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Effect of different varieties and spacing on growth, and yield, of Amaranths (*Amaranthus tricolor* L.) under Lucknow conditions

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Abstract

The present experiment was undertaken to determine the effect of different varieties and spacings on the growth, yield, and quality traits of *Amaranthus*. In this experiment five varieties i. e. Pusa Badi Chaulai, Pusa Choti Chaulai, Pusa Kirti, Pusa Kiran and Pusa Lal Chaulai and two spacing viz. 20 x 15 cm, 25 x 15 cm were used for study. The layout of the experimental was laid down in Factorial Randomized Block Design with three replications. It is revealed that the widest spacing (25 x 15 cm) produced higher plant height (124.71 cm), number of branches per plant (6.89), and length of leaves (14.61 cm) of the plant significantly. The width of leaves (8.01 cm) and intermodal length (9.20 cm) and stem diameter at collar region (12.27 cm) were also in the same pattern i.e. wider spacing (25 x 15cm). The number of spikes per plant (10.76) has also increased in the wider spacing (20x15 cm). On the contrary, the yield has been noticed highest (5.57kg/plot) at closer spacing (20 x 15 cm) and lowest yield in the wider spacing (4.26/kg plot). The amaranthus planted at wider spacing (25 x 15 cm) provided maximum iron content (1043.133 mg/ 100 g), moisture content (84.405%), TSS (2.276%) and ascorbic acid (96.835 mg/ 100g).

Keywords: Amaranthus, spacing, varieties, growth, and yield

Introduction

Amaranthus or 'Chaulai' is used as a potherb and belongs to the family Amaranthaceae. The word 'Amaranth' is derived from the Greek word "Anthos" which means "everlasting" according to Sankaran (1943) [11]. It is the most common leafy vegetable grown during the summer and rainy seasons in India. This crop is suitable for crop rotations because of its short duration and large yield/unit area. Amaranth is believed to be originated in India. Amaranth plants are fast-growing tall, soft-wooded annuals, extremely variable, erect to spreading with a strongly branched taproot. Leaf colour is green or red or with different shades of above. Leaves alternate, long petiolate, simple, and entire. The height of mature plants varies between 0.3 m and 2.5 m, depending on species, growth habits, and environment. Some species have distinct markings on their leaves. Terminal and auxiliary inflorescences occur. Most of the cultivated species are monoecious, wind-pollinated, but the grain species with colourful inflorescence are occasionally visited by bees (Khusboo and Pal, 1970) [6]. Amaranth uses a C₄ cycle photosynthetic pathway. It has a high rate of photosynthesis and excellent water use efficiency at high temperatures and high radiation intensity. The small seeds of leafy amaranths are usually very shiny and dark brown to black in colour. Amaranths, a genus consisting of more than 50 species, is an important promising food crop for its resistance to heat, drought, disease and pest, and high nutritional value (Rastogi & Shukla, 2013; Sreelathakumary & Peter, 1993; Svirskis, 2003) [8, 13]. It is one of the oldest food crops in the world; evidence of its cultivation dates back to as far as 6700 BC (RSA, 2010) [9]. It is cultivated for green leaf and grains and a few wild species (Rai and Yadav, 2005) [10]. The plant has a fleshy stem and leaves with trailing habits (Bose and Som, 1986) [5]. It is widely cultivated in Bangladesh, India, in tropical and subtropical parts of Asia, Africa, and Central America (Hardwood, 1980). Amaranths grow very fast in tropical and subtropical areas and are cultivated in many countries under a variety of soils and agroclimatic conditions during summer when vegetables are not available (Begum, 2000; Makus, 1984; Singh & Whitehead, 1996) [4]. Amaranths, an indigenous vegetable can also become popular with commercial growers if a suitable high-yielding variety and appropriate seed rate are applied to promote the yield and nutritive value of amaranths.

Amaranths, one of the cultivated indigenous vegetables has a short production cycle, high yielding with good nutritional value, and low cost of production.

Materials and Methods

The experiment was conducted at Horticulture Research Farm of Babasaheb Bhimrao Ambedkar University, Vidya-Vihar Rae Bareilly Road Lucknow (UP) during the summer season of 2018-19. Geographically, Lucknow is situated at 26°50' N latitude, 80°52' E longitude, and an altitude of 111 meters above sea level. The area experiences a summer season that stretches from March to June with the many rainy seasons from July to early October. The area receives average rainfall between 800-1000 mm with annual and maximum temperature ranging from 15 to 30°C. Five varieties viz. Pusa Badi chaulai, Pusa Choti chaulai, Pusa Kirti, Pusa Kiran, and Pusa Lal Chaulai and two spacing such as 25 x 15 cm, and 20 x 15 cm, were used for the study. The experiment was laid out in factorial Randomized Block design (RBD) and replicated in three. The observation was made on the following parameters plant height (cm), a number of branch per plant, leaf length (cm), leaf width, the diameter of stem and yield of herbage per plot. All the parameters were collected from three randomly selected plants of each treatment. The maximum growth of the amaranthus plant was obtained with the widest spacing.

