

Growth and Yield Performance of Broccoli Cultivars

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ABSTRACT

The growth and yield performance of five broccoli cultivars (Green Magic, Green Giant, Top Green, Early Green and Green Imported) were evaluated in the horticulture research field of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh, during the winter season to find out the high yielding genotype. This field experiment was laid out following a Randomized Complete Block Design. Data on yield and yield attributes were collected at different growth stages from the plants. Statistical analysis of data was performed by MSTATC program. It was noted that the maximum plant height (62.20 cm) and leaf number (24.00) was recorded from Green Imported, while the maximum canopy spread (67 cm), curd weight (601.0 g) and total yield (21.69 t/ha) was recorded from Top Green; besides Green magic produced similar curd yield (19.63 t/ha) to Top Green. From the above outcomes, it was revealed that both Top Green and Green magic cultivation might be suitable for higher yield in the red-brown terrace series soil of Bangladesh.

Keywords: Broccoli, Cultivars, Plant height, Leaf number, Canopy spread, Curd, Yield.

INTRODUCTION

Broccoli (*Brassica oleracea* L.) is one of the non-traditional and relatively new cole crops in Bangladesh. It is a biennial and herbaceous crop belonging to the family Cruciferae. Morphologically, broccoli resembles cauliflower. The terminal curd is rather loose, green in colour and flower stalks are larger than cauliflower. Broccoli originated from west Europe (Prasad & Kumer, 1999). It is an important cole crop of Europe and USA.

However, in India, broccoli is hardly considered a commercial crop. Most of the broccoli cultivars are sensitive to frost. Although the different nutrient elements were found beneficial for the growth and development of broccoli, work on nutritional response is meagre (Mitra et al., 1990). Broccoli is a minor exotic vegetable in Bangladesh. A small scale research and development in public and private sectors are now going on.

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Bangladesh Agricultural Research Institute (BARI) has developed a variety named BARI Broccoli-1 (Anonymous, 2015). It has just started cultivating in Bangladesh. Growers' level extension of broccoli farming can bring a new horizon to the agriculture sector in Bangladesh. There has been a bright prospect of farming broccoli as a high-value crop everywhere in the country except the coastal districts. Broccoli farming has started gaining popularity in the northern region for the last couple of years. In Bangladesh, only a few varieties of broccoli are being cultivated; besides, there are some other genotypes too, which have higher yield potential compared to the released varieties. Early curd bearing, flower initiation, more curd weight, size, shape etc., are inherent characters; all of these contribute to yield. Different genotypes have different genetic potential. The potential yield of broccoli is not possible to get mainly due to climatic factors. Lack of judicious application of fertilizers and sub-optimal management practices followed by the growers are also the secondary reasons for poor growth and yield of broccoli (Roni et al., 2017). Genotypes that have high adapting power to a wide range of environmental conditions, i.e. biotic and abiotic and having better acclimatizing capacity, will indeed perform better with higher yield (Chowhan et al., 2016). As broccoli is a temperate vegetable, its performance in terms of growth, yield, quality, and propagation in the tropics and subtropics are required to find out the most suitable genotype. With respect to the above circumstances, the present research investigation was carried out to unveil the suitable cultivar(s) for gaining optimum yield of broccoli under Bangladesh conditions.

