



Research Article

PERFORMANCE OF SOME KIWIFRUIT (*Actinidia deliciosa*) CULTIVARS UNDER HILL AGRO-CLIMATIC CONDITIONS OF WEST BENGAL

THAPA A.D.¹, SARKAR R.K.^{2*}, GURUNG S.³ AND BARMA P.⁴

^{1,4}Darjeeling Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, Kalimpong, Darjeeling, 734301, West Bengal, India

²Regional Research Station (TZ), Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, 736165, West Bengal, India

³Regional Research Station (HZ), Uttar Banga Krishi Viswavidyalaya, Kalimpong, Darjeeling, 734301, West Bengal, India

*Corresponding Author: Email - sarkar_ram@rediffmail.com

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Abstract: A field investigation on behaviour of kiwifruit (*Actinidia deliciosa* Chev.) cultivars viz., Hayward, Allison, Bruno and Monty were carried out during 2018-19, 2019-20 and 2020-21 in a randomized block design with six replications under hilly agro-climatic conditions of West Bengal. The results of all the yield and quality parameters showed highly significant differences in kiwifruit cultivars in all three years and also in pooled data. The maximum fruit length (5.88 cm) was recorded in Hayward which was closely followed by Allison (5.62 cm), while fruit diameter was maximum in Bruno (4.07 cm) followed by Monty (3.95 cm). The fruit length/diameter ratio was recorded maximum in Hayward (1.72) followed by Allison (1.66) cultivar. The highest average fruit weight (79.80 g) was measured in Hayward followed by Allison (69.07 g) and minimum in Monty (55.13 g). But the highest fruit yield per plant (6.58, 12.44, 20.08 & 13.03 kg in 2018-19, 2019-20, 2020-21 & pooled, respectively) was observed in Allison followed by Hayward (5.54, 11.74, 18.36 & 11.88 kg in 2018-19, 2019-20, 2020-21 & pooled, respectively), whereas, the lowest fruit yield per plant was registered in cultivar Monty (4.27, 5.36, 8.74 & 6.12 kg in 2018-19, 2019-20, 2020-21 & pooled, respectively). The average total soluble solid (TSS) was recorded maximum in Hayward (11.72 °Brix) followed by Allison (9.96 °Brix) and the least in Bruno (7.67 °Brix). While, average titratable acidity percentage was recorded maximum in Allison (0.92%) and minimum was in Monty (0.55%). Therefore, two kiwifruit cultivars, Allison and Hayward were found suitable for cultivation with respect to yield and quality characters in hill agro-climatic conditions of West Bengal.

Keywords: Kiwifruit, Cultivars, Growth, Yield, Quality

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Introduction

The kiwifruit (*Actinidia deliciosa*), also known as Chinese Gooseberry is a deciduous fruiting vine native to Yangtze river valley of South and Central China. Kiwifruit is known as "China's miracle fruit" and "Horticulture wonder of New Zealand". Kiwifruit vine actually originated in China, but its full economic potential was exploited in the New Zealand which accounts for over 70 percent of world wide trade. Its cultivation picked up momentum in other countries from the 1960 onwards and now a commercialized on large scale in USA, Italy, China, Japan, France, Germany and Australia. The kiwifruit is a subtropical fruit that belongs to the family Actinidiaceae and it has spread from China to the other parts of the world rapidly [1]. The most important commercial cultivars like Hayward, Bruno and Allison were selected for New Zealand. In Nepal, Red Kiwi for early season, Bruno for mid-season and Hayward for late season is selected for cultivation [4]. It is considered as one of the best fruits due to its high nutritive value; especially vitamin C. Besides, it has high amount of carbohydrates, proteins and minerals (calcium, magnesium, nitrate, phosphorus, potassium and iron). Hayward is grown in many countries because of its distinctive features like high yield, large fruit size and good storage properties [2]. Like other fruit, it is mainly eaten as a fresh fruit or sometimes used as salads and desserts combined with other fruits. It can be eaten as dry, frozen, canned, converted into juices or purees, used for wine and liquor production etc. The vine of the kiwifruit can be grown well between 900 to 1600 MSL consisting warm and humid climates. The kiwifruit prefers moderate and high rainfall conditions of about 150 cm rainfalls. The strong wind and frost during growing periods are however injurious to the plants. The summer temperature should not go beyond 35°C.

