



Varietal Evaluation of Broccoli (*Brassica Oleraceae* var. *Italica*)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Broccoli (*Brassica Oleraceae* var. *Italica*) is an unusual vegetable that has gained appeal among Indian producers in recent years due to its excellent nutritional content and market potential. An experiment was done to measure the broccoli's growth, yield, and quality. The research experiment was carried out at Department of Horticulture, Naini Agricultural Institute, SHUATS, Prayagraj during the year 2021-2022. The experiment was laid out in Randomized Block Design comprising of 10 Broccoli genotypes as follows: viz., Fiesta, Green Magic, Green Giant, Local Broccoli, Lucky F1, Broccoli Hybrid, Green star F1, Broccoli Captain 488, Green Fairy, Anastya, with three replications. The observed and recorded were sets of parameters divided in 3 categories as growth, yield and quality. The results revealed that the genotype "Green Magic" had the best overall performance than the other evaluated genotypes of Broccoli as revealed from the data of the growth, yield and quality parameters.

Keywords: Broccoli; plant height; curd diameter; plant spread; curd yield.

1. INTRODUCTION

Broccoli (*Brassica oleracea* var. *italica*. L) is an edible green plant in the Cruciferae family whose

large, flower head is eaten as vegetable. The word broccoli comes from the Italian plural of broccolo, which means "the flower crest of cabbage", and is the diminutive form of brocco,

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meaning "small nail" or "sprout". It belongs to the family Cruciferae under order Papaverales. It has a chromosome number of $2n=2x=18$. The broccoli is developed in the Eastern Mediterranean and Italy is the main center of diversification. Broccoli commonly known as Hari gobhi or broccoli in Hindi is gaining popularity in India. In the world market about 40% is marketed as fresh and remaining 60% as frozen [1,2]. Broccoli is a rich source of sulphoraphane which is associated with reducing the risk of cancer [3]. Broccoli has high nutritional and good commercial value (Yoldas et al., 2008). It is a recent introduction to India and is becoming popular among people because of its low fat content, low in sodium, low in calories, high vitamin C and good source of vitamin A, B1, B2 and calcium (Sanwal and Yadav, 2005). It has 130 times higher content of vitamin A than cauliflower and 22 times than cabbage [4]. The cultivation was initially restricted to hill areas of Jammu and Kashmir, Himachal Pradesh, and Uttar Pradesh but now is successfully grown under North Indian plain conditions [5]. Now-a-days broccoli attracts more attention due to its multifarious use and great nutritional value. Therefore, the aim of this work, was to promote such high value cole crops and identify new promising Broccoli varieties with high performance from a selected pool of varieties on the basis of their growth, yield and quality parameters.

2. MATERIALS AND METHODS

Prayagraj is situated at an elevation of 98 meters above sea level at 25.87° N latitudes and 81.150 E longitudes. This region has a sub-tropical climate prevailing in the South-East part of U.P. with both the extremes in temperature, i.e., the winter and the summer. In cold winter months (Dec- Jan), the temperature falls 2-5°C or even low, while in summer months (May- June) it reaches as high as 49°C. The experiment was conducted in the Vegetable Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, during the year 2021-2022.

The research experiment was laid out in Randomized Block Design comprising of 10 Broccoli genotypes with 3 replications which makes it a total of 30 plots. The transplanting of seedlings was accomplished on the second week of November, 2021 during rabi season.

A total of 6 plants from each variety was sown at a spacing of 60 cm between rows and 45 cm between plants. The unit plot size was 1 m x 1 m. The varieties were allocated randomly to a unit plot in each of the replication. Regular cultural practices, crop protection measures were taken as per the crop requirement. The crop was watered regularly. Observations were recorded as per the growth, yield and quality parameters and the mean values of data recorded were analyzed statistically by adopting the method suggested by Panse and Sukhatame [6]. The performance of different varieties of Broccoli was studied and data was collected on the basis of three categories of parameters. First are the growth parameters: Days to germination (days), Plant height (cm), Number of leaves per plant, Plant spread (cm) and Days to curd initiation(days). Second are the yield related parameters: Days to first harvest (days), Head weight (g), Curd yield per plot (kg) and Curd yield per ha (t). And last are the qualitative characters: Head diameter (cm), Total Soluble Solid (T.S.S) and Vitamin C content in head (mg/100g of fresh broccoli head).

