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

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 (*Hylocereusundatus*L.) during the year of 2022-23. The experiment was laid out in a randomized complete block design(RCBD)with three replications. There were 09 treatments, viz., T_1-Control,T_2-Azotobacter(1%),T_3-Phosphate-solubilizing bacteria-1%),T_4-Azotobacter(2%),T_5- Phosphate-solubilizing bacteria (2%),T_6-Azotobacter(1%) + Phosphate-solubilizing bacteria (1%), T_7-Azotobacter(1%) + Phosphate-solubilizing bacteria (2%), T_8- Azotobacter(2%) + Phosphate-solubilizing bacteria (1%)andT_9-Azotobacter(2%)+ Phosphate-solubilizing bacteria (2%).Treatments have showed significant differences among the growth parameters in terms of number of days taken for sprouting, percent sprouting, number of sprouts per cutting, length of the newly emerged shoot, diameter of shoot, average number of spine/areoles, diameter of shoot average number of spine/areoles.

Among the treatment combination least number of days taken for sprouting ,maximum percent sprouting , maximum number of sprouts per cutting, maximum increase in length of the newly emerged shoot, maximum number of spine/areoles, maximum increase in diameter of shoot, maximum fresh weight of shoot and maximum dry weight of shoot was found in treatment T_8- Azotobacter(2%) + Phosphate-solubilizing bacteria (1%) followed by T_9-Azotobacter(2%)+ Phosphate-solubilizing bacteria (2%) while minimum has recorded in T1(Control).

Keywords:bio-fertilizers,Shootgrowth,dragon fruit cuttings,growthparameters.

Introduction:

Dragon fruit (*Hylocereus undatus*) is a cactus, belonging to family cactaceae. Recently, dragon fruit has been introduced as super fruit in India. Its 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, pitahaya, night blooming cereus, Belle of the Night, Cinderella plant, and Jesus in the Cradle. The fruit is named as Pitaya because of thebracts or scales on the fruit skin and he 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 attracts the growers from different parts of India to cultivate this fruit crop. Dragon fruit 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, phosphorous and calcium which help to develop strong bones, teeth and skin. It isconsideredas‘healthfruit’.Betalainshaveagreatpotentialincolouringabroadarrayoffood.Inthisview,betacyaninsfromredcoloureddragonfruitaremostpromising,notonlyascolouringagentsbutalsoinpossessingantiradicalpotential.(Gunasena and Pushpakumara,2005 and Gunasena *etal*.,2005).Dragonfruitwasintroducedin1990for 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 (Barbeu,1990,WuandChen,1997*)*.Theplantspropagatedthroughstemcuttingsstartsfloweringwithin12to18monthsafterplanting.Growingmedia 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 maintains soil health. Therefore, the experiment was conducted study the effect of bio-fertilizers on the shoot growth of dragon fruit cutting

Material and Methods:

The present investigation was carried out at Horticulture Research Farm, Department of Horticulture, Babasaheb Bhimrao Ambedkar University(A Central University),Lucknow, Uttar Pradesh, India during the year of 2022-23tostudytheeffect of bio-fertilizers on shoot growth of dragon fruit cuttings under open field condition. The experiment was laid out in randomized complete block design (RCBD) with three replications.The various treatment combinations of bio-fertilizerswereT_1-Control,T_2-Azotobacter(1%),T_3- Phosphate-solubilizing bacteria (1%),T_4-Azotobacter(2%),T_5- Phosphate-solubilizing bacteria (2%),T_6-Azotobacter(1%) + Phosphate-solubilizing bacteria (1%), T_7- Azotobacter(1%) + Phosphate-solubilizing bacteria (2%), T_8- Azotobacter(2%) + Phosphate-solubilizing bacteria (1%)andT9-Azotobacter(2%)+ Phosphate-solubilizing bacteria (2%).Number of cuttings in each replication was two. Thus, a total of 54 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 media was prepared by mixing of sand, soil and FYM with 2:1:1 ratio. Data on growth parameters of dragon fruit in terms of number of days to sprouting, sprouting percentage, number

of sprout per cutting,sprout length, shoot length, shoot diameter, number of spines/areole, shoot fresh weight and shoot dry weight were recorded at 30, 60 and 90 days after planting (DAP).Data recorded from the present studies were subjected to analysis by using standard method suggested by Panse and Sukhatme (1967).

Result and Discussion:

Number of days to sprouting

Number of days to sprout initiation varied significantly by the influence of bio-fertilizers and their combination. Bio-fertilizer combination contained Azotobacter (2ml) + PSB (1ml) (T_8) showed significantly less (27.95 days) time for sprout initiation followed by Azotobacter (2ml) + PSB (2ml) (28.15 days), whereas the control treatment (T_1) 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 Slankis (1973) who stated that bio-fertilizer raised the concentration of plant growth regulators in 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.