The vine requires well drained, deep friable loam or sandy loam soil having sufficient organic matter content along with good irrigation facilities for successful cultivation. In India, the different agro-climatic conditions of Himachal Pradesh were selected to assess the performance of kiwifruit cultivation. Thereafter, it was planted in other parts of the country including A.P., Nagaland, Manipur, J&K, Uttarakhand, Darjeeling Hills, Kalimpong and Conoor (TN) in collaboration with Directorate of Horticulture/SAU's of the respective states. After the evaluation, this fruit was recommended for commercial cultivation in mid and low hills of the Himachal Pradesh during 1990 as well as mid hills of Jammu and Kashmir, Uttarakhand, Sikkim, Arunachal Pradesh, Meghalaya, Nagaland and Nilgiri hills of South India [7].

Considering the nutritive importance as well as marketing opportunities of the fruit, the present investigation was taken in hill agro-climatic conditions of West Bengal to find out most appropriate cultivar for commercial recommendation for cultivation among the farmers to elevate their status of livelihood.

Materials and Methods

The investigation was carried out on 4 (four) years old plant of kiwifruit during 2018-19, 2019-20 and 2020-21 at Dalapchand Instructional Farm of Darjeeling Krishi Vigyan Kendra to assess the performance of the cultivars under the administrative control of Uttar Banga Krishi Viswavidyalaya, Kalimpong, Darjeeling, West Bengal. The four (4) cultivars of kiwifruit namely Hayward, Allison, Bruno and Monty were tested in a randomized block design (RCBD) with six replications.

Table-1 Yield attributing characters of some kiwifruit cultivars in hill agro-climatic condition of West Bengal

Cultivars	Fruit length (cm)				Fruit diameter (cm)				Fruit length/diameter ratio				Stalk length (cm)			
	2018-19	2019-20	2020-21	Mean	2018-19	2019-20	2020-21	Mean	2018-19	2019-20	2020-21	Mean	2018-19	2019-20	2020-21	Mean
V ₁ - Hayward	5.69	5.87	6.09	5.88	3.38	3.44	3.46	3.43	1.68	1.71	1.76	1.72	2.29	2.38	2.42	2.36
V ₂ - Allison	5.54	5.65	5.67	5.62	3.30	3.42	3.40	3.37	1.66	1.65	1.67	1.66	2.28	3.07	3.15	3.03
V ₃ - Bruno	5.27	5.30	5.35	5.31	3.93	4.16	4.13	4.07	1.34	1.27	1.30	1.30	3.19	3.20	3.24	3.21
V ₄ - Monty	5.33	5.35	5.39	5.36	3.97	3.90	3.99	3.95	1.36	1.38	1.35	1.36	3.01	2.94	3.12	3.02
SE (m) ±	0.04	0.03	0.04	0.05	0.02	0.01	0.02	0.04	0.05	0.03	0.04	0.02	0.04	0.02	0.02	0.03
CD at 5%	0.11	0.11	0.12	0.15	0.04	0.04	0.06	0.11	0.16	0.09	0.12	0.07	0.12	0.07	0.04	0.10

Table-2 Fruit yield and quality attributes of some kiwifruit cultivars in hill agro-climatic condition of West Bengal