MATERIALS AND METHODS

The experiment was conducted at the Horticultural Research Farm of Bangabandhu

Sheikh Mujibur Rahman Agricultural University, Gazipur, during the period from 17th October 2015 to 21st February 2016. Five broccoli cultivars (Green Magic, Green Giant, Top Green, Early Green, Green Imported) were used as five treatments. The experiment was laid out in randomized complete block with four replications. The whole experimental area of the field was divided into four blocks which represented four replications. The treatments were randomly allotted in each replication. Replication to replication and plot to plot distance were 0.75 m and 0.50 m, respectively. The size of each unit plot was 2 m × 2.4 m = 4.4 m². Data collection was started after 20 days of transplanting, i.e. 17th October 2015, at 10 days intervals. Five plants were randomly selected from each plot for data collection. Plant height (cm), number of leaves per plant, canopy spreading per plant (cm), stem diameter (mm), leaf size (cm), biggest leaf size (cm), days to card initiation (1st to 50%), main card length (cm), main card diameter (cm), main card weight per plant (g), yield per plant (g), yield per plot (kg), yield (t/ha) from 5 randomly selected plants. The data of various parameters recorded in the experiment were compiled and statistically analyzed through partitioning the total variance with the help of the computer MSTATC program. Means were separated using Duncan's Multiple Range Test (DMRT) at 1% or 5% level of probability.

RESULTS AND DISCUSSION

Plant height

Plant height did not differ significantly among the cultivars at 30 and 40 DAT (Fig. 1). The maximum height of the plant (62.20 cm) was recorded by Green Imported, while the minimum (53.93 cm) was in Top Green. Sultana (2007) found the plant height ranging from 54.63 to 58.11 cm of broccoli at 45 DAP.

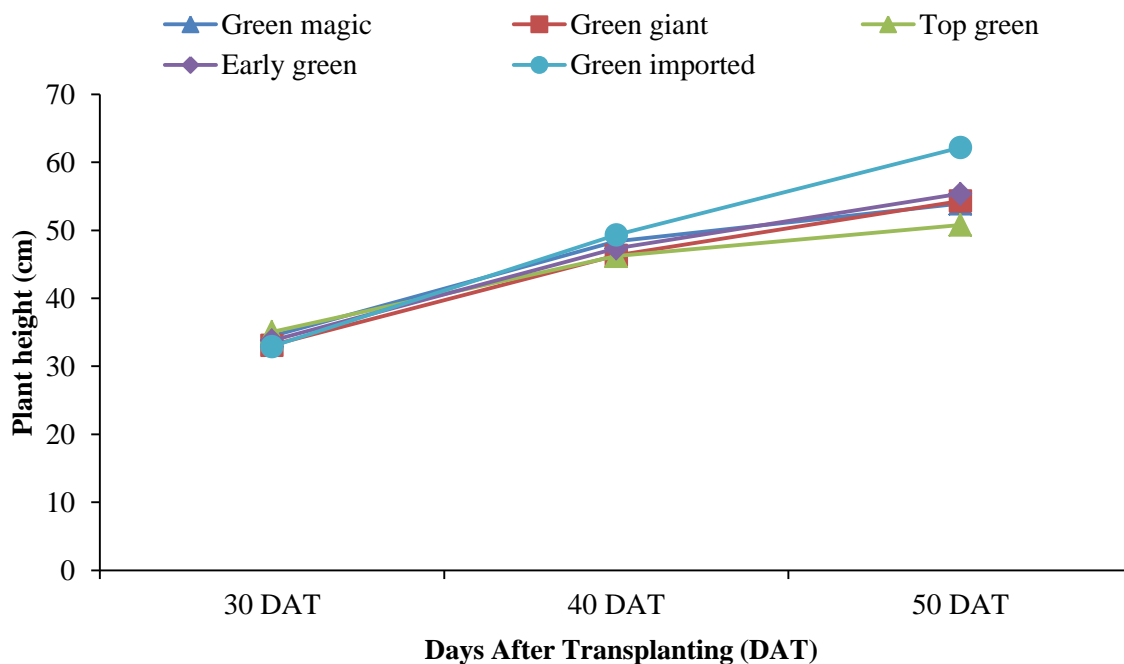


Fig.1. Plant height of broccoli cultivars at different DAT

Number of leaves per plant

Good foliage indicates higher growth, development and productivity of the plant. The number of leaves did not vary significantly at 30 and 40 DAT (Fig. 2), but it varied significantly at 50 DAT. The maximum leaf

number was recorded by Green imported (24.00) followed by Green magic (20.13), and the minimum was in Green Giant. Thapa and Rai (2012) found that the number of leaves per plant varied from 11.33 to 20.20 which were in agreement with the result of the present study.

