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Comparative performance of different methods of propagation for multiplication of bush pepper (*Piper nigrum L.*)

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Abstract
An investigation comparative performance of different methods of propagation for multiplication of bush pepper was conducted at College of Horticulture, Dapoli, Dist. Ratnagiri during the year 2020-2021. The experiment was conducted in factorial randomized block design with three replications. It consisted of two factors *viz*. methods of propagation and month of propagation. The results revealed that maximum survival percentage, sprouting percentage, survival percentage, days required for initiation of sprouting, days required for completion of sprouting, number of leaves, leaf area, length of root was recorded in T3M3 (Grafted seedling in month of June).

Keywords: Bush pepper, Propagation, Grafting, Cutting, Air-layering.

Introduction
Black pepper (*Piper nigrum* L.) is the oldest and most ancient spice in the family piperaceae and called as "King of spices" (Damanhouri, 2014) [2]. It is one of the most economically important spice crops of the world. Bush Pepper is simply a miniature of Black Pepper (*Piper nigrum* L.) raised from plagiotropic branches of pepper plant resulting into a pepper bush instead of a vine. In Konkan region of Maharashtra, the black pepper variety Panniyure - 1 generally grown as bush pepper at a spacing of 1×1m under 50% shade net or using polyhouse under protected cultivation. (Sharon *et al.*, 2019) [9]. Bush pepper is an alternative to the climbing pepper as it has potential for cultivation in homestead situation. In case of propagation, it is observed that the rooting of the laterals for making planting material for bush pepper is difficult and has much lesser success per cent. Pepper is being leader of spices and the demand for bush pepper cultivation is increasing at alarming rate with the view to produce good quality planting material with high percentage of success is the need of hour hence, further many scientists has worked in black pepper as well as in crops belongs to piperaceae family but very less work has been found in use of the different methods of propagation and performance in the propagation of the Bush Pepper so other alternative methods of propagation *viz.* layering and grafting needs to be exploited for commercial propagation and good success. Hence, considering the importance of these aspects the present investigation was taken on bush pepper at college of Horticulture, Dapoli, Ratnagiri (M.S.)

Material and Methods
The field experiment on bush pepper. was conducted at Nursery no. 4 College of Horticulture, Dapoli, Ratnagiri (M.S.). The experiment was carried out in factorial randomized block design with three replications. There were two factors *viz*. Methods of propagation T1 – Cutting, T2-Grafting on rooted cuttings, T3-Grafting on seedlings, T4- Air layering by notching at node with single girdling, T5 -Air layering by notching at node with double girdling, T6-Air layering by notching, T7 -Air layering by single girdling, T8 -Air layering by double girdling and month of propagation (1st week of April, May and June respectively). Media was prepared with soil and FYM in 3:1 proportion and the cuttings, grafts and layers were immediately planted in polybags *viz*. 4" × 6". The observations were recorded on growth parameters and data was analysed by using standard methods as described by Panse and Sukhatme (1995) [8].

Result and Discussion
At 90 Days After Treatment, the highest sprouting percentage (87.91%) was recorded in

treatment T3 which was significantly superior over the other treatments. The highest sprouting percentage (66.32 %) was recorded in treatment M3 (June) which was significantly superior over the other months. The treatment combination T3M3 recorded the highest sprouting percentage which was 91.52 % at 90 DAT which was significantly superior over other treatment combinations. More sprouting in T3M3 might be due to high humidity and less fluctuation in temperature and good cambial connectivity in grafting. The similar result was also found by Velsalakumar (1991) [6] who reported that per cent sprouting (83.30 %) were highest in jackfruit when soft wood grafting was done in June.

At the end of experiment *i.e.*, after 180 days after treatment, treatment T3 recorded the highest survival percentage (49.15 %) which was significantly superior over the other treatments. The highest survival percentage (44.64 %) was observed in treatment M3 (June) in the end of the investigation *i.e* 180 DAT. The treatment combination T3M3 observed the highest (49.60 %) survival percentage which was superior over the other treatment combination. The higher survival percentage was found in treatment combination T3M3 (Grafted seedling in month of June). It might be due to the good callus formation of softwood grafting leads to early wound healing of tissue at scion stock joint in grafting because of high humidity and temperature available in month of June which help to early recovery of union wound. The findings of present results agreed with Gunjate (1989) [5] in mango (72-78%) Velsalakumar (1991) [6] in jackfruit (61.67%).

The minimum days required for initiation of sprouting (10.60 days) were recorded under treatment T3. The minimum days required for initiation of sprouting (10.76 days) were recorded in treatment M3 (June). The minimum (9.02 days) days required for initiation of sprouting observed in T3M3 **(**Grafted seedling in month of June). The early initiation of sprouting was recorded in seedling grafted in month of June. It might be due to the favourable climatic conditions namely high rainfall; high humidity helps to early wound healing in scion and rootstock. Similar result found by Giri and Lenka (2007) [4] graft in jamun, the minimum day taken to sprouting was 8.66 days in June and Beshir *et al*. (2019) [1] in mango plant grafted through cleft grafting with minimum number of days to bud sprout when propagated in the month of June 18.87 days.