3. RESULTS AND DISCUSSION

The data on different genotypes' growth parameters, such as days to germination, plant height, number of leaves, plant spread, and days to curd initiation, vary significantly at various growth phases is shown in (Table 1). The least number of days to germination was observed in the variety Green Magic (3 days) followed by Lucky F1 and Anastya (3.3 days respectively), whereas the Local variety took more days (4.07 days) for germination. The variation on days taken for germination may be due to genetic makeup of individual variety. These results are in accordance with the findings of Singh [7] in cluster bean, Thakor [8] in vegetable pea and Gogoi et al., [9] in broccoli. The maximum plant height was recorded in Green Magic (63.78 cm) followed by Green Giant (59.11) and Green Fairy (58.55 cm) while the lowest plant height was found in Anastya (21.16 cm). The highest plant height observed in some varieties might be due to its inherent genotypic characteristics or because of variations in agro climatic conditions. These findings are in close conformity with that of Chaudari et al., (2015) in Knol-khol, Hafiz et al., [10] and Islam et al., (2015) in broccoli. The maximum number of leaves per plant was recorded in Green Magic (34.89) followed by Fiesta (29.11) and Green Giant (28.89) respectively. The minimum number of leaves

was recorded in Anastya (19.9). In this investigation variation in number of leaves per plant under different varieties, might be due to differences in their genetic inherent capacity, and suitability under this climate. The lower number of leaves in some cultivars was probably due to slow rate in leaf initiation. These findings are in close accordance with the findings of El-Magd et al., [11], El-Magd et al., [12], Thapa and Rai [13] in broccoli. The maximum number of plant spread was recorded in Green Magic (62.67cm) followed by Broccoli Captain-488 (53.08 cm) and Green Star F1 (51.37 cm). The minimum plant spread was recorded in Local variety (42.67 cm). The variation in different varieties with respect to plant spread [E-W and N-S] may be due to their inherent genetic makeup, number of days taken for head harvesting and suitability under this climate. These findings are in accordance with the findings of El-Bassiony et al., [14], Singh et al., [7], Hafiz et al., [10] and Thakur et al., [15] in broccoli. The earliest curd initiation was recorded in Anastya (61.66 days) followed by Green magic (64.67days) and Broccoli Captain-488 (69.33 days), whereas the last head initiation was recorded in Broccoli Hybrid (75.34 days). The earliness in edible maturity might be due to genetically difference among the different varieties. These results are collaborating with the findings of Thapa and Rai [16], Nooprom and Santiprachi (2013), Gogoi et al., [9], and Thakur et al., [15] in broccoli.

The yield parameters of different genotypes vary dramatically at different growth stages, as seen

in the data (Table 2). The lowest number of days to head harvest was recorded in Anastya (87.1 days) followed by Green Magic (88.57 days) and Green Star F1(91.02 days) , whereas the highest number of days to head harvest was recorded in Local broccoli (96.15 days). The highest curd weight was recorded in Green Magic (501.41g) followed by Anastya (448g) and Lucky F1 (438.63g), whereas the lowest curd weight was recorded in Local Broccoli (299.14g). The highest curd yield per plot was recorded in Green Magic (3.08 kg) followed by Anastya (2.69 kg) and Lucky F1 (2.64), whereas the lowest curd yield per plot was recorded in Local Broccoli (1.80 kg). The maximum curd yield per ha was obtained in Green Magic (10.02 t/ha) followed by Anastya (8.97 t/ha) and Lucky F1 (8.77 t/ha). The minimum curd yield per ha was recorded in Local Broccoli (5.98 t/ha). These significant differences with respect to fresh weight of head, head yield per plot and head yield per hectare among different varieties may be due to their own-genetic makeup and the suitability of varieties to the weather conditions of this zone. These findings are in conformity with the results, El-Bassiony et al., [14] in knol-khol, Bhangre et al., (2011) in broccoli, Moniruzzaman (2011) in cabbage, Thapa and Rai [17] of broccoli, Uddain et al., (2012) in knol-khol, Thapa et al., [13], Chandan et al., (2013) in broccoli, El-Magd [12], Giri et al., (2013), Nooprom et al.,(2013), Nguille et al., [18], Singh et al., [7] and Islam et al., (2015) and Thakur et al., [15] in Broccoli.