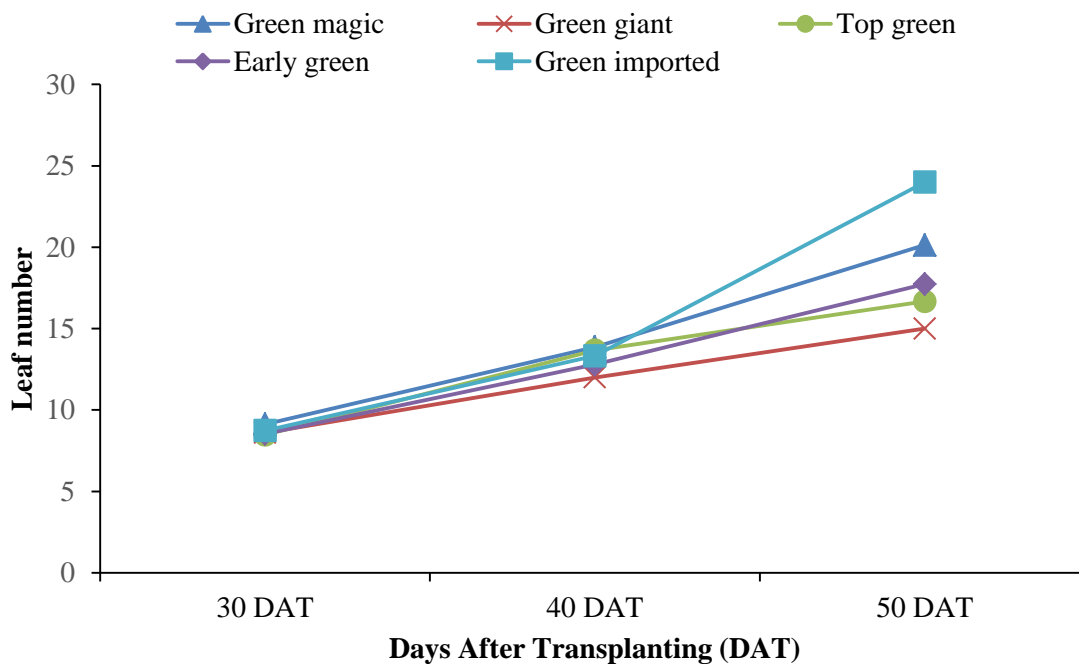


Fig.2. The number of leaves at different DAT

Leaf size

Leaf size differed significantly among the cultivars ranging from 329.3 to 433.4 cm² at 30 DAT (Fig. 3). The maximum (436.6 cm²) was recorded by Top Green which was statistically identical to Green Giant (371.1 cm²) followed by Early Green (343.6 cm²). The lowest leaf size (329.3 cm²) was recorded by Green Imported. Leaf size differed significantly among the cultivars ranging from 589.9 to 771.8 cm² at 40 DAT (Fig. 3). The highest leaf

size (771.8 cm²) was recorded by Green Magic which was statistically identical to Top Green (702.9 cm²). The lowest leaf size (589.9 cm²) was recorded by Green imported which was statistically identical to Early Green (590.2 cm²) and Green Giant (619.6 cm²). Although the largest leaf size was recorded at 50 DAT compared to 30 and 40 DAT, statistically, all are identical, and it ranged from 804.6 to 890.9 cm² (Fig. 3). Roni (2012) found that the leaf size varied from (653.91 to 885.71 cm²).