Cultivars	Average fruit weight (g)				Fruit yield/plant (kg)				Titratable acidity (%)				TSS (°Brix)			
	2018-19	2019-20	2020-21	Mean	2018-19	2019-20	2020-21	Mean	2018-19	2019-20	2020-21	Mean	2018-19	2019-20	2020-21	Mean
V ₁ - Hayward	76.68	80.72	82.01	79.80	5.54	11.74	18.36	11.88	0.62	0.61	0.63	0.62	11.54	11.73	11.88	11.72
V ₂ - Allison	67.37	69.53	70.30	69.07	6.58	12.44	20.08	13.03	0.90	0.92	0.93	0.92	9.95	9.96	9.98	9.96
V ₃ - Bruno	56.21	59.29	61.05	58.85	4.75	6.70	10.28	7.24	0.60	0.61	0.62	0.61	7.68	7.63	7.71	7.67
V ₄ - Monty	52.73	53.90	58.75	55.13	4.27	5.36	8.74	6.12	0.53	0.56	0.57	0.55	7.95	7.96	8.02	7.98
SE (m) ±	1.16	0.87	0.92	0.94	0.13	0.23	0.19	0.24	0.01	0.01	0.01	0.01	0.02	0.02	0.07	0.04
CD at 5%	3.44	2.60	2.73	2.79	0.39	0.69	0.57	0.70	0.04	0.03	0.04	0.03	0.07	0.06	0.19	0.13

The location of the trial lies between 26°31' to 27°13' N latitudes and 87°59' to 88°53' E longitudes and situated at an altitude of about 1076 m above MSL. It has five distinct seasons: spring, summer, autumn, winter and the monsoons. The annual temperature is 18°C. Summer seasons are mild with an average maximum temperature of 25.5°C in August. Summers are followed by the monsoon rains between June and September. The winter lasts from December to February, with the minimum temperature being around 8°C. The average rainfall of the experimental site is about 220 cm. The soils of experimental plots are shallow to very deep in depth; dark yellowish brown to brown in colour; sandy loam to sandy clay loam texture; rich in organic matter (0.73%) and acidic in nature, pH ranged from 5.8-6.1. The soil nutrient status *i.e.*, average available N: P₂O₅: K₂O was 389: 27: 346 kg/ha during the experimentation.

The saplings of kiwifruit were collected from Dirang district of Arunachal Pradesh and planted at Dalapchand farm at 9 ft x 9 ft spacing on T-Bar (Telephonic structure) trellis system of planting during 2014-15. The cultivar Allison as pollinator (male) was planted at the centre of 8 female plants (1:8) for successful fruit setting. Recommended cultural practices *i.e.*, application of manures and fertilizers and other intercultural operations were followed to raise the crops successfully. First fruit harvesting was started three years after planting. For fruit characteristics, about 10 sample fruits of each cultivar randomly were collected from the field with uniform shape, size and weight. The physical properties *viz.*, fruit length, fruit diameter, stalks length and fresh fruit weight were determined after the fruits washed with fresh tap water in laboratory. The fruit length, fruit diameter and stalk length were measured with a digital Vernier caliper with 0.01 mm accuracy. The individual fresh fruit weight was measured with digital weighing balance. For measurement of fruit quality parameters, fruits were peeled and pulped. Total soluble solids (TSS) of the fruit juice were determined with hand refractometer calibrated using distilled water and measured in degree Brix (°Brix). Titratable acidity was estimated by titration of the extracted fruit juice with 0.1 N NaOH solutions. It is expressed in percentage. The statistical analysis was done as per standard procedures [3].

Results and Discussion

The perusal of data on fruit characteristics *viz.*, fruit length, fruit diameter, fruit length/diameter ratio and stalk length were presented in [Table-1]. The results indicated that all the fruit characteristics were found to be highly significant in all the years and also in pooled data. The maximum average fruit length was recorded in Hayward (5.88 cm) followed by Allison (5.62 cm) and it was found minimum in Bruno (5.31 cm). The average fruit diameter was recorded highest in Bruno (4.07 cm) followed by Monty (3.95 cm), whereas it was recorded minimum in Allison (3.37 cm). Comparing the fruit length/diameter ratio, the cultivar Hayward (1.72) had the highest which was at par with Allison (1.66) during all the years and also in pooled. The cultivar Bruno recorded the lowest fruit length/diameter ratio of 1.30, though this cultivar had the highest fruit diameter and was at par with Monty (1.36). The cultivar Bruno recorded maximum fruit stalk length of 3.21 cm followed by Allison (3.03 cm) and Monty (3.02 cm). Highly significant differences in the individual fruit weight and fruit yield per plant

