

Effect of bio-fertilizers on shoot growth of dragon fruit cuttings (*Hylocereus undatus* L. (Haworth Britton & Rose))

Abstract

The present investigation was carried out under open field condition at Horticulture Research Farm, Babasaheb Bhimrao Ambedkar University, Lucknow Uttar Pradesh, India to determine the effect of bio-fertilizers on the shoot growth of dragon fruit cutting (*Hylocereus undatus* L.) during the year of 2022-23 at the Horticulture Research Farm, Department of Horticulture, Babasaheb Bhimrao Ambedkar University (A Central University), Vidya Vihar Rae Bareilly Road, Lucknow U.P. (India). The experiment was laid out in a randomized complete block design (RCBD) with three replications. There were nine treatments, viz., T₁-Control, T₂-Azotobacter(1%), T₃-PSB(1%), T₄-Azotobacter(2%), T₅-PSB(2%), T₆-Azotobacter(1%) + PSB(1%), T₇- Azotobacter(1%) + PSB(2%), T₈- Azotobacter(2%) + PSB(1%) and T₉-Azotobacter(2%)+PSB(2%). 09 treatments combination for shoot growth parameter of dragon fruit cuttings with one factor and three replications under open field condition. The treatment combination has shown the significant differences among the growth parameters in terms of -----, Among the different treatment combinations, used media containing of sand + soil and FYM enriched with bio-fertilizers combination of Azotobacter + PSB (Phosphate Solubilizing Bacteria) has recorded minimum days taken to shoot initiation and maximum Shoot length.

Keywords: bio-fertilizers, Shoot growth, dragon fruit cuttings, growth parameters.

Introduction:

Dragon fruit (*Hylocereus undatus*) (Haworth Britton & Rose) is a cactus, belonging to family cactaceae. Recently, dragon fruit has been introduced as a super fruit in India. It is considered to be a promising and remunerative fruit crop. Dragon fruit is a long day plant with beautiful night-blooming flowers that is nicknamed "Noble Woman" or "Queen of the Night". The fruit is also known as strawberry, pear, dragon fruit, pitahaya, night blooming cereus, Belle of the Night, Cinderella plant, and Jesus in the Cradle. The fruit is named as Pitaya because of the bracts or scales on the fruit skin and hence, the name pitaya means "the scaly fruit". The fruit has a very attractive colour and mellow mouth-melting pulp with a black colour edible seed embedded in the pulp along with tremendous nutritive properties. It which attracts the growers from different parts of India to cultivate this fruit crop. Dragon fruit which is native to tropical and subtropical forest regions of Mexico and Central South America (Mizrahi *et al.*, 1996). It is a nutritious fruit with a variety of uses. The fruit pulp can be eaten as fresh and can also be made into various valuable processed products. The fruit possesses some medicinal properties. It is known to prevent colon cancer and diabetes, neutralizes toxic substances such as heavy metals, reduce cholesterol and high blood pressure. It is also reported to control high sugar levels. The fruit is rich in vitamin C, phosphorus and calcium which help to develop strong bones, teeth and skin. The fruit is considered as 'health fruit'. Betalains have a great potential in colouring a broad array of food. In this view, betalain from red coloured dragon fruit are most promising, not only as colouring agents but also in possessing an anti-radical potential. It is considered as a fruit crop for future. Hence, widely favoured (Gunaseena and Pushpakumara, 2005 and Gunaseena *et al.*, 2005). Dragon fruit was introduced in 1990 for its commercial cultivation in South Asian tropical countries. At present, significant production and expansion of fruit are occurring in many countries viz., Australia, Cambodia, China, Columbia, Ecuador, Guatemala, Hawaii, Indonesia, Israel, Japan, Laos, Malaysia, Mexico, New Zealand, Nicaragua, Peru, Philippines, Spain, Sri Lanka, Taiwan, Thailand, South Western USA and Vietnam (Barbeau, 1990, Wu and Chen, 1997). The plants propagated through stem cuttings start flowering within 12 to 18 months after planting. Growing media is the important factor for the plants that give anchorage to the plants and provide essential nutrients required by the plants. The growing media enriched with bio-fertilizers possess the advantages like more availability of nutrients in the available forms through natural process like nitrogen fixing, phosphorus solubilizing and stimulate plant growth through the synthesis of growth promoting substances. They build up soil microflora and thereby maintain soil health. So therefore, the experiment was conducted present investigation was carried out to study the effect of bio-fertilizers and their interaction on the shoot growth of dragon fruit cuttings.