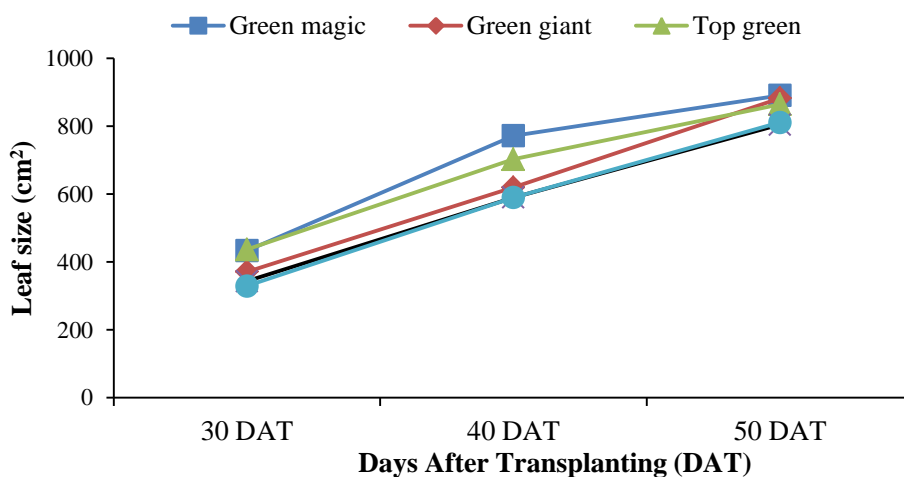


Fig.3. Leaf size of broccoli cultivars at different DAT

Canopy spread of plant

A good spread of plant is directly related to yield. Canopy spread increased gradually with the advance of days (Fig. 4). It did not vary significantly at 30 and 50 DAT. It varied

significantly in 40 DAT. The highest canopy spread (51.33 cm) was recorded from Top Green and the lowest in Early Green (45.47 cm). Roni (2012) observed canopy spread ranges from 54.08 to 67.05 cm.

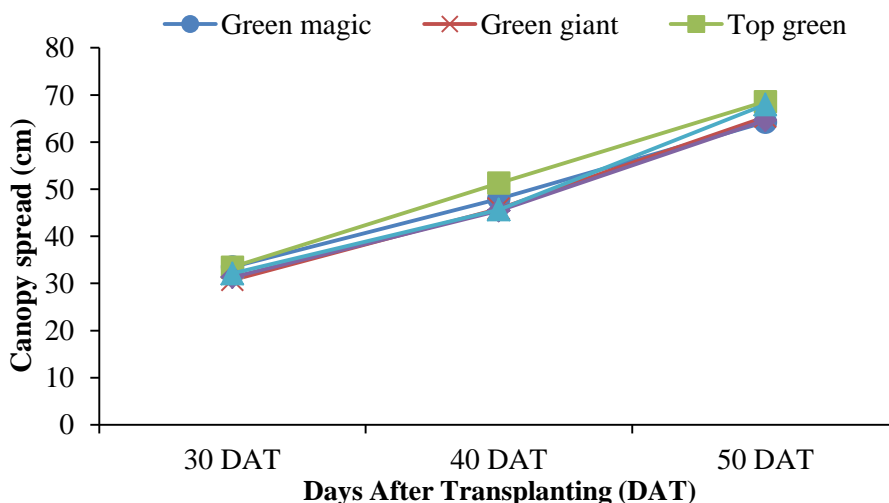


Fig.4. Canopy spread of broccoli cultivar at different DAT

Stem diameter

Stem diameter differed significantly among the cultivars ranging from 12.13 to 14.93 mm (Fig. 5). The maximum stem diameter (15.53 mm) was recorded in Top Green, and the lowest was in Green imported (12.13 mm) at 30 DAT. On 40 DAT, most of the genotypes were statistically identical except Green Imported, which showed the lowest

performance. Whereas, Stem diameter on 50 DAT differed significantly among the cultivars ranging from 18.87 to 26.87 cm. The highest (26.87 mm) stem diameter was recorded by Green Magic. The lowest (18.87 mm) was found in Green imported. Thapa and Rai (2012) found the stem diameter ranging from 33.20 to 37.2 mm of broccoli.

