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Research Article

Performance of Broccoli (*Brassica oleracea* var. *italica* L.) genotypes under high altitude Tribal zone of Andhra Pradesh

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Abstract

The agro-ecological conditions of the Eastern Ghats region of Andhra Pradesh with the modest temperatures, high rainfall, and rich soil organic carbon provide immense opportunity for the farming of non-traditional high-value crops like broccoli. By considering the favorable climatic conditions available in the Eastern Ghats region of Andhra Pradesh, an experiment on evaluation of different broccoli varieties was taken up to introduce the high-value broccoli crop as well as to suggest a suitable variety for doubling the farmer's income of tribal zone. The present experiment was conducted at Horticultural Research Station, Dr. YSR Horticultural University, Chintapalle during 2017-18 to 2019-20 with nine genotypes in Randomized Block Design in three replications to assess the performance of growth and yield parameters of broccoli genotypes. Among the different genotypes, Palam Vichitra recorded more plant height (63.94 cm) followed by Palam Kanchan (63.29 cm). The leaf length was found to be maximum in Palam Kanchan (51.09 cm) whereas the maximum leaf width was recorded in F1 Festival (16.48 cm). The maximum head diameter was observed in Pusa Samridhi (18.11 cm). The maximum head weight per plant (422.68 g) and yield per hectare (191.72 q) was recorded in the var. Saki. So, Saki variety can be recommended for cultivation at high altitudes and tribal areas of the Eastern Ghat region of Andhra Pradesh to double the tribal farmer's income.

Keywords Eastern ghat region, evaluation, nontraditional area, yield

Introduction

Broccoli (*Brassica oleracea* var. *italica* L.) belongs to the family Brassicaceae, originated from Western Europe, and is considered a cool-season crop, which has now been distributed to both tropical and subtropical areas. Cauliflower, cabbage, and kale are also members of the same family [1]. Its optimum growing temperature is in the range of 160 to 200 C and is a biannual, herbaceous vegetable crop [2]. The United States of America is a leading producer of broccoli. In India, broccoli has become a commercial crop very recently and is grown in a smaller areas. Cultivation of sprouting broccoli is now gaining popularity among Indian growers for the last couple of years apparently due to increasing awareness of its nutritional value.

The nutritional value of broccoli is highly different from cabbage and cauliflower in protein (3.6%), carbohydrate (5.9%), vitamin A (9000 I.U.), fat (0.3%), calcium (2-16%), and iron (684 ppm). This nutritious vegetable crop also contains an active metabolite called indole-3-carbinol, which is believed to possess anti-cancerous properties [3]. It is reasonably rich in carotene,

Table 1. Source of seed material collected

Genotype Name	Source of Seed material
Palam Kanchan	Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur
F1 Festival	Private source
Palam Samradhi	Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur
Oynasty	Private source
Pusa Samradhi	Indian Agriculture Research Institute, Katrain, Himachal Pradesh
Saki	Sakata Company
Palam Vichtira	Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur
NSC 105 B	Collected from Leaf Organization, Ooty
Pusa KTS 1	Indian Agriculture Research Institute, Katrain, Himachal Pradesh

ascorbic acid and also contains appreciable quantities of thiamin, riboflavin, niacin, and iron. The agro-ecological conditions of the Eastern Ghats region in Andhra Pradesh with an average annual rainfall of 1350 mm, maximum temperature range from 17 to 35ºC, minimum temperature differs from 3 to 24ºC, and is located at an altitude of 300-1350 m above Mean Sea Level [4]. These conditions are suitable for the cultivation of temperate vegetable crops, especially broccoli. The soils in this region contain high organic carbon that offers immense opportunity for the organic cultivation of different horticultural crops. So far no attempt has been made on the assessment of broccoli genotypes under the Eastern Ghats region conditions of Andhra Pradesh. However, several efforts have been made to assess the performance of available genotypes with considerable variability about morphological and yield characters in different environmental conditions [5-6].

The performance of a crop or variety is mainly based upon its genetic makeup. In addition, the performance of the crop also relies on prevailing climatic conditions under which the crop or variety is grown. As a result, genotypes that perform well in one zone might not perform well in other zones of varying climates. Hence, it is necessary to bring together and evaluate all the available genotypes to select an appropriate and high-yielding cultivar or genotype for a particular agro-climatic condition. Because of the nutritional importance of broccoli, prevailing suitable agro-climatic conditions, and also due to very high market price and export demand, research on this crop is highly essential to find out the suitability of various genotypes for a particular region [5].

By considering the favorable climatic conditions available in the Eastern Ghats region of Andhra Pradesh, an experiment on evaluation of different broccoli varieties was taken up at Horticultural Research Station, Dr. Y.S.R. Horticultural University, Chintapalle to introduce the high-value broccoli crop as well as to suggest a suitable variety for doubling the farmer's income of tribal zone.

Methodology

A field experiment was carried out at Horticultural Research Station, Dr. YSR Horticultural University, Chintapalle during Rabi 2017-18, 2018-19, and 2019-20 to select suitable broccoli genotypes to cultivate under the Eastern Ghats region of Andhra Pradesh. The experimental site is located at an altitude of 933 m above MSL and the geographical coordinates are 170.13′ N latitude and 840.33′ E longitude. The soil condition of the experimental field was well-drained loamy soils. The experiment was conducted in a randomized block design with nine genotypes viz. Palam Kanchan, F1 Festival, Palam Samradhi, Oynasty, Pusa Samradhi, Saki, Palam Vichtira, NSC 105B and Pusa KTS-1 (Table 1) in three replications in a plot size of 1.8 m x 2.7 m. The broccoli seedlings were planted in at a spacing of 45cm x 45 cm to accommodate twenty-four plants per plot. Incorporated FYM @20 t/ha, phosphorus @80 kg/ha, potassium @100 kg/ha during last ploughing, and 60 kg nitrogen in three split doses during 25 days, 50 days, and 70 days after transplanting. Need-based irrigations depend on soil moisture and plant protection measures were followed