Material and Methods:

The present investigation was carried out at the Horticulture Research Farm, Department of Horticulture, Babasaheb Bhimrao Ambedkar University (A Central University), Vidya Vihar Rae Bareilly Road, Lucknow Uttar Pradesh, U.P. (India) during the year of 2022-23 to study the effect of bio-fertilizers on the shoot growth of dragon fruit (*Hylocereus undatus* L.) cuttings under open field conditions. The present investigation experiment was laid out in randomized complete block design (RCBD) with three replications. The various treatment combinations of bio-fertilizers were as follows: T₁-Control, T₂-Azotobacter(1%), T₃-PSB(1%), T₄-Azotobacter(2%), T₅-PSB(2%), T₆-Azotobacter(1%) + PSB(1%), T₇- Azotobacter(1%) + PSB(2%), T₈- Azotobacter(2%) + PSB(1%) and T₉-Azotobacter(2%)+PSB(2%) respectively. 09 treatments combination replicated thrice and number of cuttings in

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each replication ~~was~~ two. Thus, ~~there were a total of 54 plants~~ cuttings were taken as planting materials in this experiment. The ~~shooted~~ cuttings of three year old plant were collected from ~~the~~ progressive farmer ~~namely~~ "Shri Ram Sharan Verma" at Rasoolpur, Sultanpur. The ~~shooting-shooting~~ media ~~was~~ prepared by mixing of sand, soil and FYM with 2:1:1 ratio. ~~The various treatment combination of bio-fertilizers were as follows:~~ [T1 Control, T2 Azotobacter(1%), T3 PSB(1%), T4 Azotobacter(2%), T5 PSB(2%), T6 Azotobacter(1%) + PSB(1%), T7 Azotobacter(1%) + PSB(2%), T8 Azotobacter(2%) + PSB(1%) and T9 Azotobacter(2%) + PSB(2%)] respectively. Data on growth parameters of dragon fruit in terms of ~~The observation on~~ number of days to taken for sprouting, sprouting percentage, number of sprout per cutting, sprout length, shoot length, shoot diameter, number of spines/aerole, shoot fresh weight and shoot dry weight were recorded at 30, 60 and 90 days after planting (DAP). ~~The~~ Data recorded from the present studies were analyzed statistically using windows based computer software of " " version and then the mean differences were adjudged with the Least Significant Difference (LSD) test, subjected to analysis by using standard method suggested by Panse and Sukhatme (1967).

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Result and Discussion:

Number of days taken for sprouting:

~~Data collected on~~ Number of days taken to sprout initiation varied significantly by the ~~as~~ influenced of by bio-fertilizers and their combination. Bio-fertilizer combination contained Azotobacter (2ml) + PSB (1ml) (T₈) showed significantly less (27.95 days) time for sprout initiation ~~and it is~~ followed by Azotobacter (2ml) + PSB (2ml) (28.15 days), whereas the control treatment (T₁) had taken comparatively more (46.24 days) time for sprout initiation. This may be due to increase level of plant growth regulators in the cutting. Therefore, the physiological processes involved in rooting and sprouting of cuttings were completed earlier as a result of the increased amount of auxins (PGR's). ~~The results are in agreement with the findings of~~ Additionally, according to Slankis (1973) who stated that, bio-fertilizer raised the concentration of plant growth regulators in the plants. Bio-fertilizers has ability to fix or increase the nitrogen content and is vital for cellular processes, growth, electron transport, and photosynthetic rate. It is also a vital source of proteins needed for metabolic processes that occur during growth and development (Chaplin and Westwood, 1980). Similar results were also reported by Awasthi *et al.* (2008) in guava and by Minz (2021) in dragon fruit cuttings.

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Percent sprouting:

The data pertaining to sprouting percentage as influenced by ~~different various~~ concentration and combinations of bio-fertilizers with ~~different combination~~ at the different stages of growth are presented in table 1. The ~~maximum highest~~ percentage of sprouting at 30 AND 60 DAP were recorded in cuttings treated with ~~treatment~~ (T₈) Azotobacter (2ml) + PSB (1ml) (33.33 and 49.88%) at 30 and 60 DAP (33.33% and 49.88%, respectively). While the control treatment (T₁) recorded showed the ~~minimum lowest~~ percentage of sprouting (11.44% and 18.22%, respectively). The ability to produce more sprouts is due to the use of bio-fertilizers, which assisted in the creation of beneficial hormones and growth factors, which in turn increased cell division, cell multiplication, and increased assimilation and accumulation of food resources. Similar results were observed in apple by Raman (2021) and in shea tree by Abdullah *et al.* (2012) ~~shea tree~~. This finding was also supported by Kaur (2017) in Mango.

