



Performance of Different Varieties of Broccoli (*Brassica oleracea var. italica*) under Prayagraj Agro-climatic Condition

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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

A study entitled "Performance of different varieties of broccoli (*Brassica oleracea var. italica*) under Prayagraj agro-climatic condition" was carried out at crop Vegetable Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (Allahabad), U. P. during academic session 2021-22. The experiment consists of 7 Varieties in 3 replications. The result showed that there were significant differences found among all the varieties. Growth parameters viz. plant height, plant spread, no. of leaves/plant and leaf area were significantly higher in V1(GREEN MAGIC) their respected values are 59.26cm, 65.77cm, 20.33 and 207.33cm² whereas minimum in V7 (WALTHAM) 55.58cm, 63.22cm, 18.11 and 146.55cm² respectively. Yield parameters viz. head diameter, net curd weight, total curd weight, curd yield /plot(kg) and curd yield /hectare (tonnes) were higher in V1(GREEN MAGIC) their respected values are 25.67cm, 517.69grams, 592.49grams, 3.92kg and 21.80tonnes whereas minimum in V7 (WALTHAM) 318.28grams, 375.58grams, 2.58kg and 14.39tonnes respectively. Regarding quality parameters viz. TSS and Vitamin-C Content were significantly

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higher in V1 (GREEN MAGIC) (8.20 ⁰B and 82.12 mg/100 g). And quality parameters of the crop were lower in V7 (WALTHAM). Further, it can be concluded that V1 (GREEN MAGIC) was the best Variety on the basis of growth, yield and quality parameters.

Keywords: Broccoli; plant growth; yield; quality.

1. INTRODUCTION

India has been primarily an Agriculture based economy with an enterprising farming community. The Diverse Agro-climatic conditions it possessed enabled the production of a wide array of horticultural crops. Since the country is endowed with the special gift of nature's varied environment and various seasons, it is possible to grow a variety of vegetables that includes more than a hundred different varieties [1,2]. As the largest private enterprise in India, agriculture contributes more than one-fourth of the national GDP, sustains the livelihood of about two third of the population and is the backbone of the Agro-based industries.

Agriculture has been and will continue to be the lifeline of the Indian economy. Vegetables play a major role in the daily human diet since they are the most important and cheapest source of natural protective foods. They are rich sources of carbohydrates, proteins, fats, minerals and vitamins, which are required for maintaining good health. Vegetables add valuable roughages that prevent constipation. They are also called protective foods [3,4].

Broccoli (*Brassica oleracea* L. var. *italica*) is a cool-season vegetable of the family Brassicaceae. Broccoli is commonly known as Hari Gobi in Hindi. It was a rare Cole crop in India but now it is gaining popularity [5,6]. In the world market about 40 percent is marketed as fresh and remaining 60 percent as frozen. The word broccoli comes from the Italian plural of broccolo, which means "the flower crest of a cabbage", and is the diminutive form of brocco, meaning "small nail" or "sprout". It belongs to the family Cruciferae under order Papaverales. It has a chromosome number of $2n=2x=18$.

Broccoli has been regarded as a uniquely valuable food by Italians since the time of the Roman Empire. Peter Scheemakers introduced broccoli to England from Antwerp in the mid-18th century [7,8]. Broccoli was brought to the United States by Southern Italian immigrants, but it did not become highly popular until the 1920s. In India, the cultivation of broccoli 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. It is classified into two types, heading and sprouting. Sprouting broccoli is more popular in India.

Broccoli is a rich source of vitamins, minerals, proteins etc. It has about 130 times higher content of Vitamin A than cauliflower and 22 times more than cabbage. The nutritive value of broccoli per 100g is moisture 89.3 g, energy 141 kg, carbohydrates 6.64 g, sugar 1.7 g, dietary fiber 2.6 g, fat 0.37 g, protein 2.82 g, calcium 47 mg, iron 0.73 mg, phosphorous 66 mg, thiamine 0.071 mg, riboflavin 0.117 mg, niacin 0.639 mg, vit C 89.2 mg. Broccoli has anticarcinogenic properties and reduces the risk of prostate cancer by up to 45 percent. In, 2005-06, India produced 113.5 million tonnes of vegetables from 7.2 million hectares of land (Anon., 2006a).

However, this production does not meet the requirements of 285 g of vegetables per capita per day. Thus, with the large vegetarian population, the production of vegetables in India needs to be greatly increased. Though the Central and State Governments have taken some steps for increasing the production of vegetable crops, it needs a further boost from the research activities.