Table 2. Information of weather parameters during the cropping period

Month	Rainfall			Maximum Temperature			Minimum Temperature		
	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20
October	28.8	31.2	227.9	27.13	29.4	29.90	17.10	12.3	19.40
November	46.0	16.5	33.00	28.30	28.4	29.10	11.12	10.8	11.80
December	0.0	111.1	0.00	27.76	25.9	28.10	10.10	11.0	13.20
January	0.0	1.0	5.5	26.66	26.9	28.10	9.84	8.1	13.40
Total/Avg.	**74.8**	**159.8**	**266.4**	**27.46**	**27.65**	**28.80**	**12.04**	**10.55**	**14.45**

to control abiotic and biotic stresses. Weather parameters during the crop growing period were mentioned in Table 2. Observations Viz., plant height, leaf length, leaf width, days to 50% head initiation, head weight, head diameter, and yield per hectare were recorded from 5 plants selected at random in each treatment in each replication on growth and yield parameters and the pooled replicated mean values of each character was used for statistical analysis as per the method given by Panse and Shukhatme [7].

Results and Discussion

Three years of pooled data (2017-17 to 2020-21) on the performance of diverse varieties of broccoli revealed that there is a significant variation for all growth and yield parameters except for leaf width (Table 3). The variety Palam Vichitra recorded maximum plant height (63.94 cm) followed by Palam Kanchan (63.29 cm). Low plant height was recorded in the var. Palam Samradhi (42.19 cm). The variation in diverse genotypes for plant height might be because of their genetic makeup and expression in particular environmental conditions. Similar variability was observed for plant height by [6] in 17 broccoli genotypes, among them, Frualora recorded the maximum plant height (61.33 cm); Green calabrese (53.7 cm) produced the tallest plant [8] among the five genotypes, while [9] reported that Palam Samridhi recorded the maximum plant height (58.4 cm) when compared to other genotypes.

Table 3. Performance of different broccoli genotypes for growth and yield over the years

Treatments	Plant height (cm)	Leaf length (cm)	Leaf width (cm)	Days to 50% head initiation	Head weight (g)	Head Diameter (cm)	Yield/ha (q)
Palam Kanchan	63.29	51.09	15.25	70.00	357.54	11.84	151.75
F1 Festival	46.43	41.96	16.48	63.94	291.50	16.91	138.76
Palam Samradhi	42.19	36.10	14.83	83.22	335.46	13.59	154.28
Oynasty	49.34	41.27	14.04	68.67	365.55	14.06	160.79
Pusa Samradhi	45.29	42.14	14.93	78.56	264.00	18.11	110.76
Saki	54.36	43.51	15.55	79.00	422.68	12.27	191.72
Palam Vichtira	63.94	45.10	15.49	90.78	381.72	12.29	166.34
NSC 105 B	51.28	42.56	13.88	67.56	405.48	17.49	180.90
Pusa KTS 1	51.51	39.44	14.22	63.11	304.26	12.97	123.99
CD (5%)	**3.55**	**4.13**	**NS**	**2.81**	**36.85**	**0.68**	**3.69**
Se(m)±	**1.17**	**1.36**	**0.54**	**0.93**	**12.19**	**0.23**	**1.22**

The maximum leaf length was recorded in Palam Kanchan (51.09 cm) followed by Palam Vichitra (45.10 cm) and the least was observed in the Palam Samradhi (36.10 cm). The maximum leaf width was noticed in F1 Festival (16.48 cm) followed by Saki (15.55 cm) whereas the lowest leaf width was recorded

with Oynasty (14.04 cm). From the perusal of data given in table 3, it was observed that a significant minimum number of days for 50 % head initiation was recorded with treatment Pusa KTS-1 (63.11) followed by F1 Festival (63.94), and the maximum number of days were taken by Palam Vichtira (90.78). This similarity and dissimilarity among the genotypes for the number of days taken for head initiation may be attributed to the variability in their genetic configuration along with the suitability of the climatic conditions of a particular zone. These results are in agreement with the conclusions of [5, 6, 10, 11, 12] in broccoli.

The highest head diameter was recorded in Pusa Samridhi (18.11 cm) followed by NSC105 B (17.49 cm) and the least was recorded in Palam Kanchan (11.84 cm). The maximum head weight per plant (422.68g); head yield hectare-1 (191.72 q) were recorded in genotype Saki followed by NSC 105 B (405.48 g and 180.90 q respectively) and the lowest yield was noticed with var. Pusa Samradhi (110.76 q/ha). The maximum head weight per plant and hectare might be due to the result from the compact head. Similar differences are found for head weight per plant (375g, 523.33g, 154.8g respectively), head yield per hectare (145.47 q, 175q, 70.75q respectively) by [5, 6, 13] among the different broccoli genotypes at various climatic conditions while in cabbage K- K Cross (73.32 t/ha) recorded the highest head yield followed by Southern Treasure (71.71 t/ha) by Moniruzzaman [14] and by El-Bassiony et al., [15]. These significant differences for head diameter and head yield hectare-1 among diverse genotypes might be due to the own-genetic makeup of the genotypes and their suitability to the environmental conditions of this High Altitude Tribal zone.

Conclusion

From this study, it could be concluded that the broccoli variety Saki can be recommended for further extensive cultivation at high altitude and tribal areas of the Eastern Ghat region of Andhra Pradesh duly creating the marketing competence in this zone to double the tribal farmer's income.

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