweighed. Fiber content was determined by using following formulae-

$$\text{Fiber content } \% = \frac{\text{loss in weight}}{\text{weight of sample}} \text{ X } 100$$

Ash percentage (%)

After the estimation of fiber, crucible was taken and weight was measured. Then 2g of oven dried sample weighted in silica dish was taken and ignited on burner till red hot and then kept in the muffle furnace at 600 ^{0}C temperature for complete ignition. After the temperature came down to 75 ^{0}C, crucible was removed from furnace and kept in desiccator and after cooling weight was recorded. Then following formulae was used.

$$\text{Ash } \% = \frac{\text{final weight of crucible} - \text{(initial weight of crucible)}}{\text{weight of sample}} \text{ X } 100$$

Beta- carotene content (mg/100 g)

β-carotene was estimated from fresh sample of Zucchini as per the method suggested by Ranganna, β-carotene was determined by using the following formula.

$$\beta - \text{carotene (mg/100g)} = \frac{\text{(O. D x 13.9 x 10,0000 x 100)}}{\text{weight of sample x 560 x 1000}}$$

Moisture percentage (%)

Freshly cut and well chopped yellow fruit samples from each treatment were dried in dryer to get the constant weight as per the procedure suggested by (Ranganna, 1977). The moisture content was worked out by using following formula:

$$\text{Moisture } \% = \frac{\text{(initial weight} - \text{final weight)}}{\text{initial weight}} \text{ X } 100$$

Protein percentage (%)

The total nitrogen of dried fruit samples was estimated by Micro-Kjeldahl method employing auto analyzers (kelphus pelican model). Fruit sample (0.5 g) was digested by using con. H_2SO_4 (15 ml) and H_2O_2 (5 ml) followed by making 50 ml aliquot after digestion. Accurate quantity of aliquot was taken for nitrogen distillation by kelphus pelican model. The percent protein content in sample was calculated by formula

Protein (%) = Nitrogen (%) X 6.25

Fat percentage (%)

Fat was extracted by ether extract of the dry material. The 2 g accurate dry sample weight was taken into thimble and plugged with cotton. Petroleum ether was poured into beaker and loaded to the system. Set the temperature 90 °C for 50 minutes. Later temperature raised to 170 °C for 30 minutes. The ether was evaporated from the flask remaining residue only. Beaker along with residue was dried in an oven at 100 °C, cooled and weighed.

$$\text{Fat } \% = \frac{\text{weight of ether extract}}{\text{weight of sample taken}} \text{ X } 100$$

Results and Discussion

It is evident from the Table 1 the variations due to both fertilizer and planting time found to be significant with superior fiber quality in P1 (0.92%) and T3 (0.88%) and lowest were found in P3 (0.82%) and T0 (0.85%). However, their interaction effect was non-significant. This variation may be due to Nitrogen and Phosphorous which are responsible for controlling photosynthesis, carbon absorption, and plant production by producing plant dry matter and other energy-rich substances (Wu *et al*., 1998) [10]. In addition, moderate temperature in the first planting leads to healthy fruit growth and development. Similar findings were reported by Bello *et al*. (2014) [2] in cucumber, Narke *et al*. (2015) [5].

The ash percentage were significantly different amongst the treatment of planting time P1, P2, P3 and fertilizer treatments T0, T1, T2, T3 with the highest value in P1 (0.59%) and the lowest (0.57%) were found in P3 (Table 1). The highest ash percentage was found in T3 (0.61%) and the lowest (0.55%) was found in T0. The variations found to be significant. These reports attributed to the increase in dry matter content due to higher fertilizer levels and optimum fruit developing condition in early planting time. However, their interaction effect was non-significant. These conclusions are consistent with the observations of Adebayo *et al*. (2013) [1] in pumpkin, Narke *et al*. (2015) [5] in zucchini, Lata (2017) [3] in zucchini.

The highest β-carotene content was found in planting time P1 (7.68 mg) and under treatment control T0 (7.69 mg) and the lowest were found in P3 (7.65 mg) and T3 (7.63 mg) (Table 1). The variations due to fertilizer, planting time and their interactions found to be significant. Among, the interactions, the lowest β-carotene content was observed in T2P3 (7.63 mg), T3P3 (7.63 mg), T3P2 (7.63 mg) and highest was found in T1P1 (7.71 mg) followed by T0P1 (7.70 mg) and T0P2 (7.70 mg). Increase in temperature in the later plantings and high fertilizer level discouraged β-carotene content. These findings corroborated with the studies done by Narke *et al*. (2015) [5] in zucchini and Wadas and Mioduszewska (2011) [9] in spaghetti squash (*Cucurbita pepo* L.).

