

Comparative quality analysis of cucumber grown under polyhouse and in open condition

ABSTRACT

Cucumber is one of the important cucurbitaceous vegetable grown in Assam and its neighbouring states. Although a large number of F_1 varieties are available in the market, there comparative quality assessment has not been made for their suitability to be grown under polyhouse. So, the present experiment involves cultivation of six different F_1 hybrids namely Malini, Don, NS 404, Noori, Alisha and Sedona under polyhouse and in open condition having a wide variation in terms of quality characters. During the experiment, various quality parameters or characters were investigated for each of the genotypes. All the genotypes had a wide range of variation for most of the characters under investigation. The highest moisture content per fruit under polyhouse condition was observed in genotype Malini (96.75 %) while in open condition Noori recorded the highest moisture content. Highly significant differences were also observed with respect to ascorbic acid, TSS, reducing sugar and non reducing sugar for the conditions of cultivation. The highest TSS content (4.06°B), highest total sugar 3.46 % and reducing sugar 0.58 % was observed in Malini under polyhouse. However, Sedona was found to have highest maximum TSS content (4.22°B), total sugar 3.51 % and reducing sugar 0.61 % in open condition. High ascorbic acid content as mg 100 g⁻¹ under both polyhouse and in open condition (6.38 and 6.25) and the highest SOD activity (28.47 and 26.94 μ mg⁻¹ protein), respectively was observed in Alisha. The result revealed that cucumber cultivated under polyhouse condition significantly differ various quality aspects than the ones cultivated in open condition and are found to be superior in terms of quality. Thus we may say that growing environment is an important factor that could reflect on the quality characters of the cucumber.

Keywords: *Cucumber, F_1 varieties, quality, ascorbic acid, TSS*

1. INTRODUCTION

Cucumber (*Cucumis sativus*) is an important cucurbitaceous vegetable commercially grown throughout the country. It is considered as fourth most important vegetable crop after tomato, cabbage and onion in Asia [1]. In India, it is mainly grown as a summer warm season

31 vegetable crop. It is cultivated in an area of 41,000 hectares in India with the total estimated
32 production of 6.10 lakh MT [2].

33 A highly demanding salad vegetable used for various preparations. It is a source of variety of
34 conventional nutrients and antioxidants. It also has several health benefits such as:
35 rehydrating the body, health regulating the blood pressure, body weight management,
36 cholesterol reduction and cancer prevention. One of the antioxidants found in cucumber has
37 been identified as an essential component in organisms defence mechanisms against
38 oxidative stress [3]. Superoxide dismutase is found in all cells of the human body. It breaks
39 down superoxide radicals which are toxic to living cells and cause DNA mutations into
40 harmless components consisting of oxygen and hydrogen peroxide. SOD is an important
41 factor improving tolerance to environmental stresses in organisms, there is a desire to
42 introduce SOD as an ingredient of medicine, food, cosmetic, etc. It has been reported that
43 SOD is effective for the prevention and cure of various human diseases, such as arthritis,
44 rheumatism, ischemic heart disease and radiation hazard [4].

45 Apart from this cucumber are also a rich source of silica, triterpene phytonutrients called
46 cucurbitacins. Cucumber is also a good source of iodine, and contains a total of 4-6% of dry
47 substances, approximately 2% sugars, 1% albuminous substances, 0.7% cellular tissue and
48 0.1% fat [5]. The flavour of cucumber has two compounds, 2,6-nonadenal and 2,6-
49 nonadenol. The pleasant aroma of cucumber is said to derive mainly from the 2, 6-
50 nonadialenal, with assistance from 2-hexenal.

51 The growing environment plays a major role in determining the quality aspects of the fruits.
52 The microclimate present under the polyhouse condition resulted in the development of a
53 congenial environment especially with respect to temperature that helped them to flourish
54 well with increase in moisture content and TSS content.

