Original Research Article

Effect of varieties and spacing on vegetative growth and root yield of Safed Musli (*Chlorophytum borivilianum*)

Abstract

The experiment entitled "Effect of varieties and spacing on vegetative growth and root yield of safed musli (*Chlorophytum borivilianum*)" was carried out to find out the suitable variety with optimum spacing 2018-19 and 2019-20 which was designed in factorial RBD with two varieties and three spacing levels. The trials were sown in two years *i.e.* on 02-07-2018 and 31-05-2019. The present investigation has been carried out at the main experiment station, Department of Horticulture at Medicinal and Aromatic Plant, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India. The data has been recorded in the following parameters, like Leaf length, Leaf width, Number of tillers/hill, Length and diameter of fingers, Number of fingers per plant, Fresh root yield, and Dry root yield.

Keywords: Safed Musli, spacing, vegetative growth and root yield

Introduction

Chlorophytum Borivilianum belongs to the family *Liliaceae*. It is the most eminent medicinal plant, which is commonly known as *Safed Musli* or *Dholi Musli*. (Puri, 2004). It is partly an herb with sub-erect lanceolate leaves. This plant is used for medicinal purposes for about 4000 years as per the Hindu epic *Srimad Bhagwat.* (Kumari, 2021). There are about 256 species of Chlorophytum and 17 among them are found in India. It is mainly cultivated in the drier parts of Madhya Pradesh, Punjab, Rajasthan, and South India. In Madhya Pradesh, it is cultivated in about 4000 hectares area (Nigam *et al.*, 1984). The major producers and importers of organic products are the European Union, the United States of America, and Japan. The plant is well known for its tuberous roots because of bioactive constituents like flavonoids, alkaloids, saponins, phenols, steroids, triterpenoids, vitamins, and tannins. (Nakasha *et al*., 2017). Safed Musli (*Chlorophytum borivilianum)* is an eminent medicinal plant of India and is considered a 'white gold' or

'divyaaushad' in Indian systems of medicine. In Ayurveda, *Chlorophytum borivilianum* belongs to the group of "Vajikaran Rasayana" corroborated by its rejuvenating and aphrodisiac properties and effectiveness in alleviating sexual disorders. It is largely used as ethnic medicine by local healers of indigenous communities of India. This chemical constituent has a specific mode of action in the human body as the intake of this plant improves physical stamina, and physical and mental health improves sexual desire, increases semen volume, and keeps the body healthy and energetic. (Thakur *et al*., 2008). It also helps to cure rheumatoid arthritis, post-menopausal syndrome, (Deore *et al*., 2009) diabetes, and piles. (Nikam *et al*., 2009). These root tubers are used in the traditional medicinal system of India since the 11th century to cure a variety of diseases. (Kirtikar *et al*.,1975). *Safed Musli* is medicinally used in various medicinal systems such as Ayurveda, *Unani*, allopathic, homeopathic, and *Siddha*. (Sharma *et al*., 1999). The description of this plant is mentioned in multiple ancient works of literature such as *Rasendra Sarsangrah*, *Bhavaprakash Nighantu*, and *Raja Ballabh Nighantu* as *Vajikaran* or a special type of immunomodulatory. (Thakur *et al*., 2009). It is effective against male sexual disorders such as erectile dysfunction, premature ejaculation, and infertility and is used as a health tonic. (Choudhary *et al*., 2021). Roots of this plant are used widely in the ayurvedic and Unani medicinal systems for therapeutic purposes. (Oudhia *et al*., 1999; Khanam *et al*., 2013). It is also reported that *Safed Musli* is popular in western countries as this plant is considered an alternative to Viagra and effective in curing chronic leucorrhea, high BP, delayed menopause, arthritis, and diabetes. (Maiti *et al*., 2005). In India, it was first described by *Santapau* and Fernandes in 1954. (TIE, 1999). The new drug named "*Nai Chetn*a" was launched by the Gujarat State Forest Development Corporation, India, a *Safed Musli*-based potency drug. (Kalra *et al*., 2013). The tubers of this plant have a remarkable effect on the Central nervous system. It was also reported that fleshy roots contain the highest amount of saponin content. This plant is promoted and protected by the Medicinal Plant Board of India, as it is recognized as 26th among the top priority medicinal plant because of its high medicinal properties. The Indian government has started promoting its cultivation due to its high economic perspective. (Kalra *et al*., 2015; Thakur *et al*., 2021). This plant is also used as a culinary food in India. (Kumari *et al*., 2021). The roots of *Chlorophytum brovilianum* are being