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Number of sprouts per cutting:

At 30, 60 and 90 DAP, significant differences were observed on the ~~parameter~~ number of sprouts per cutting among different combinations of bio-fertilizers. Among ~~different the~~ bio-fertilizers, the used highest numbers of sprouts per cutting (0.75, 1.53 and 2.05 was recorded in Azotobacter (2ml) + PSB (1ml) (T₈) combination (0.75, 1.53 and 2.05 at 30, 60 and 90 DAP, respectively) ~~number of sprouts per cutting was recorded in~~ Azotobacter (2ml) + PSB (1ml) (T₈) combination. The ~~minimum lowest~~ numbers of sprouts per cutting response was observed (0.32, 1.12 and 1.43) were observed at 30, 60 and 90 DAP, respectively) in the control (T₁). The ability to produce more sprouts is due to the use of bio-fertilizers, which assisted in the creation of beneficial hormones and growth factors, which in turn increased cell division, cell multiplication, and increased assimilation and accumulation of food resources. Similar results were observed in apple by Raman (2021) and in shea tree by Abdullah *et al.* (2012) ~~shea tree~~. This finding was supported by Kaur (2017) in Mangomango.

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Shoot diameter (mm) and sprout length length of sprout (cm):

~~Bio-fertilizers and their combinations~~ The data pertaining to the had significant influence on the diameter of shoot, ~~as influenced by bio-fertilizers and their combinations~~. The mixture applied with Azotobacter (2ml) + PSB (1ml) (T₈) showed recorded the largest diameter of shoot diameter (2.45, 3.15, and 4.12 mm at 30, 60 and 90 DAP, respectively), ~~and it is~~ followed by Azotobacter (T₉) (2.13, 2.99 and 3.99 cm at 30, 60 and 90 DAP, respectively), ~~and~~ the largest length of sprouts per stem cutting recorded (2.45, 7.01 and 14.75 cm 30, 60 and 90 DAP respectively) was also given by the same treatment (T₈). ~~Statistically similar results were found in~~ T₉ treatment (and it is followed by (2.39, 6.36 and 14.25 cm at 30, 60 and 90 DAP). The un-inoculated seedlings (control) had the smallest shoot diameter of shoot (1.05, 1.44, 1.52 mm at 30, 60 and 90 DAP, respectively), ~~and~~ the minimum lowest length of sprouts per stem cutting was recorded (1.06, 1.38 and 2.82 cm at 30, 60 and 90 DAP, respectively) in control. The shoot diameter increased ~~shoot diameter was~~ due to the uptake of NPK by the plants which was improved by the bio-fertilizers used applied. Similarly, increased length of sprouting increased due to because of the increased availability of NPK and uptake of other nutrients uptake. The results of experiment as conducted

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by Vermaet *al.* (2019) in dragon fruit and Rana *et al.* (2020) research on sweet orange were in accordance with these findings. The beneficial nutrients provided by the bio-fertilizers, caused the diameter of the seedlings to increase. Both Ganeshnauth *et al.* (2018) study on pepper plants and obtained the same findings.

Fresh weight of shoot-(g):

The data on the shoot fresh weight of dragon fruit cuttings as influenced by different concentrations of bio-fertilizers with different combination are furnished in table 1. The treatments shoot fresh weight per cutting differed significantly at 30, 60 and 90 days after planting DAP. The highest fresh weight of shoot fresh weight was seen in dragon fruit cuttings treated with (T₃) Azotobacter (2ml) + PSB (1ml) (14.97, 24.69 and 51.34 g, respectively). The lowest fresh weight was seen found in (T₁) control (9.51, 18.46 and 24.28 g, respectively). The observation on days taken to sprout initiation, number of grouts per cutting and shoot diameter recorded at 30, 60 and 90 DAP. The data recorded from the present studies were subjected to analysis by using standard method suggested by Panse Sukhatme (1967).

Dry weight of shoot-(g):

The stem cuttings of dragon fruit showed significant differences among the treatments and the control for in terms of shoot dry weight. The untreated cuttings showed the least dry weight of shoot dry weight at all their growth stages of its growth. This may be because of slow sprout initiation, minimum leaf area and a smaller number of leaves.