55 **2. MATERIALS AND METHODS**

56 **2.1 Geographical location of the experimental site**

57 The experimental site was situated at 26°47'N latitude and 94°12'E longitude having an
58 elevation of 94 meters above mean sea level. The field experiment was carried out during the
59 year 2015-2016 in the Horticultural orchard/Experimental Farm, Department of Horticulture,
60 College of Agriculture, Assam Agricultural University, Jorhat. The experimental location
61 was considered to be well drained with uniform topography. The soil of the experiment site
62 belonged to the order inceptisol and derived from the alluvial deposits of the river
63 Brahmaputra. The soil of the experimental field is acidic, well drained and sandy loam in

texture. Jorhat falls within Upper Brahmaputra Valley Zone of Assam. The climatic condition of this zone is characterized by a subtropical humid climate having hot humid summer and relatively dry and cool winter. Hot summer is experienced during May to August and the cold winter from December to January, whereas a mild winter is experienced during September to November and February to April. The average rainfall is about 2200 mm but unevenly distributed throughout the year. Normal monsoon rain starts from June and continuous up to September with the premonsoon shower commencing from mid-March. The intensity of the rainfall is the highest in monsoon season which normally begins from the first week of June and the intensity of rainfall decreases from October onwards. In general, the maximum temperature is around 34°C during summer and the minimum of around 9.1°C during winter [6].

2.2 Treatment and Design

The present experiment was undertaken under polyhouse as off season crop and as normal crop in open condition as main season crop during the period December-2015 to March-2016 and February-2016-June-2016 respectively. Six F₁ hybrids *i.e.* Don, Malini, Sedona, NS 404, Alisha and Noori, collected from market. The spacing maintained under polyhouse was at 60cm × 30cm while in open condition the seedlings were planted at spacing at 100cm × 60cm. For both the conditions five replications were adopted for each variety in a randomized block design. The crop duration was of three months in each season. Individual plot size was 2.8 m² and 12.6 m² and the total area of the experimental site was 200 m² and 536 m² for polyhouse and open condition, respectively.

2.3 Data Collection

Uniform cultural practices were followed for all the treatments. A fertilizer of NPK @ 100:75:50 kg/ha were applied 7 days before sowing under polyhouse and in open condition. Half of N with full doses of P₂O₅ and K₂O was applied as basal and remaining half of N was top dressed at 30 days emergence of seedlings as per the recommendation of package of practices of Assam. Black polythene mulch (30 micron thick and 1.5 m wide) was used and planting holes were made on the polythene film at a spacing of 60 cm × 30cm to sow the seeds for poly-house and 100cm × 60cm cm for open condition, respectively. For sowing under poly-house healthy seeds with uniform size were sown during last week of November on tray containing a mixture of three parts of cocopeat, two part of vermiculite and one part of perlite. Seedlings were transplanted 10 days after sowing on raised beds and by maintaining a spacing of 60 cmx30cm between the rows and plants respectively. Similarly in

open condition healthy seeds with uniform size were sown during first week of February on tray containing a mixture of three parts of cocopeat, two part of vermiculite and one part of perlite. Seedlings were transplanted 10 days after sowing on raised beds and by maintaining a spacing of 100 cm x 60cm between the rows and plants, respectively. The harvesting was done at tender stage before they attained full maturity. For harvesting cucumbers were cut with a sharp knife. The proximate analysis was carried out at the food science laboratory of the Horticulture Department, Assam Agricultural University, Jorhat using standard laboratory technique as described by Association of Analytical Communities. Fruit samples were collected and were cut into small pieces. Their fresh as well as dry weight was calculated. The percent moisture content in plant was calculated as follows.

$$\text{Moisture content, \%} = \frac{\text{Fresh weight (g)} - \text{Dry weight (g)}}{\text{Dry weight (g)}} \times 100$$

The total soluble solids of the fresh fruits were determined with the help of Zeiss hand refractometer and were expressed in °Brix [7]. The ascorbic acid content was determined by using 2, 6- Dichlorophenol indophenols dye visual titration method given by Ranganna [8] and expressed in mg 100 g⁻¹ fresh weight. Reducing sugar and total sugar was estimated by using the standard method of A.O.A.C. [9]. The superoxide dismutase (SOD; EC1.15.1.1) activity was determined spectrophotometrically by measuring the inhibition of blue diformazone in the presence of riboflavin/nitro blue tetrazolium (NBT) and light [10].

2.4 Data Analysis

The experimental data obtained from various observations were analyzed statistically by using Fischer's method of analysis of variance in Randomized Block design as described by Panse and Sukhatme [11]. The Significance of the variance of variety effect was determined by calculating respective 'F' values.