used as an aphrodisiac, health-promoting, adaptogen, and antiaging agent. Besides this, it is also used in pharmaceutical industries to prepare shampoos, confectionery, soaps, soft drinks, beer, and other anti-hemorrhoidal ointments because of its high saponin constituents. The saponin components named stigmasterol and hacogenin found in the roots of *Safed Musli* hold significant aphrodisiac properties. (Tapre *et al*., 2021). This plant species has now become endangered due to depletion in the natural habitat because of extensive denudation of the forest floor, poor seed setting, and germination (Suri *et al.*, 1998), and high incidence of viral and bacterial diseases affecting rhizomes (Bhattacharjee, 1998). Moreover, economics is directly related to the input and output of the production system, so optimization of spacing and fertilizer doses becomes an important aspect of productivity estimation research activities. Evaluation of quantitative characteristics of medicinal plants is necessary, before recommending it to farmers, as these factors depend upon local climatic and edaphic conditions. Keeping the above-mentioned objectives in consideration, an experiment was conducted to know the impact of different levels of spacing and organic fertilizer on fleshy roots productivity of *Chlorophytum borivilianum*.

Materials and Methods

The present investigation has been carried out at the main experiment station, Department of Horticulture at Medicinal and Aromatic Plant, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India, during the year 2018-19 and 2019-20. Which is designed in factorial RBD with 2 varieties and 3 spacing levels. Geographically the experimental site is situated between the latitude of 24.47 and 26.75 North and longitude of 82.12 and 83.98 East at the elevation of 118 meters above mean sea level. The experimental site is located under humid subtropical climate conditions having three climate seasons *i.e.* summer, rainy, and winter. The data has been recorded in the following parameters, Leaf length, Leaf width, Number of tillers/hill, Length and diameter of fingers, Number of fingers per plant, Fresh root yield, and Dry root yield. Data recorded on various parameters of growth and yield attributes were subjected to statistical analysis by following fisher's method of analysis of variance (Panse and Sukhatme, 1967).

Results and Discussion

Leaf length:

Data on leaf length (cm) showed in Table 1, indicated that non-significant varieties were obtained on leaf length due to varietal and spacing traits during both years. However, variety MCB 412 (32.58 cm and 27.96 cm) showed comparatively better during 2018-19 and 2019-20, respectively spacing at 20 cm (32.36 cm) during 2018-19 and 15 cm (28.65 cm) during 2019-20 gave better results. Table 1 indicated that the significant interaction effort due to varieties and various spacing levels were observed during 2019-20 only which varied from 26.48 cm to 29.53 cm.

Leaf width:

Observations concerning leaf width (cm) were recorded and depicted in Table 1, revealed that non-significant varieties due to varieties and spacing levels were recorded individually internationally during both the years, except in the following (2019-20) in case of spacing levels, significant results showed, which varied from 1.74 cm to 1.97 cm.

Number of tillers/ hill:

Data presented in Table 5, indicated that variation due to variety and spacing was found non-significant during the first year (2018-19). But in the following year (2019-20), the number of tillers/ hill increased significantly due to variety and spacing. The higher number of the tiller (3.40) was recorded at 10 cm spacing during 2019-20. But in 2019-20, 15 cm spacing showed better results. The interaction due to variety and spacing was found significant during both the year. The maximum number of tillers (4.10) was recorded when variety MCB 412 was sown at 15 cm spacing level during 2018-19.

Length and diameter of fingers:

Data pertaining to the above parameter were depicted in Table 6, length of finger varied non-significantly due to variety and spacing levels during both the years, except in the year 2019-20, variety MCB 405 (13.20 cm) showed significantly higher finger length than variety MCB 412. Variety MCB 412 significantly increased the diameter of finger

(0.71 cm) than MCB 405 (0.64 cm) while varieties due to spacing level showed non-significant during 2018-19. But in the second 2019-20, variation due to variety was found non-significant. Interestingly significant variations were observed due to various spacing levels during 2019-20. The maximum average diameter (0.71 cm) was found due to 10 cm spacing.

Number of fingers per plant:

Data presented in Table 6, Showed that number of fingers/plants varied significantly due to variety and spacing levels during both the years. However, variety MCB 405 (17.33 and 16.56) gave a higher number of fingers than MCB 412 during 2018-19 and 2019-20. The maximum average number of fingers (17.24) was recorded when sown at 20 cm spacing.