The differences among the treatments may be due to bio-fertilizers which activate shoot growth, resulting in elongation of stems and leaves through cell division accounting for higher dry weight of shoot. The results are in agreement line with the findings of Deviet *al.* (2019) in Lemon lemon. Among the treatments, application of (T₃) Azotobacter (2ml) + PSB (1ml) showed the higher weight of shoot dry matter. This could be due to earliness in sprouting, increase in number of leaves and leaf area and higher shoot fresh weight. Similar results are in conformity with the findings of Deviet *al.* (2019) in Lemon lemon cuttings.

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Table 1: Effect of bio-fertilizer on shoot growth parameters of dragonfruit (<i>Hylocereus undatus</i> L.) cuttings:																							
Sr. No.	Treatment	Number of days taken for sprouting	sprouting percentage			Number of sprout per cutting			Sprout and shoot length (cm)			Diameter of shoot /cutting (cm)			Number of spines/aerole			Shoot fresh weight per cutting (g)			Shoot dry weight per cutting (g)		
			30 DAP	30DA P	60DA P	30DAP	60DAP	90DAP	30DA P	60DA P	90DA P	30DA P	60DA P	90DA P	30DA P	60DA P	90DA P	30DA P	60DA P	90DA P	30DA P	60DA P	90DA P
T1	T1- Control	16.24	11.44	18.22	0.32	1.12	1.43	1.06	1.38	2.82	1.05	1.44	1.52	3.23	3.64	3.79	9.51	18.46	24.28	1.85	3.77	6.85	
T2	T2- Azotobacter(1%)	14.45	16.45	28.12	0.45	1.15	1.55	1.42	3.45	7.85	1.25	2.15	2.99	3.42	3.98	4.25	12.85	20.15	31.45	3.15	5.45	9.15	
T3	T3- PSB (1%)	13.25	15.25	27.16	0.42	1.14	1.53	1.39	3.25	8.15	1.56	2.25	3.15	3.37	3.87	4.23	11.75	19.85	30.38	2.95	5.25	9.05	
T4	T4- Azotobacter(2%)	13.12	19.33	35.18	0.56	1.25	1.65	1.55	4.55	9.12	2.05	2.89	3.14	3.45	4.01	4.46	12.95	21.25	35.44	3.25	5.85	9.25	
T5	T5- PSB(2%)	11.25	21.27	36.25	0.58	1.28	1.72	1.65	3.75	8.76	1.69	1.78	2.85	3.56	4.12	4.65	13.25	22.15	37.63	3.45	6.12	9.45	
T6	T6- Azotobacter(1%) + PSB (1%)	12.36	25.47	34.56	0.61	1.35	1.76	1.75	5.75	9.32	2.00	2.26	3.25	3.65	3.99	4.76	14.15	21.85	41.26	3.75	6.45	9.75	
T7	T7- Azotobacter(1%) + PSB (2%)	9.46	29.38	39.44	0.65	1.51	1.85	1.95	5.25	12.33	2.21	3.01	3.85	3.78	4.24	4.82	14.35	23.65	46.74	3.96	6.88	10.01	
T8	T8- Azotobacter(2%) +	7.95	33.33	49.88	0.75	1.53	2.05	2.45	7.01	14.75	2.45	3.15	4.12	3.99	4.56	5.02	14.97	24.69	51.34	4.12	7.48	10.64	

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	PSB (1%)																						
T_9	<u>T_9</u> Azotobacter(2%) + PSB (2%)	8.15	31.68	48.68	0.72	1.48	1.99	2.39	6.36	14.25	2.13	2.99	3.99	3.88	4.45	4.99	14.75	24.25	50.16	4.01	7.36	10.25	
	S.Em(\pm)	0.132	0.325	0.535	0.008	0.027	0.042	0.023	0.062	0.182	0.03	0.04	0.06	0.036	0.047	0.067	0.183	0.296	0.559	0.077	0.087	0.173	
	<u>C.D.LSD(at5%)</u>	0.399	0.984	1.618	0.025	0.081	0.128	0.070	0.187	0.550	0.10	0.12	0.19	0.110	0.141	0.202	0.552	0.896	1.691	0.233	0.262	0.522	

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Conclusion:

From the experimental results, it may be concluded that among the different treatments of bio-fertilizers either single or in combination have great potential to accelerate shooting in stem cuttings of dragon fruit. Among all of the treatments, Azotobacter (2%) + PSB (1%) gave better results with respect to shooting parameters followed by the treatment, Azotobacter (2%) + PSB (2%). Based on the findings of current investigation, it is recommended that vegetative method of propagation through stem cuttings in dragon fruit treated with bio-fertilizers is a reliable method for commercial production of planting materials and it is quick and economical also.

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