The standard error of the difference was calculated by using the formula:

$$S.E.d = \sqrt{\frac{2EMS}{r}}$$

The critical difference (C.D) at 5% probability level was calculated to find out the mean difference between the treatments CD was calculated by using the following expression

$$C.D. = S.E.d \times t_{5\%} \text{ for error degree of freedom}$$

128 Where,

129 T = tabulated value of 't' at 5% probability level for appropriate degree of freedom.

130 **3. RESULTS AND DISCUSSION**

131 **3.1 Moisture percent**

132 From the Table 1, it is evident that the hybrids grown under polyhouse were found to have
133 the mean moisture per cent in the range of 95.72 (Don) to 96.75 (Malini) and the values were
134 found to be non significant. The mean moisture per cent for cucumbers grown in the open
135 condition was recorded in the range of 95.54 (Don) to 96.16 (Noori) and the values were
136 found to be non significant.

137 **3.2 Total soluble solid (TSS)**

138 Significant variation was observed among hybrids of cucumber with respect to TSS (Table 1)
139 under both polyhouse and open condition. The values of TSS for varieties ranged from 2.94
140 °Brix (Alisha) to 4.06 °Brix (Malini) under the polyhouse. The highest TSS was recorded in
141 Malini (4.06 °B) which was found to be statistically significant over Sedona (3.88 °B) and
142 Noori (3.50 °B). However, Noori was on par with Don (3.43°B) but differed significantly
143 over NS 404 (3.32 °B). The lowest TSS content was recorded in Alisha (2.94°B). These
144 results are also confirmed by Pragathi [12] who showed that there were significant
145 differences in TSS of fruits between the varieties. The TSS of the hybrids grown in the open
146 condition ranged from 3.01 °Brix (Alisha) to 4.22 °Brix (Sedona) as presented in Table 1.
147 The highest TSS content was recorded in Sedona (4.22 °B) which was significant over Malini
148 (3.98 °B). Similarly, Sedona were significant over NS 404 (3.62 °Brix). However, NS 404
149 was at par with Noori (3.50 °Brix) but was significant over Don (3.38 °Brix). The least TSS
150 content was recorded in Alisha (3.01 °B).

151 **3.3 Ascorbic acid**

152 Highly significant difference was observed with respect to ascorbic acid content of
153 cucumbers for both the conditions of cultivation (Table 1). Under the polyhouse the mean
154 ascorbic acid content ranged from 3.53 (Malini) to 6.38 (Alisha) as illustrated in Table 1. The
155 highest ascorbic acid content was recorded in Alisha (6.38 mg). The experimental results
156 obtained by Phookan *et al.*, [13], also showed highest ascorbic recorded by Alisha. The
157 hybrid NS 404 (4.34mg), Don (4.24 mg) and Noori (4.17 mg) and Sedona (3.86 mg) was on

par. However, Malini (3.53 mg) recorded the lowest. The mean ascorbic acid content in open condition ranged from 3.02 (Sedona) to 6.25 mg (Alisha) of fresh fruit (Table 1). The hybrid, Alisha (6.25 mg) recorded the maximum ascorbic acid content and was significant over Don (4.10 mg). However, Don, Noori (3.92 mg), NS 404 (3.92 mg) and Malini (3.58 mg) did not differ statistically. The least ascorbic acid content was observed in Sedona (3.02 mg).

3.4 Reducing sugar

The hybrids grown under polyhouse were found to have the mean reducing sugar in the range of 0.43 % (Alisha) to 0.58 % (Malini) as presented in Table 1. The highest quantity of reducing sugar was in Malini (0.58) which was closely followed by Sedona (0.55) but differed significantly over Noori (0.53). However, Noori, Don (0.52) and NS 404 (0.50) were on par. The hybrid Alisha was found to have the lowest reducing sugar content among all the hybrids. In the open condition the mean reducing sugar content was recorded in the range of 0.46 % (Alisha) to 0.61 % (Malini) as presented in Table 1. The hybrid Sedona (0.61) recorded the highest amount of reducing sugar and was found to be on par with Malini (0.59) but differed significantly over NS 404 (0.55). However, NS 404, Noori (0.54) and Don (0.53) were at par. The hybrid Alisha (0.46) was found to have the lowest reducing sugar content among all the hybrids. The mean total sugar content under polyhouse ranged between 3.19 % (Alisha) to 3.46 % (Malini) as presented in Table 1. The highest sugar content was recorded in Malini (3.46) which was followed by Sedona (3.42) but was significant over Noori (3.39). In the similar decreasing trend Don (3.30), NS 404 (3.23) and Alisha (3.19) were found with the lowest sugar content while Alisha and NS 404 were at par. In the open condition the mean total sugar content as presented in Table 1 ranged from 3.25 % (Alisha) to 3.51 % (Sedona). Among all the hybrids Malini recorded the highest total sugar content which was closely followed by Malini (3.48) but statistically differed over NS 404 (3.42). However, NS 404 was at par with Noori (3.37) but was significant over Don (3.35) and Alisha (3.25).