Interaction effort on length and diameter of fingers and number of fingers/ plant:

Table 7, Showed that significant interaction effort due to variety and spacing levels were observed on increasing length, diameter on number of fingers/ plant during 2019-20 but in previous year (2018-19), interaction effort has found non-significant. The maximum length of finger (13.71 cm) was found, when variety MCB 405 sown at 15 cm spacing level during 2019-20 as for as diameter of finger is concerned, the highest diameter (0.73 cm) was noticed when MCB 412 interacted (sown) with 10 cm spacing level during 2019-20. When variety MCB 405 interacted (sown) at 20 cm level which gave the highest number of fingers (18.53) during 2019-20.

Fresh root yield:

Observations concerning fresh root yield were recorded and presented in Table 8, perusal of data revealed that maximum fresh root yield (66.57 q $ha^{-1)}$ and 29.82 q ha^{-1}) was obtained by the variety MCB 405 which was found significantly higher than MCB 412 (60.64 q ha^{-1} and 27.60 q ha^{-1}) during the years 2004-05 and 2005-06, respectively. The closer spacing (10 cm- 77.43 q ha^{-1} and 30.97 q ha^{-1}) proved better to enhance fresh root yield which was found significantly superior to other spacing levels. The minimum root yield (48.64 q ha^{-1} and 26.98 q ha^{-1}) was observed with higher spacing (90 cm). The maximum average fresh root yield 54.20 q ha^{-1}) was also recorded due to the same

treatment (10 cm) spacing. The interaction effort due to variety and spacing was found significant. The maximum fresh root yield (79.52 q ha^{-1}) was obtained by the variety MCB 405 sown at relatively closure spacing (10 cm) during the previous year 2018-19. But in the following year (2019-20), when same variety interacted at relatively less closure spacing (15 cm), which showed the highest root yield (36.68 q ha^{-1}).

Dry root yield:

Data presented in Table 8, showed that there was an almost similar trend as for as dry root yield is concerned significant variations were observed due to variety and spacing levels individually and internationally during both the years, except in the second year (2019-20) variation due to variety showed non-significant results. However, the same variety MCB 405 (13.14 q ha^{-1-}) performed a higher dry root yield than MCB 412 (11.52 q ha^{-1}) during 2018-19. The closure spacing (10 cm-15.11 g ha^{-1} and 5.87 q ha^{-1}) also proved to be beneficial in terms of dry root yield. During 2018-19 and 2019-20, respectively. The maximum average dry root yield (10.49 q ha^{-1}) was also obtained at closer spacing (10 cm) significant interaction effort was noticed due to variety and spacing levels during both years. In the second year (2019-20), root yield and other parameters were recorded which were found comparatively lower than the previous year (2018-19) due to poor germination percentage and other factors.

Table 1: Effect of variety and spacing on vegetative character of Safed Musali during 2018-2019 and 2019-20.

Treatments	Leaf length (cm)	Leaf width (cm)

	2018-19	2019-20	2018-19	2019-20
A. Varieties				
(V_1) MCB 412	32.58	27.96	2.09	1.80
(V_2) MCB 405	31.48	27.49	1.91	1.88
SEm±	0.50	0.48	0.09	0.04
CD at 5%	NS	NS	NS	MS
B. Spacing				
(S_1) 10 cm	32.24	27.64	1.95	1.97
(S_2) 15 cm	31.49	28.65	2.08	1.74
(S_3) 20 cm	32.36	26.89	1.97	1.81
SEm±	0.62	0.59	0.11	0.05
CD at 5%	NS	NS	NS	0.14

Table 2: Interaction effect S X V of variety and spacing on Leaf length (cm) of Safed Musali during 2019-20.

Spacing / Variety	S_1	S_2	S_3
V_1	27.88	29.53	28.48
V_2	27.40	27.78	27.30
SEm (S X V)	0.97		
C.D. at 5% (S X V)	2.92		

Table 3: Effect of variety and spacing on vegetative character of Safed Musali during 2018-19

Treatment	No. of tillers/hill		
	V_1	V_2	Mean
Spacing			

(S_1) 10 cm	2.15	3.25	3.10
(S_2) 25 cm	4.10	2.95	3.53
(S_3) 20 cm	3.30	3.20	3.25
Mean	3.45	3.13	
SEm$\pm$ A	0.14		
SEm$\pm$ B	0.17		
SEm$\pm$ A x B	0.24		
CD at 5% A	NS		
CD at 5% B	NS		
CD at 5% A x B	0.72		

*V_1 = MCB 412, V_2 = MCB 405

Table 4: Effect of variety and spacing on vegetative character of Safed Musali during 2018-19 and 2019-20.