Result and Discussion

Effect of varieties on growth and yield of amaranthus: The data presented (Table-1) on growth and yield revealed that different spacing and varieties showed the significant effect was found among the varieties for all parameters studied highest yield (5.57kg/plot) was obtained from a variety of Pusa Kiran. It is identical to the yield (5.43kg /plot) of Pusa Kirti. The lowest yield (2.21kg/plot) was produced by the variety Pusa Badi Chaulai. Identical performance was recorded in respect of plant height, the number of leaves per plant, neck thickness of plant, stem diameter, length of leaf, the weight of leaf per plant, and a number of branches per plant, yield Kg per plot, and yield per hectare. No significant variation was found between the varieties Pusa Badi chaulai, Pusa Choti chaulai, Pusa Kirti, Pusa Kiran, and Pusa Lal Chaulai.

Effect of spacings on growth and yield of Amaranthus: The represented data in (Table-2) revealed the significant effect of different spacing on plant height, number of leaves

per plant, stem diameter, leaf width, length of leaf, length of root, number of branches per plant, yield per plot. Significantly, the highest plant height (124.71cm) and diameter (12.35 cm) was observed from the widest spacing (25 x 15 cm) and followed by the spacing 20 x 15 cm (79.05 cm) and 8.40 cm. The maximum number of branches per plant (6.04) was obtained from the spacing 25 x 15 cm followed by the spacing (20 x 15 cm) (6.17). The maximum width of leaves (14.70 cm) followed by the spacing (20 x 15 cm) 12.44 cm). The highest (8.82cm) internodal length of leaves was obtained from the spacing 25 x 15 cm and followed by the spacing 20 x 15 cm (6.94 cm). However, the closer spacing of 20 x 15 cm produces a higher yield (5.57 Kg/plot) followed by the yield (5.43 Kg/ plot).

Interaction effect of spacing and different cultivars on growth and yield of amaranthus: The interaction effect of spacing and different varieties had influenced significantly on the parameters (Table -3). Significantly, the highest plant height (143.63 cm) was obtained from the variety Pusa Kiran with spacing 25 x 15 cm. The shortest plant height (65.88 cm) was obtained from the variety Pusa Badi Chaulai with spacing 20 x 15 cm. The maximum (7.72) number of branches per plant was obtained from the variety Pusa Kiran with spacing 25x 15 cm. The minimum (4.86) number of branches per plant was obtained from the variety Pusa Kirti with spacing 20 x15 cm. The length of leaves (15.14 cm) was recorded from the variety Pusa Kiran with spacing 25 x 15 cm. The maximum width of leaves (9.33cm) was recorded from the variety Pusa Kiran with the spacing (25 x 15 cm) followed by the variety Pusa Badi Chaulai and The biggest stem diameter (15.39 cm) was recorded from the variety Pusa Kiran with spacing 25x 15 cm followed by the variety Pusa Badi Chaulai with spacing 20 x 15 cm. The maximum (9.87cm) root length of the plant was recorded from the variety Pusa Kiran with spacing 25 x 15 cm followed by variety Pusa Badi Chaulai with spacing 20 x 15 cm. The maximum herbage weight was obtained from the variety Pusa Kiran with spacing 25 x 15 cm and the minimum Herbage weight with spacing 20 x 15 cm. The maximum number of spikes per plant (10.76) was obtained from the variety Pusa Kiran with spacing 25 x 15 cm followed by variety Pusa Badi Chaulai with spacing 20 x 15 cm. The maximum seed yield per plot of (97.24g/plot) was obtained from a variety of Pusa Kiran and spacing 25 x 15 cm. The lowest yield per plot (58.33g/plot) was obtained from a variety of Pusa Badi Chaulai with spacing 20 x 15 cm.