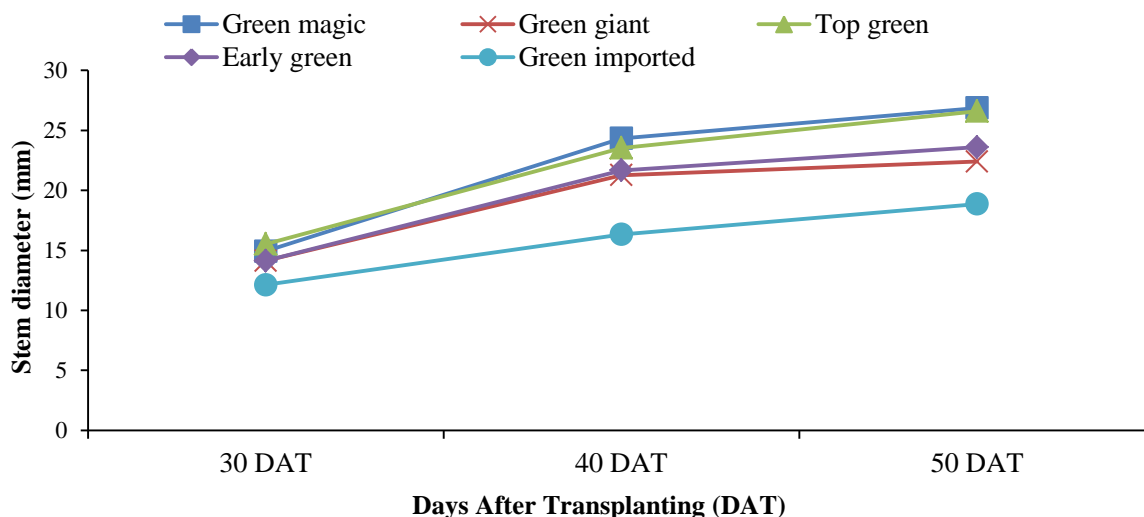


Fig.5. Stem diameter of broccoli cultivar at different DAT

Curd initiation

All cultivars took 38 to 45 days to initiate the first curd (Table 1). Top Green took minimum days for first curd initiation (38.33 days), which was statistically identical to Green Magic (40.33 days) and Green Giant (41.00 days). Early Green took more time (45 days) than others cultivars. Roni (2012) reported that cultivars vary in first curd initiation, which

ranged from 41.67 days to 46.33 days from DAT. Top Green required minimum days (41.33 days) for 50% curd initiation. Green Imported took the maximum time (47.00 days) for 50% curd initiation, which was statistically identical to Early Green (46.67 days). Roni (2012) reported that days to 50% curd initiation varied from 47.33 days to 51.00 days from DAT.

Table 1: Days need to curd initiation of broccoli cultivars

Cultivars	Days to 1 st curd initiation	Days to 50% curd initiation
Green magic	40.33 c	42.33 bc
Green giant	41.00 bc	43.33 b
Top green	38.33 c	41.33 c
Early green	45.00 a	46.67 a
Green imported	43.33 ab	47.00 a
Level of significance	*	**
CV%	6.28	2.55

Means bearing the same letter (s) in a column do not differ significantly at 1 or 5% level of probability by DMRT. ** and * - Significant at 1% and 5% level of probability, respectively

Curd length, diameter and weight

Curd length differed significantly among the cultivar ranging from 17.93 to 13.00 cm (Table 2). The maximum curd length (17.93 cm) was recorded from Green Imported, which was statistically identical to Early Green (15.93 cm), Green Magic (15.37cm) and Green Giant (15.19 cm). The lowest (13.00 cm) was recorded from Top Green. Anonymous (2015) reported that the highest curd length, 14.78 cm, was recorded from the BARI Broccoli 1 as a check variety.