Treatments	Leaf length (cm)		Mean	Leaf width (cm)		Mean	Pooled mean
	2018-19	2019-20		2018-19	2019-20		
A. Varieties							
(V_1) MCB 412	32.58	27.96		2.09	1.80		
(V_2) MCB 405	31.48	27.49		1.91	1.88		
SEm±	0.50	0.48		0.09	0.04		
CD at 5%	NS	NS		NS	NS		
B. Spacing							
(S_1) 10 cm	32.24	27.64		1.95	1.97		
(S_2) 15 cm	31.49	28.65		2.08	1.74		
(S_3) 20 cm	32.36	26.89		1.97	1.81		
SEm±	0.62	0.59		0.11	0.05		
CD at 5%	NS	NS		NS	0.14		

Table 5: Effect of variety and spacing on vegetative character of Safed Musali during 2018-19 and 2019-20.

Treatment	No. of tillers/hill					
	2018-19			2019-20		
	V_1	V_2	Mean	V_1	V_2	Mean
Spacing						
(S_1) 10 cm	2.15	3.25	2.70	2.83	3.98	3.40
(S_2) 25 cm	4.10	2.95	3.53	2.55	3.18	2.86
(S_3) 20 cm	3.30	3.20	3.25	3.13	3.05	3.09
Mean	3.45	3.13		2.83	3.40	
SEm± A	0.14			0.07		
SEm± B	0.17			0.09		
SEm± A x B	0.24			0.14		
CD at 5% A	NS			0.21		
CD at 5% B	NS			0.26		
CD at 5% A x B	0.72			0.43		

*V_1 = MCB 412, V_2 = MCB 405

Table 6: Effect of variety and spacing on reproductive characters of safed musali during 2018-19 and 2019-20.

Treatments	2018-19			2019-20		
	Finger length (cm)	Finger diameter (cm)	Number of fingers/plant	Finger length (cm)	Finger diameter (cm)	Number of fingers/plant
A. Varieties						
(V_1) MCB 412	13.36	0.71	15.47	11.93	0.69	14.33
(V_2) MCB 405	13.37	0.64	17.33	13.20	0.66	16.56
SEm±	0.39	0.01	0.31	0.27	0.01	0.29
CD at 5%	NS	0.04	0.95	0.82	NS	0.87
B. Spacing						
(S_1) 10 cm	13.79	0.69	14.90	12.59	0.72	14.60
(S_2) 15 cm	13.20	0.69	16.15	13.01	0.65	15.41
(S_3) 20 cm	13.11	0.66	18.15	12.09	0.64	16.33
SEm±	0.48	0.02	0.39	0.33	0.02	0.35
CD at 5%	NS	NS	1.16	NS	0.04	1.06

Table 7: Interaction effect S X V of variety and spacing on reproduction characters of Safed Musli during 2019-20.

Treatments	Finger length (cm)			Finger diameter (cm)			No. of finger per plant		
Spacing / Variety	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
V_1	11.78	12.31	11.70	0.73	0.68	0.64	14.60	14.28	14.13
V_2	13.41	13.71	12.47	0.71	0.63	0.64	14.60	16.55	18.53
SEm ± (S X V)	0.54	-	-	0.02			0.58		
CD at 5% (S X V)	1.63	-	-	0.07			1.74		

Table 8: Effect of variety and spacing on yield of Safed Musali during 2018-19

Treatment	2018-19			2019-20				2018-19			2019-20			
	Fresh root yield (q/ha)							Dry root yield (q/ha)						
	V_1	V_2	Mean	V_1	V_2	Mean	Pooled mean	V_1	V_2	Mean	V_1	V_2	Mean	Pooled mean
Spacing														
(S_1) 10 cm	75.34	79.52	77.43	33.37	28.56	23.97	54.20	14.31	15.90	15.11	6.34	5.41	5.87	10.49
(S_2) 25 cm	65.97	63.51	64.74	19.67	36.68	28.17	45.84	12.53	12.70	12.61	3.73	5.48	4.61	8.61
(S_3) 20 cm	40.62	56.66	48.64	29.76	24.21	26.98	37.81	7.71	10.83	9.27	5.95	4.84	5.39	7.33
Mean	60.64	66.57		27.60	29.82			11.52	13.14		5.34	5.24		
Pooled mean				44.12	48.91						8.43	9.19		
SEm± A	1.34			0.55				0.18			0.16			
SEm± B	1.64			0.618				0.22			0.20			
SEm± A x B	2.32			1.10				0.31			0.32			
CD at 5% A	4.04			1.66				0.54			NS			
CD at 5% B	4.95			2.04				0.66			0.59			
CD at 5% A x B	6.70			3.32				0.94			0.96			

*V_1 = MCB 412, V_2 = MCB 405

Treatement MCB 412 and MCB 405, Spacing (S1) 10 cm (S2)25 (S3)20 cm

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