3.5 Total sugar

The highest sugar content was recorded in Malini (3.46) which was followed by Sedona (3.42) but was significant over Noori (3.39). In the similar decreasing trend Don (3.30), NS 404 (3.23) and Alisha (3.19) were found with the lowest sugar content while Alisha and NS 404 were at par. In the open condition the mean total sugar content as presented in Table 1 ranged from 3.25 % (Alisha) to 3.51 % (Sedona). Among all the hybrids Malini recorded the highest total sugar content which was closely followed by Malini (3.48) but statistically

differed over NS 404 (3.42). However, NS 404 was at par with Noori (3.37) but was significant over Don (3.35) and Alisha (3.25).

3.6 Superoxide dismutase

Significant difference was observed with respect to superoxide dismutase activity as mg 100g⁻¹ protein of cucumbers for both the conditions of cultivation. Under the polyhouse the mean of SOD activity was found in the range of 24.46 μ mg⁻¹(Noori) to 28.47 μ mg⁻¹ (Alisha) as presented in Table 1. The highest SOD activity was found in Alisha (28.47 μ mg⁻¹) which was closely followed by NS 404 (27.59) but was statistically significant over Sedona (27.20). However, NS 404, Sedona and Malini (26.68) had no significant difference among them but significantly differed over Don (25.17) and Noori (24.46). In the open condition the mean of SOD activity as mg 100g⁻¹ protein was recorded in the range 20.47 (Noori) - 26.94 (Alisha) presented in Table 1. The highest activity was observed in Alisha (26.94) which was closely followed by Malini (25.03) and NS 404 (25.05). However, NS 404 were at par with Sedona (24.01) but differed significantly over Don (22.46). The hybrid Noori (20.47) recorded the lowest SOD activity.

4. CONCLUSION

It was observed that the off-seasons polyhouse grown cucumbers had been endowed with more moisture percentage which was slightly got reduced in the open condition. Similarly, polyhouse grown cucumbers had a TSS range of 2.94 to 4.06 ° Brix against 3.01 to 4.22 °Brix TSS indicating high catabolic activities under the Sun. The total sugar content and the reducing sugar content were found to be lowest under polyhouse than in open condition. So the inversely proportionate content of TSS content versus ascorbic acid content was found to be decreased under polyhouse than that of open. Ascorbic acid content of hybrid Alisha (6.38 mg 100g⁻¹) was found to be higher under polyhouse than in open (6.25 mg 100g⁻¹). The SOD activity was also found to be lesser in open condition which may be ascribed to the intense heat.

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252 **Table 1: Quality parameters of cucumber grown under polyhouse and in open condition**

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Varieties	Moisture (%)		TSS (°B)		Ascorbic Acid (mg100 g ⁻¹)		Reducing Sugar (%)		Total sugar (%)		Superoxide dismutase (μ mg ⁻¹ protein)	
	Polyhouse	Open	Polyhouse	Open	Polyhouse	Open	Polyhouse	Open	Polyhouse	Open	Polyhouse	Open
V1: Don	95.72	95.54	3.43	3.38	4.24	4.10	0.52	0.53	3.30	3.35	25.17	22.46
V2: Malini	96.75	96.05	4.06	3.98	3.53	3.58	0.58	0.59	3.46	3.48	27.20	25.30
V3: Sedona	96.65	95.65	3.88	4.22	3.86	3.02	0.55	0.61	3.42	3.51	26.68	24.01
V4: NS 404	96.23	95.79	3.32	3.62	4.34	3.87	0.50	0.55	3.23	3.42	27.59	25.05
V5: Alisha	95.94	95.60	2.94	3.01	6.38	6.25	0.43	0.46	3.19	3.25	28.47	26.94
V6: Noori	96.68	96.16	3.50	3.50	4.17	3.92	0.53	0.54	3.39	3.37	24.46	20.47
S.Ed	0.63	0.65	0.07	0.10	0.36	0.34	0.01	0.01	0.02	0.03	0.45	0.93
C.D _(0.05)	NS	NS	0.14	0.20	0.76	0.72	0.03	0.02	0.04	0.07	0.94	1.94