Table 1: Quality parameters of Zucchini influence by planting time and fertilizers

Treatments	Fiber percentage (%)	Ash percentage (%)	β- carotene (mg/100 g)	Moisture percentage (%)	Protein percentage (%)	Fat percentage (%)
Fertilizers						
To	0.85	0.55	7.69	95.85	6.08	0.65
T1	0.86	0.57	7.69	95.94	6.17	0.66
T2	0.87	0.60	7.65	95.76	6.24	0.66
T3	0.88	0.61	7.63	95.41	6.28	0.67
SEm ±	0.001	0.003	-	-	-	-
CD 5%	0.004	0.008	0.001	NS	NS	NS
Planting time						
P1	0.92	0.59	7.68	95.19	6.30	0.66
P2	0.87	0.58	7.66	95.90	6.19	0.66
P3	0.82	0.57	7.65	96.13	6.08	0.66
SEm ±	0.001	0.002	0.004	-	-	-
CD 5%	0.004	0.007	0.014	NS	NS	NS
Interactions						
T0P1	0.90	0.55	7.70	95.28	6.27	0.65
T0P2	0.85	0.55	7.70	95.75	6.02	0.65
T0P3	0.81	0.54	7.68	96.52	5.94	0.66
T1P1	0.92	0.58	7.71	95.33	6.32	0.66
T1P2	0.86	0.57	7.69	95.68	6.18	0.66
T1P3	0.82	0.57	7.67	96.82	6.01	0.65
T2P1	0.93	0.61	7.68	94.72	6.38	0.67
T2P2	0.87	0.60	7.64	96.28	6.22	0.66
T2P3	0.83	0.59	7.63	96.28	6.14	0.66
T3P1	0.93	0.63	7.65	95.44	6.25	0.67
T3P2	0.88	0.62	7.63	95.89	6.36	0.67
T3P3	0.84	0.60	7.63	94.90	6.24	0.65
SEm ±	0.002	0.003	0.007	0.56	0.09	0.006
CD 5%	NS	NS	0.003	NS	NS	NS

Non-significant impact was witnessed on the moisture content due to planting time, different levels of fertilizers and their interaction effects (Table 1). The highest moisture content found in P3 (96.13%) and the lowest (95.19%) were found in P1. The highest moisture content was found in T1 (95.85%) and the lowest (95.41%) was found in T3. The lowest moisture content was observed in treatment combination T2P1 (94.72%) and highest was found in T1P3 (96.82%). Higher moisture percentage in the fruits at low level of fertilization and later planting may be attributed due to less accumulation of dry matter such as carbohydrates, protein, fat, fiber in fruits and lower carbon assimilation. Adebayo *et al*. (2013) [1] found similar trend in pumpkin, Bello *et al*. (2014) [2] in cucumber, Narke *et al*. (2015) [5] in zucchini and Lata (2017) [3] in zucchini.

The variations in protein percentage due to fertilizer, planting time and their interaction effect found to be non-significant (Table 1). It was observed that the highest protein percentage in P1 (6.30%) and T3 (6.28%) with the lowest in P3 (6.08%) and T0 (6.08%) was recorded. The results supported the findings of Bello *et al*. (2014) [2] in cucumber, Narke *et al*. (2015) [5] in zucchini, Adebayo *et al*. (2013) [1] in pumpkin.

Variations in fat percentage influenced by fertilizer found to be non-significant. The highest fat percentage (Table 1) was found in T3 (0.67%) followed by T1 and T2 treatments gave similar results (0.66%) and the lowest (0.65%) was found in T0. Planting times (P1, P2, P3) gave similar results of fat percentage 0.66%. The variations due to planting time, fertilizer and their interaction effect were non-significant. These observations corroborated to studies by Narke *et al*. (2015) [5].

Conclusion

The present study demonstrated that the planting time of zucchini P1 (1st December) and higher level of fertilizer treatment T3(75: 80: 80 NPK kg/ha) gave best results for quality parameters, except for β-carotene content which gave better results in lower levels of fertilizer treatment T1P1

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