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 7 Broccoli Varieties with 3 replications which makes it a total of 21 plots. The transplanting of seedlings was accomplished on the first 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 2 m x 2 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. 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: Plant height (cm), Number of leaves per plant, Plant spread (cm). Second are the yield related parameters: head diameter (cm), net curd weight (g), total curd weight (g), curd yield per plot (kg), curd yield per hectare (tonnes) And last are the qualitative characters: Total Soluble Solid (T.S.S) and Vitamin C content in head (mg/100g of fresh broccoli head).

3. RESULTS AND DISCUSSION

The result of the investigation based on the various observations viz., Plant growth, Yield and quality of different varieties of Broccoli (*Brassica oleracea var. italica*) are presented and to determine best performing variety of broccoli in terms of growth, yield, and quality.

3.1 Growth Attributes (Table 1)

Plant Height (cm)

The Maximum Plant height at 25 DAT (9.77 cm), 50 DAT (28.82 cm) and 75 DAT (59.26 cm) was recorded in the variety GREEN MAGIC and the

minimum Plant height at 25 DAT (8.54 cm), 50 DAT (25.72 cm) and 75 DAT (55.58 cm) was found for the Variety WALTHAM. These findings are in close conformity with that of Chaudari et al., [9] in Knol-khol, Hafiz et al. [10], and Islam et al., (2015) in broccoli.

Plant Spread (cm)

The Maximum Plant spread at 25 DAT (35.00 cm), 50 DAT (45.66 cm) and 75 DAT (65.77 cm) was recorded in the variety GREEN MAGIC and the minimum Plant spread at 25 DAT (33.00 cm), 50 DAT (44.11 cm) and 75 DAT (63.22 cm) was recorded in WALTHAM.

No. of Leaves

The Maximum No. of leaves at 25 DAT (7.33), 50 DAT (13.11) and 75 DAT (20.33) was recorded in GREEN MAGIC and the minimum No. of leaves at 25 DAT (5.00), 50 DAT (10.89) and 75 DAT (18.11) was recorded in the variety WALTHAM. These findings are in close accordance with the findings of El- Magd et al., [11], El Magd et al., Thapa and Rai in broccoli.

Leaf area (cm²)

The Maximum Leaf area at 25 DAT (7.66), 50 DAT (124.33) and 75 DAT (207.33) was recorded in the variety GREEN MAGIC and the minimum Leaf area at 25 DAT (6.44), 50 DAT (95.55) and 75 DAT (146.55) was recorded in the variety WALTHAM.

3.2 Yield Attributes (Table 2)

The following findings are in conformity with the results, El-Bassiony et al.[12], in knol-khol, Bhangre et al., [13] in broccoli, Moniruzzaman (2011) in cabbage, Thapa and Rai of broccoli, Uddain et al., (2012) in knol-khol, Thapa et al., Chandan et al., (2013) in broccoli, El-Magd [14], Giri et al., [15], Nooprom et al, (2013), Nguille et al., Singh et al. [16], and Islam et al., (2015) and Thakur et al. [17], in Broccoli.

Chart 1. Variety details

Varietal Notation	Varieties	Source
V ₁	GREEN MAGIC	SAKATA
V ₂	SAKI	SAKATA
V ₃	LUCKY	BEJO SEEDS
V ₄	PARAISO	TAKII SEED
V ₅	MATSURI	TOKITA SEEDS
V ₆	TSX-0788	TOKITA SEEDS
V ₇	WALTHAM	RICHGROW SEEDS

Table 1. Growth Attributes Plant Height (cm), Plant Spread (cm), No. of Leaves/Plant and Leaf Area (cm²) of Different Broccoli Varieties

S.NO	VARIETIES	Plant Height (cm)			Plant Spread (cm)			No. of Leaves/Plant			Leaf Area (cm ²)		
		25 DAT	50 DAT	75 DAT	25 DAT	50 DAT	75 DAT	25 DAT	50 DAT	75 DAT	25 DAT	50 DAT	75 DAT
V1	GREEN MAGIC	9.77	28.82	59.26	35.00	45.66	65.77	7.33	13.11	20.33	7.66	124.33	207.33
V2	SAKI	8.94	25.61	57.45	34.00	44.66	64.33	6.11	11.89	19.11	6.91	115.33	171.77
V3	LUCKY	9.19	27.40	58.01	34.33	45.00	64.77	6.55	12.22	19.55	7.23	117.77	180.88
V4	PARAISO	8.77	26.35	56.90	33.66	44.11	64.00	5.77	11.55	18.77	6.72	104.88	157.55
V5	MATSURI	8.66	26.03	56.43	33.33	44.33	63.66	5.33	11.22	18.44	6.60	98.11	152.77
V6	TSX-0788	9.47	28.03	58.70	34.66	45.33	65.22	6.88	12.55	19.88	7.53	123.33	205.66
V7	WALTHAM	8.54	25.72	55.58	33.00	43.77	63.22	5.00	10.89	18.11	6.44	95.55	146.55
F-TEST		S	S	S	S	S	S	S	S	S	S	S	S
SE.d (±)		0.11	0.62	0.22	0.00	0.28	0.19	0.13	0.06	0.12	0.13	1.12	2.60
CD (5%)		3.00	1.36	3.00	0.01	0.62	0.21	0.28	0.13	0.27	0.29	2.43	5.67
CV		1.48	2.85	0.46	0.01	0.78	0.19	2.57	0.61	0.79	2.33	1.23	1.82

