PERFORMANCE OF DIFFERENT VARIETIES OF BROCCOLI (*Brassica oleracea var. italica*) UNDER PRAYAGRAJ AGRO-CLIMATIC CONDITION

Abstract

A study entitled **"PERFORMANCE OF DIFFERENT VARIETIES OF BROCCOLI (*Brassica oleracea var. italica*) UNDER PRAYAGRAJ AGRO-CLIMATIC CONDITION"** was carried out 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. 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 was 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 significantly higher in V1(GREEN MAGIC) (8.20 ^{0}B 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.

Key words: 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 wide array of horticultural crops. The country being blessed with the unique gift of nature of diverse climate and distinct seasons, it makes it possible to grow an array of vegetables whose number exceeds more than a hundred types. As the largest private enterprise in India, agriculture contributes more than one fourth of the national GDP, sustains 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 daily human diet since they are most important and cheapest source of natural protective foods. They are the rich sources of carbohydrates, proteins, fats, minerals and vitamins, which are required for maintaining the good health. Vegetables add valuable roughages that prevent constipation. They are also called protective foods.

Broccoli (Brassica oleracea L. var. italica) is a cool season vegetable of family Brassicaceae. Broccoli commonly known as Hari Gobi in Hindi. It was a rare Cole crop in India but now it is gaining popularity. 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 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.

Since the time of the Roman Empire, broccoli has been considered a uniquely valuable food among Italians. Broccoli was brought to England from Antwerp in the mid-18th century by Peter Scheemakers. Broccoli was first introduced to the United States by Southern Italian immigrants [1], but did not become widely 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 fibber 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 [2]. Broccoli has anticarcinogenic properties and reduce 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 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).

List 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

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 discussed in this chapter under appropriate headings and sub headings. The DAT given in the table are the mean values and have been statistically analyzed.

The experimental findings on different aspects are integrated and presented in tables along with suitable/scientific illustrations.

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 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.

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 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 minimum No. of leaves at 25 DAT (5.00), 50 DAT (10.89) and 75 DAT (18.11) was recorded in the variety WALTHAM.

Leaf area (cm^2)

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 minimum Leaf area at 25 DAT (6.44), 50 DAT (95.55) and 75 DAT (146.55) was recorded in the variety WALTHAM.

3.5. Yield Attributes (Table. 2)

Head Diameter (cm)

Maximum Head Diameter (25.33cm) was recorded in the variety GREEN MAGIC and 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. Minimum Net Curd Weight (318.28 g) was recorded in the variety WALTHAM.

Total Curd Weight (g)

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

Curd Yield Per Plot (kg)

Maximum Curd Yield Per Plot (3.92 Kilo Grams) was recorded in the variety GREEN MAGIC and Minimum Curd Yield Per Plot (2.58 Kilo Grams) was recorded in the variety WALTHAM.

Curd Yield Per Hectare (t)

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

3.10. Quality Attributes (Table. 3)

TSS (ºB)

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.

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 (cm²)		
		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	44.33	64.00	5.77	11.55	18.77	6.72	104.88	157.55
V5	MATSURI	8.66	26.03	56.43	33.33	43.77	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**	**44.11**	**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**	**416.02**	**3.92**	**21.80**
V2	SAKI	21.33	417.02	522.34	3.18	17.68
V3	LUCKY	22.70	466.09	459.26	3.34	18.58
V4	PARAISO	21.13	407.15	433.82	2.82	15.73
V5	MATSURI	20.67	386.98	562.98	2.65	14.76
V6	TSX-0788	24.70	499.15	375.58	3.46	19.25
V7	WALTHAM	**19.70**	**318.28**	**416.02**	**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 (ºBrix) and Vitamin-C Content (mg/100g) of Different Broccoli Varieties

S.NO	VARIETIES	Total Soluble Solids (ºBrix)	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 (±)	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

4. CONCLUSION

On the basis of 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.

In the Economics, GREEN MAGIC again turns out to be highest in terms of gross returns (Rs. 5,45,000/ Ha) and net return (Rs. 4,40,800/ha). The highest benefit cost ratio was also seen in the Variety GREEN MAGIC (4.23) under Prayagraj Agro-climatic Condition.

5. REFERENCES

Afzal. S., Sher, M. and Hafiz, D. 2003. Performance of exotic cultivars of broccoli under the agro-climatic conditions of Mingora (North), Swat. Sarhad J. Agric. 19 (2): 189- 191.

Arjona, D. H. and Greig. J. 1984. Study of the effect of four planting distances and four levels of nitrogen fertilization on yields, chlorophyll content and nitrate reeducate activity in broccoli. Agronomia Columbiana. 2 (1-2): 71-81.

Bhangre, K.K., Sonawane, P. C and Warade, S. D. (2011). Effect of different varieties and spacing on growth and yield parameters of broccoli (*Brassica oleracea var. italica*) under Pune conditions, Asian Journal of Int.J.Curr.Microbiol.App.Sci (2018) 7(6): 690-698 697 Horticulture. 6(1): 74-76.

Bhattacharjee, A. K., Husain, A. and Siddique, M. A. 1972. A study on the performance of five cauliflower varieties as a basis for selection under Bangladesh conditions. South Indian Hort. 20 (1-4): 50-54.

Chandan, K., Raturi, H. C. and Uniyal, S.P. (2013). Performance of cabbage hybrids under rainfed mid-hill conditions of Uttarakhand. The Asian Journal of Horticulture. 8(1): 110-113.

Chaudari, A. H., Vadodaria, J. R., Patel, H. T. and Patel, G. S. (2015). Performance of different varieties and planting data on growth of Khol-knol (*Brassica oleracea var. gongylodes*). IMPACT: International Journal of Research in Applied, Natural and Social Sciences. 3(8): 39-42.