were observed during 2018-19, 2019-20 & 2020-21 and also in pooled data [Table-2]. The average individual fruit weight was found maximum in cultivar Hayward (79.80 g) followed by Allison (69.07 g) and the least weight in Monty (53.13 g). The average individual fruit weight of 44.7% and 25.3% higher in cultivar Hayward and Allison respectively as compared to Monty. On the other hand, the difference in average fruit weight between two promising cultivars *i.e.*, Hayward and Allison were only 15.5%. The analysed data indicated that though the individual fruit weight was registered maximum in Hayward, the fruit yield per plant was recorded maximum in Allison (6.58, 12.44, 20.08 & 13.03 kg in 2018-19, 2019-20, 2020-21 & pooled, respectively) followed by Hayward (5.54, 11.74, 18.36 & 11.88 kg in 2018-19, 2019-20, 2020-21 & pooled, respectively), whereas, the minimum fruit yield per plant was observed in Monty (4.27, 5.36, 8.74 & 6.12 kg in 2018-19, 2019-20, 2020-21 & pooled, respectively). Comparatively, the two superior cultivars *i.e.*, Allison and Hayward yielded 112.9% and 94.1% respectively more fruit in pooled than cultivar Monty. The more fruit yield per plant might in Allison and Hayward might be due to higher fruit weight, a greater number of fruits per plant and higher fruit length/diameter ratio as compared to Bruno and Monty. The different pomological traits *viz.*, fruit length, fruit diameter, individual fruit weight are the most prominent characters which play important role to contribute more yield of kiwifruit varieties. Similarly, the fruit weight, size, total soluble solids, firmness were higher in Hayward cultivar under mid-hill conditions of Himachal Pradesh as compared to other cultivars [6].

The fruit quality characters presented in [Table-2] indicated that both titratable acidity percentage and total soluble solid (TSS) showed significant differences among the kiwifruit cultivars. It is clear from the result that the average total soluble solid (TSS) was maximum in Hayward (11.72 °Brix) closely followed by Allison (9.96 °Brix), while it was least in Bruno (7.67 °Brix). On the other hand, the percentage titratable acidity was recorded highest in Allison (0.92%) followed by Hayward (0.62%) and Bruno (0.61%) and the minimum in cultivar Monty (0.55%). Significant variation among kiwifruit cultivars might be due to genetic characters with respect to both yield and quality parameters which were in accordance with some findings [5].

Conclusion

The present findings of the field investigation indicated that the kiwifruit or Chinese gooseberry can be grown successfully in hilly agro-climatic conditions of West Bengal. Among the four kiwifruit cultivars tested for performance in this region Allison as well as Hayward can be used for getting more fruit yields with better quality considering their fruit yield as well as quality characters. There are also huge scope of further research and experiments on different management practices, physico-chemical changes during harvesting and storage, etc. for exploration of this crop as the success of the production of this crop depends on management, soil, climate and altitude of that particular region.

Application of research: The research findings from the above investigation were demonstrated among the farmers in participatory mode in the surrounding area of hill region of Kalimpong District under West Bengal.

The participated farmers showed keen interest for adopting the technology for producing this kiwifruit to earn more returns.

Research Category: Varietal Trial

Abbreviations: TSS-Total Soluble Solid; RCBD-Randomized Complete Block Design

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University: Uttar Banga Krishi Viswavidyalaya, Kalimpong, Darjeeling, 734301

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Study area / Sample Collection: West Bengal

Cultivar / Variety / Breed name: Kiwifruit (*Actinidia deliciosa*) Hayward, Allison, Bruno and Monty

Conflict of Interest: None declared

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