Percent sprouting

The data pertaining to sprouting percentage as influenced by various concentrations and combinations of bio-fertilizers with at different stages of growth are presented in table 1. The highest percentage of sprouting were recorded in cuttings treated with treatment (T_8) Azotobacter (2ml) + PSB (1ml) at 30 and60 DAP(33.33% and 49.88%, respectively). While the control treatment (T_1) showed the 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 (2012) and in shea tree by Abdullahi *et al.* (2012). This finding was also supported by Kaur (2017) in Mango.

Number of sprouts per cutting

At 30, 60 and 90 DAP, significant differences were observed on the number of sprouts per cutting among different combinations of bio-fertilizers. Among the bio- fertilizers, the highest numbers of sprouts per cutting (0.75, 1.53 and 2.05 was recorded in Azotobacter (2ml) + PSB (1ml) (T_8) combination at 30, 60 and 90 DAP, respectively). The lowest numbers of sprouts per cutting (0.32, 1.12 and 1.43) were observed at 30, 60 and 90 DAP, respectively) in the control (T_1). 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 (2012) and in shea treeby Abdullahi*et al.* (2012). This finding was supported by Kaur (2017) in mango.

Shoot diameter and length of sprout

Bio-fertilizers and their combinations had significant influence on the diameter of shoot.. The mixture applied with Azotobacter (2ml) + PSB (1ml) (T_8) showed the largest diameter of shoot (2.45, 3.15, and 4.12 mm at 30, 60 and 90 DAP, respectively) followed by Azotobacter (T_9) (2.13, 2.99 and 3.99 cm at 30, 60 and 90 DAP, respectively).The largest length of sprout per stem cutting (2.45, 7.01 and 14.75 cm 30, 60 and 90 DAP respectively) was also given by the same treatment (T_8). Statistically similar results were found in T_9 treatment (2.39, 6.36 and 14.25 cm at 30, 60 and 90 DAP). The un-inoculated seedlings (control) had the smallest diameter of shoot (1.05, 1.44, 1.52 mm at 30, 60 and 90 DAP, respectively). The 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 due to the uptake of NPK by the plants which was improved by the bio-fertilizers applied. Similarly, length of sprouting increased because of the increased availability of NPK and uptake of other nutrients. The results of experiment as conducted by Verma *et al.* (2019) in dragon fruit and Rana *et al.* (2020) 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. Ganeshnauth *et al.* (2018) study on pepper plants and obtained the same findings.

Fresh weight of shoot

Shoot fresh weight of dragon fruit cuttings as influenced by different concentrations of bio-fertilizers are furnished in table 1. The shoot fresh weight per cutting differed significantly at 30, 60 and 90 DAP. The highest fresh weight of shoot was seen in dragon fruit cuttings treated with (T_8) Azotobacter (2ml) + PSB (1ml) (14.97, 24.69 and 51.34 g, respectively). The lowest fresh weight was found in (T_1) control (9.51, 18.46 and 24.28 g, respectively).

Dry weight of shoot

The stem cuttings of dragon fruit showed significant differences among the treatments in terms of shoot dry weight. The untreated cuttings showed the least dry weight of shoot at all their growth stages. This may be because of slow sprout initiation, minimum leaf area and 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 with the findings of Devi *et al.*

(2019) in lemon. Among the treatments, application of (T_8) 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 Devi *et al.* (2019) in lemon cuttings.

Table1:Effect of bio-fertilizers on the shoot growth parameters of dragon fruit cuttings

Treatment	Number of days to sprouting	Sprouting percentage		Number of sprout per cutting			Sprout and shoot length (cm)			Diameter of shoot /cutting (cm)			Number of spines/areole			Shoot fresh weight per cutting (g)			Shoot dry weight per cutting (g)		
	30 DAP	30DAP	60DAP	30DAP	60DAP	90DAP	30DAP	60DAP	90DAP	30DAP	60DAP	90DAP	30DAP	60DAP	90DAP	30DAP	60DAP	90DAP	30DAP	60DAP	90DAP
T_1 -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
T_2- 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- 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
T_4- 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- 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
T_6- 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
T_7- 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 - Azotobacter(2%)+ PSB (1%)	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
T_9- 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(±)	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
C.D.at 5%	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

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. Of the treatments, Azotobacter (2%) + PSB (1%) gave better results with respect to shooting parameters followed by the treatment, Azotobacter (2%) + PSB (2%). It is recommended that vegetative method of propagation through stem cuttings in dragon fruit treated with bio-fertilizers can be reliable for commercial production of planting materials and it is quick method also.

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