Dev, H. (2012) Standardization of planting time and spacing in broccoli cv Green Head for lower hills of northern India. International Journal of Farm Science. 2: 36-42.

El-Bassiony, A. M., Fawzy, Z. F., El-Nemr, M. A. and Yunsheng, L. (2014). Improvement of growth, yield and quality of two varieties of khol-rabi plants as affected by application of some bio-stimulants. Middle East Journal of Agriculture Research. 3(3): 491-498.

El-Magd, M. M. (2013). Evaluation of some broccoli cultivars on growth, head yield and quality under different planting dates. Journal of Applied Sciences Research. 9(11): 5730-5736.

El-Magd, M. M. A., El-Bassiony, A.M. and Fawzy, Z.F. (2006). Effect of organic manure with or without chemical fertilizers on growth, yield and quality of some varieties of broccoli plants. Journal of Applied Science Research. 2(10): 791- 798.

Giri, R. K., Sharma, M. D., Shakya, S. M., GC, Y. D. and Kandel, T.P. (2013). Growth and yield response of broccoli cultivars to different rates of nitrogen in western chitwan, Nepal. Agriculture Science. 4 (7A): 8-12.

Gogoi, S., Millu, R., Das, P., Bora, N. and Das, B. K. (2016). Effect of sowing dates and spacing on broccoli (*Brassica oleracea var. italica*) seed production. Indian Journal of Agricultural Research. 50(4): 350-353.

Hafiz, M. A., Biswas, A., Zakaria, M., Hassan, J. and Ivy, N.A. (2015). Effect of planting dates on the yield of broccoli genotypes. Bangladesh Journal of Agriculture Research. 40(3): 465-478.**Jeffery, 2005.** Maximizing the anti-cancer power of broccoli. Science daily, 5th, April, 2005. www.sciencedaily.com/ releases/2005/03/050326114810.htm.

Kumar, R., Singh, R.P. and Pal, Y. (2012). Yield and Quality of Brassica species as influenced by different dates of sowing and varieties. Pantnagar Journal of Research. 6(1): 112-115.

Kumar, N., Praskash, V. and Srivastva, A.K. (2007). Effect of transplanting dates and geometries on broccoli (*Brassica oleracea var. italica*) under mid hill conditions of North- West Himalaya. Indian Journal of Agricultural sciences. 77 (7): 448-450.

Moniruzzaman. M. (2011). Effect of plant spacings on the performance of hybrid cabbage (*Brassica oleracea var. capitata*) varieties. Bangladesh Journal of Agriculture Research. 36(3): 495-506.

Ngullie, R. and Biswas, P.K. (2014). Performance of different varieties of broccoli under rainfed mid-hill conditions of Mokokchung district of Nagaland. International Journal of Farm Science. 4(2): 76-79.

Nooprom, K. and Santiprachi, Q. (2013). Effects of planting dates and varieties on growth and yield of broccoli during rainy season. American Journal of Agricultural and Biological Sciences. 8(4): 37-361.

Patel, D.M. (2015). Varietal evaluation of vegetable cowpea (*Vigna unguiculata* L.) Walp.]. under North Gujarat condition. Unpublished M.Sc. (Veg.) Thesis submitted to S. D. Agricultural University, Sardarkrushinagar.

Ramos, N. L. G. and Loria, M. W. 1975. Planting distances and varieties of broccoli in the Juan Vinas area. Boletin Tecnico Faculdad de Agronomia Universidad de Costa Rica. 8 (4): pp. 15.

Sharma, A., Sonia, S., Sharma, J.J. and Kumar, R. (2005). Effect of Planting date, plant density and fertilizer levels on sprouts yield and yield attributing characters of brussels sprout (*Brassica oleracea var. gemmifera*) under high hill dry temperate conditions of north- west Himalayas. Indian Journal of Agricultural Science. 75 (5): 292-293.

Sharma, S. (1998). Varietal response of cabbage (*Brassica oleracea var. capitata* L.) to planting dates and plant population during summer season. M.sc (thesis), Himachal Pradesh, KVK, Palampur.

Singh, R., Chaursasia, S. N. S and Singh, S. N. (2006). Response of nutrient sources and spacing on growth and yield of broccoli (*Brassica oleracea var. italica*). Vegetable science. 33: 198-200.

Singh, R., Kumar, S. and Sanjay Kumar. (2014). Performance and preference of broccoli varieties grown under low-hill conditions of Himachal Pradesh. Indian Research Journal. 14(1): 112-114.

Thakor, D.P. (2008). Influences of different cultivars and plant spacing on growth, yield and quality of garden pea. Unpublished M.Sc. (Agri.) Thesis, submitted to Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar.

Thakur, S., Thakur, R. and Mehtha, D. K. (2016). Evaluation of different genotypes of broccoli in dry temperate conditions of Kinnur district of Himachal Pradesh in India. International Journal of science, Environment and Technology. 5(3): 1673- 1679.

Tejaswini, T., L.R. Varma, P. Verma, R.I. Prajapathi and Vani, F.B. 2018. Performance of Different Varieties with Respect to Growth, Yield and Quality of Broccoli (Brassica oleracea var. italica L.) under North Gujarat Conditions. Int.J.Curr.Microbiol.App.Sci. 7(06): 690-698.

Yadav, M., Prasad, V. M. and Ahirwar, C.S. (2013). Varietal evolution of cauliflower (*Brassica oleracea var. botrytis* L.) in Allahabad Agro-climate condition. Trends in biological science. 6(1): 99-100.