Table 1: Effect of varieties on growth and yield of amaranthus

Variety	Plant height (cm)	Number of branches/plant	Length of leaves (cm)	Width of leaves (cm)	Diameter of the stem (mm)	Internodal length (cm)	Length of root (cm)	Herbage yield/plot	No. of spikes/plant	Seed yield/plot
Pusa Badi Chaulai	99.94	6.32	12.60	7.10	8.62	6.44	8.01	3.48	6.27	71.39
Pusa Choti Chaulai	85.98	5.58	13.31	8.06	9.70	7.22	8.44	3.21	6.20	77.092
Pusa Kirti	94.55	5.68	14.46	6.95	10.34	8.35	8.96	4.22	7.42	78.44
Pusa Kiran	115.10	6.89	14.61	8.01	12.27	9.20	9.46	4.91	8.76	85.35
Pusa Lal Chaulai	113.77	6.05	12.89	7.99	10.95	8.22	8.99	4.14	7.96	76.31
CD (%)	10.72	0.056	0.692	0.06	0.078	0.04	.03	0.032	0.014	1.77
SE (m)	3.58	0.019	0.231	0.022	0.026	0.01	0.01	0.011	0.005	0.592

Table 2: Effect of spacing on growth and yield of amaranthus

Spacing (cm)	Plant height (cm)	Number of branches/plants	Length of leaves (cm)	Width of leaves (cm)	Diameter of the stem (mm)	Internodal length (cm)	Length of root (cm)	Herbage yield/plot	No. of spikes/ plant	Seed yield/plot
20 x15	79.00	6.17	12.44	6.97	8.40	6.94	7.92	3.12	5.555	66.43
25 x 15	124.71	6.20	14.70	8.27	12.35	8.82	9.62	4.86	9.097	89.001
SE (m)	2.26	0.012	0.14	0.014	0.017	0.009	0.006	0.007	0.003	0.374
CD (%)	6.78	0.036	0.43	0.042	0.50	0.028	0.019	0.020	0.009	1.121

Table 3: Interaction effect of spacing and different varieties on growth and yield of amaranthus

Variety x Spacing	Plant height (cm)	Number of branches/plants	Length of leaves (cm)	Width of leaves (cm)	Diameter of the stem (mm)	Internodal length (cm)	Length of root (cm)	Herbage yield/plot	No. of spikes/ plant	Seed yield/plot
Pusa Badi Chaulai x 20 x 15 cm	65.88	4.93	10.71	5.83	8.01	4.94	6.77	2.21	3.68	58.33
Pusa Badi Chaulai x 25 x 15 cm	72.87	5.76	11.62	6.80	8.13	6.36	7.23	4.76	8.86	84.45
Pusa Chhoti Chaulai x 20x 15 cm	78.62	6.51	13.79	6.82	8.45	7.37	8.05	2.75	4.67	61.75
Pusa Chhoti Chaulai x 25x 15 cm	91.60	6.98	14.16	7.87	8.26	7.72	8.42	3.67	7.73	92.42
Pusa Kirti x 20 x 15 cm	86.58	6.69	11.96	7.54	9.15	8.33	9.15	3.01	4.98	68.35
Pusa Kirti x 25 x 15 cm	134.00	6.81	14.49	8.36	9.22	7.93	9.25	5.43	9.85	88.52
Pusa Kiran x20 x15 cm	99.49	5.41	15.00	8.43	11.26	8.08	9.66	3.38	6.76	73.45
Pusa Kiran x25 x15 cm	110.48	4.86	15.07	7.09	12.23	9.32	9.56	5.57	10.76	97.24
Pusa Lal Chaulai x 20 x 15 cm	143.63	7.72	15.14	9.33	15.39	10.08	9.87	4.26	7.66	70.27
Pusa Lal Chaulai x 25 x 15 cm	135.94	5.41	13.83	8.15	13.66	8.71	9.77	4.90	8.27	82.35
SE (m)	5.06	0.027	0.32	0.03	0.037	0.02	0.014	0.015	0.007	0.837
CD @ 5%	15.16	0.079	0.97	0.09	0.111	0.06	0.042	0.045	0.020	2.506

Conclusion

The study was conducted to investigate the best plant spacing for the highest yield. The spacing used in the study showed significant variation among the different treatments. Growth parameters like plant height, number of branches per plant, leaf length, the width of leaves, diameter of the stem, Weight of leaf were significantly affected due to the different plant spacing. When the distance between plants decreased the growth and yield-related parameters were increased. Generally, the widest the plant spacing the better is the performance of the amaranthus plant. Hence, it can be concluded from the study that the widest spacing of 25 x 15 cm produced significantly the highest plant height, leaf number, leaf length, stem diameter, and individual weight of leaf. The total yield/plot when evaluated, it was evident that the producing (5.57 kg/plot) was compared to 4.94kg /plot from closer spacing (20x 15 cm). The highest yield from the widest spacing is mainly due to the high plant density through the plant size was comparatively smaller.

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