A significant variation in curd diameter was observed among the cultivars (Table 2). Curd diameter was maximum (19.67 cm) in Green Giant, which was statistically similar to all except Green Imported.

Curd weight differed significantly among the cultivars ranging from 336.7 to 601.0 g (Table 2). The maximum card weight (601.0 g) was recorded from Top Green which was statistically identical to Green Magic (544.0 g). The lowest curd weight (365.7 g) was recorded from Green Imported. Thapa and Rai (2012) found the curd weight ranging from 253.33 g to 333.67 g.

Yield

Yield per plant varied significantly among the cultivars ranging from 365.7 g to 650.7 g (Table 2). The maximum card yield (650.7 g) was recorded from Top Green which was

statistically identical to Green Magic (589.0 g) and Green Giant (529.3 g). The lowest curd yield (365.7 g) was recorded from Green Imported. Roni (2012) reported that the yield per plant ranges from 543.81g to 287.02g. Anonymous (2015) found that the highest curd weight was recorded from 349.30 g to 456 g by the BARI Broccoli 1 as a check variety.

Yield per plot differed significantly among the cultivars ranging from 5.85 kg to 10.40 kg (Table 3). The maximum card yield per plot (10.40 kg) was recorded from Top Green which was statistically identical to Green Magic (9.42 kg), followed by Green Giant (8.47 kg) and Early Green (8.24 kg). The lowest curd yield per plot (5.85 kg) was recorded from Green Imported.

Total yield (t/ha) differed significantly among the cultivars ranging from 12.19 to 21.69 (Table 3). The maximum total yield (21.69 t/ha) was recorded from Top Green which was statistically identical to Green Magic (19.63 t/ha) followed by Green Giant (17.64 t/ha) and Early Green (17.18 t/ha). The lowest yield (12.19 t/ha) was recorded from Green Imported. Anonymous (2015) found that the total yield was recorded from this range 11.18 t/ha to 24.68 t/ha by the BARI Broccoli 1 as a check variety. Roni (2012) reported that the total yield ranged from 21.54 t/ha to 11.15 t/ha.

Table 2: Curd length, diameter, weight, yield/plant, yield/plot and yield ton/ha of broccoli cultivars

Cultivars	Curd length (cm)	Curd diameter (cm)	Curd weight (g)	yield/plant (kg)	yield/plot (kg)	Yield (t/ha)
Green magic	15.37 ab	19.53 a	544.0 ab	589.0 ab	9.42 ab	19.63 ab
Green giant	15.19 ab	19.67 a	529.3 b	561.5 ab	8.47 b	17.64 b
Top green	13.00 b	18.87 a	601.0 a	650.7 a	10.40 a	21.69 a
Early green	15.93 a	19.47 a	513.3 b	538.7 b	8.24 b	17.18 b
Green imported	17.93 a	16.20 b	336.7 c	365.7 c	5.85 c	12.19 c
Level of significance	*	**	**	**	**	**
CV%	6.31	2.82	4.83	5.10	5.09	5.10

Means bearing the same letter (s) in a column do not differ significantly at 1 or 5% level of probability by DMRT. ** and * - Significant at 1% and 5% level of probability, respectively

CONCLUSION

Top Green performed the best in terms of individual curd weight and curd yield in ton per hectare among the five genotypes. But the cultivar, Green Magic also gave almost similar

results as Top Green. The findings of this experiment may not be the same for all Agro-ecological zones (AEZ) of Bangladesh due to variation in soil edaphic, topography, weather, climate, etc.

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Conflict of interest

The authors declare no conflict of interest exists.

Author Contributions

Mahmud Hasan Rifat and Md. Shyduzzaman Roni did the field experiments, data collection, analysis and initial drafting of the manuscript. Mohammad Zakaria, Md. Mijanur Rahman Rajib and Md. Ruhul Amin helped to generate the research idea, supervision and follow up the entire research activities.

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