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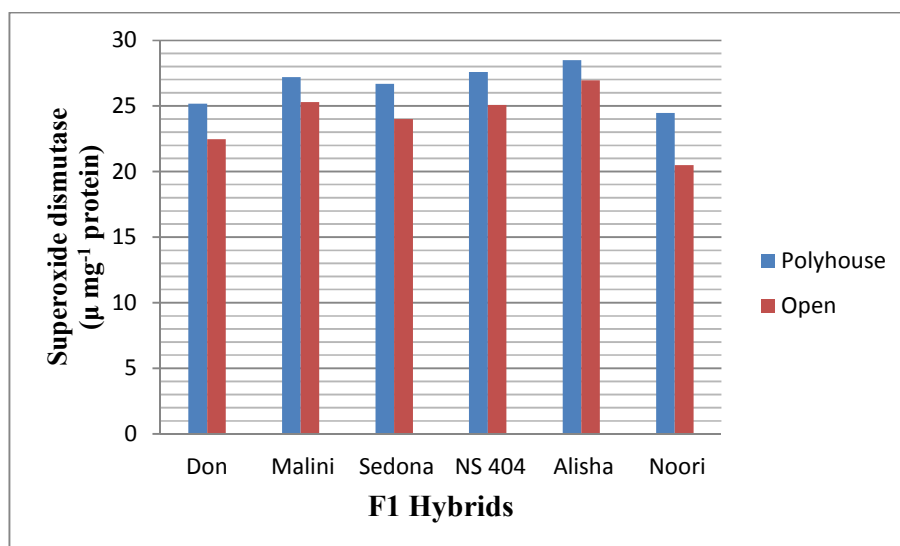


Fig. 1 Superoxide dismutase content of cucumber fruits under open and polyhouse condition.

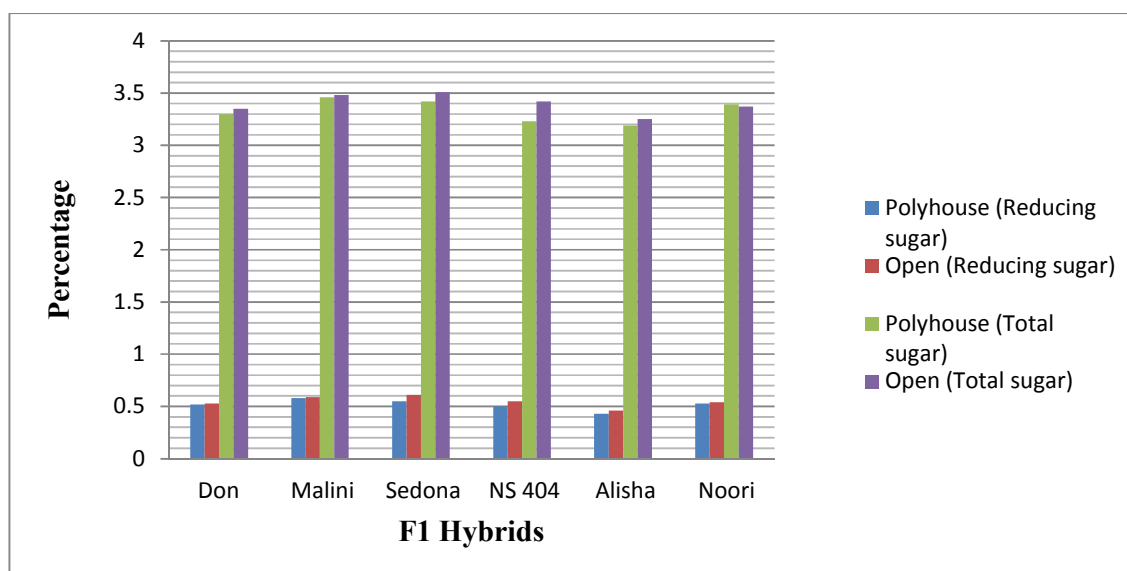


Fig. 2 Reducing Sugar and Total Sugar content of cucumber fruits under open and polyhouse condition.