Table 1. Growth parameters of Broccoli (*Brassica Oleraceae var. Italica*)

Varieties	Days to germination (days)	Plant height (cm)	Number of leaves per plant.	Plant Spread (cm)	Days taken for head initiation (days)
Fiesta	3.45	54	29.11	47.33	70.67
Green Magic	3	63.78	34.89	62.67	64.67
Green giant	3.48	59.11	28.89	46.39	70
Local Broccoli	4.07	51.11	27.56	42.67	74.67
Lucky F1	3.30	56.33	27.67	47.67	72.33
Broccoli Hybrid	3.78	52.67	28.67	45.67	75.34
Green Star F1	3.63	54.89	24.67	51.37	70.34
Broccoli Captain-488	3.33	56.44	28.67	53.08	69.33
Green Fairy	3.9	58.55	25.44	50.44	71.33
Anastya	3.3	21.16	19.9	43.00	61.66
C.D at 5%	0.49	2.75	2.33	4.62	7.79
S.Ed. (+)	0.23	1.31	1.11	2.20	3.71

Note: C.D = Critical Difference, S.Ed. = Standard Error of Deviation

Table 2. Yield parameters of Broccoli (*Brassica oleraceae var. Italica*)

Varieties	Days to head harvest	Curd weight (g)	Curd yield per plot (kg)	Curd yield per ha (t/ha)
Fiesta	93.07	418.45	2.51	8.36
Green Magic	88.57	501.41	3.08	10.02
Green giant	92.48	352.88	2.12	7.05
Local Broccoli	96.15	299.14	1.80	5.98
Lucky F1	94.74	438.63	2.64	8.77
Broccoli Hybrid	95.79	329.89	1.98	6.59
Green Star F1	91.02	383.79	2.30	7.67
Broccoli Captain-488	92.24	411.52	2.47	8.23
Green Fairy	93.37	351.8	2.11	7.03
Anastya	87.1	448.9	2.69	8.97
C.D at 5%	3.71	30.13	0.37	1.78
S.Ed. (+)	1.77	14.34	0.68	0.85

Note: C.D = Critical Difference, S.Ed. = Standard Error of Deviation

Table 3. Varietal evaluation on quality attributes of broccoli

Varieties	Curd diameter (cm)	TSS (°BRIX)	Vitamin C mg/100g
Fiesta	14.48	7.40	75.15
Green Magic	16.40	8.19	87.38
Green giant	15.09	7.04	76.44
Local Broccoli	13.60	6.39	67.30
Lucky F1	15.33	7.38	78.54
Broccoli Hybrid	13.33	7	71.25
Green Star F1	13.18	7.28	80.73
Broccoli Captain-488	16.17	7.09	70.27
Green Fairy	14.24	6.39	67.92
Anastya	15.48	7.46	78.17
C.D at 5%	2.05	0.91	9.18
S.Ed. (+)	0.97	0.43	4.37

As seen in the data, the quality metrics of different genotypes change considerably during different growth stages as seen in (Table 3). The maximum curd diameter was recorded in Green Magic (16.40 cm) followed by Broccoli Captain-488 (16.17 cm) and Anastya (15.48 cm), whereas the minimum curd diameter was recorded in Green Star F1 (13.18 cm). The difference in diameter of the head might be due to genetic makeup in the different varieties and adaptability to soil and climatic condition of this region. These findings are in accordance with the findings of Sharma et al., [1] in Brussels sprout, Kumar et al., (2007) in broccoli, Bhangre et al., (2011) in broccoli, Uddain et al., (2012) in knol-khol, Kumar et al., (2012) in cabbage, Yadav et al., (2013) in cauliflower and Giri et al., (2013) in broccoli. The maximum TSS (BRIX) value was found in Green Magic (8.19) followed by Anastya (7.46) and Fiesta (7.40). The minimum TSS value was found in Green Fairy (6.39). The maximum content of Vitamin C mg/100g was recorded in Green Magic (87.38) followed by Green star F1 (80.73) and Lucky F1 (78.54). The minimum Vitamin C mg/100g was recorded in Local Broccoli (67.30). These findings are in accordance with the findings of Kalloo et al., (2005) in vegetable pea, Bhangre et al., (2011) in broccoli, Uddain et al., (2012) in knol-khol, Chandan et al., (2013) in broccoli, El-Magd et al., [12], Amin et al., (2014) in cowpea, Islam et al., (2015) in broccoli and Patel (2015) in cowpea.

4. CONCLUSION

According to the results of the current study the variety Green Magic was found to be the most suitable for the local conditions among the selected pool of varieties in terms of growth, yield and quality of Broccoli [19-22].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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