Table 2. Yield Attributes Head Diameter (cm), Net Curd Weight (g), Total Curd Weight(g), Curd Yield/Plot (kg) and Curd Yield/Hectare(t) of Different Broccoli Varieties

S.NO	VARIETIES	Head Diameter (cm)	Net Curd Weight(g)	Total Curd Weight(g)	Curd Yield/Plot (kg)	Curd Yield/Hectare(t)
V1	GREEN MAGIC	25.67	517.69	592.49	3.92	21.80
V2	SAKI	21.33	417.02	416.02	3.18	17.68
V3	LUCKY	22.70	466.09	522.34	3.34	18.58
V4	PARAISO	21.13	407.15	459.26	2.82	15.73
V5	MATSURI	20.67	386.98	433.82	2.65	14.76
V6	TSX-0788	24.70	499.15	562.98	3.46	19.25
V7	WALTHAM	19.70	318.28	375.58	2.58	14.39
F-TEST		S	S	S	S	S
SE.d (±)		0.92	8.43	9.18	0.03	0.18
CD (5%)		2.01	18.37	19.99	0.07	0.40
CV		5.08	2.40	2.31	1.31	1.29

Table 3. Quality attributes total soluble solids ($^{\circ}$ Brix) and Vitamin-C Content (mg/100g) of different broccoli varieties

S.NO	VARIETIES	Total Soluble Solids ($^{\circ}$ Brix)	Vitamin-C Content (mg/100g)
V1	GREEN MAGIC	8.20	82.12
V2	SAKI	7.43	70.61
V3	LUCKY	7.67	71.34
V4	PARAISO	7.13	62.74
V5	MATSURI	6.37	61.85
V6	TSX-0788	7.83	74.77
V7	WALTHAM	6.03	59.34
F-TEST		S	S
SE.d (\pm)		0.17	1.38
CD (5%)		0.36	3.00
CV		2.81	2.45

**Fig. 1. Main Field****Fig. 2. Closure View of Broccoli****Head Diameter (cm)**

The Maximum Head Diameter (25.33cm) was recorded in the variety GREEN MAGIC and the Minimum Head Diameter (19.70cm) was recorded in WALTHAM.

Net Curd Weight (g)

The Maximum Net Curd Weight (3517.69 g) was recorded in the variety GREEN MAGIC. The Minimum Net Curd Weight (318.28 g) was recorded in the variety WALTHAM.

Total Curd Weight (g)

The Maximum Total Curd Weight (592.49 Grams) was recorded in the variety GREEN MAGIC, and the minimum Total Curd Weight (375.58 Grams) was recorded in the variety WALTHAM.

Curd Yield Per Plot (kg)

The Maximum Curd Yield per Plot (3.92 Kilo Grams) was recorded in the variety GREEN

MAGIC and the Minimum Curd Yield Per Plot (2.58 Kilo Grams) was recorded in the variety WALTHAM.

Curd Yield Per Hectare (t)

The Maximum Curd Yield Per Hectare (21.80 Tonnes) was recorded in the variety GREEN MAGIC and the Minimum Curd Yield Per Hectare (14.39 Tonnes) was recorded in WALTHAM.

3.3 Quality Attributes (Table. 3)**TSS ($^{\circ}$ B) (Total Soluble Solids)**

The highest TSS (8.20 Brix) was recorded in the variety GREEN MAGIC. While the lowest TSS (6.03 Brix) recorded in WALTHAM.

Vitamin C content (mg/100gm)

Vitamin C content (mg/100gm), the maximum (82.12) was recorded in the variety GREEN MAGIC. While the minimum (59.34) was recorded in WALTHAM.

4. CONCLUSION

On the basis of the present investigation entitled, "Performance of different Varieties of Broccoli (*Brassica oleracea* var. *italica*) under Prayagraj Agroclimatic condition" it is concluded that the variety (GREEN MAGIC) recorded superior performance for growth, yield and quality parameters. However, numerically V1 showed superior performance for growth, yield and quality parameters.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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