The treatment T3 has been perceived minimum days required for the completion of sprouting (39.55 days). The minimum days required for completion of sprouting (39.49 days) was observed in treatment M3 (June), The minimum days required for the completion of sprouting (39.02 days) was observed in the treatment combination T3M3. The early completion of sprouting was recorded in grafting in the month of June. It might be due to the less temperature fluctuation in June promotes scion and stock to connected so fast due to high humidity and start nutrient uptake resulted in higher survival percentage similar result was found by Upadhya *et al*. (2014) [11] in mango (18.83 days) when soft wood grafting was done in June.

In the end of experiment *i.e.*, at 180 DAT, the maximum number of leaves (4.36) recorded with treatment T3 at 180 DAT. The maximum number of leaves (5.98) were recorded in treatment M3 (June) which were significantly superior over the other months, In the end of trial means 180 DAT, treatment combination T3M3 observed the highest number of leaves (6.07) which were superior over the other treatment combination. The maximum number of leaves found in grafted seedling in month of June it might be due to high humidity as compared to the rest of the months and scion and stock connected so fast which starts to increase the number of leaves in June in grafting coupled with rapid physiological condition. Similar result found by Mulla *et al*. (2011) [7] in jamun. He stated that the maximum number of leaves (12.48) were recorded in the softwood grafting in month of May-June. Further, the maximum leaf area (105.86 cm^2) observed in treatment T3 which was significantly superior over other treatments. In the end of trial means at 180 DAT, the maximum leaf area (101.95 cm^2) of the plant was recorded in treatment M3 (June). The treatment combination T3M3 observed the maximum leaf area (107.83 cm^2) of the plant which was significantly superior over the rest of the treatment combinations. The maximum leaf area of the plant was recorded in Grafted seedling in month of June. It might be due to in grafting leads to early wound healing process in June and increase in humidity better physiological activities viz, photosynthesis and respiration. Similar result was found by Ghritlahare and Ashutosh (2018) [3], The sapota plants propagated in month of June was recorded with maximum number of leaves per plant i.e., 15.40 in softwood grafting.

The maximum length of root (34.74 cm) was recorded under treatment T3 which was at par with T2 (32.58). The maximum root length (31.43 cm) was observed under M3 (June) which was significantly superior over the other months. The treatment combination T3M3 recorded the maximum root length (35.82 cm). In case of grafted seedling in month of June, root length was best due to congenial environment conditions that helped in early wound healing and cell activity started as well as nutrient uptake started through root. In June month relative humidity was also increased so stock and scion connected early resulted in rapid physiological activities and growth viz. length of sprout, number of sprouts, number of leaves etc. Similar results were found by Sundhariaya *et al*., (2016) [10] in long pepper.

Table 1: Effect of different propagation methods, months of propagation and their interaction on days required for initiation of sprouting

Days required for initiation of sprouting				
	M_1	**M_2**	**M_3**	**MEAN**
T_1	11.57	11.22	10.82	11.20
T_2	11.27	10.79	10.24	10.76
T_3	11.05	10.70	10.04	10.60
T_4	12.04	11.35	10.76	11.38
T_5	12.13	11.48	10.88	11.50
T_6	12.15	11.74	11.02	11.64
T_7	12.24	11.82	11.12	11.73
T_8	12.32	11.80	11.18	11.77
MEAN	11.85	11.36	10.76	11.32
	S.E.m (±)	S.E.d (±)	CD 5%	F-test
T	0.014	0.020	0.041	SIG
M	0.008	0.011	0.021	SIG
T X M	0.025	0.035	0.071	SIG

T_1: cutting	T_5: Air layering by notching at node with double girdling	M_1: April
T_2: Grafting on rooted cuttings	T_6: Air layering by notching	M_2: May
T_3: Grafting on seedlings	T_7: Air layering by single girdling	M_3: June
T_4 : Air layering by notching at node with single girdling	T_8: Air layering by double girdling	

Table 2: Effect of different propagation methods, months of propagation and their interaction on Leaf area of plant

Leaf area of plant (cm^2)												
	30 DAT				60 DAT				90 DAT			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
T_1	35.08	39.04	40.82	38.31	45.70	47.81	49.33	47.61	62.14	64.85	66.99	64.66
T_2	36.36	40.35	39.97	38.89	46.37	49.83	50.32	48.84	63.81	65.84	67.81	65.82
T_3	39.03	41.02	43.01	41.02	48.61	50.14	52.73	50.49	64.56	66.19	68.71	66.49
T_4	33.31	37.14	40.05	36.84	44.31	46.57	48.77	46.55	59.71	62.08	64.07	61.95
T_5	33.91	36.83	38.91	36.55	44.81	44.31	46.08	45.07	59.00	60.04	62.01	60.35
T_6	33.24	36.81	39.28	36.44	43.12	45.02	47.04	45.06	58.02	59.23	62.28	59.84
T_7	33.84	36.01	38.98	36.28	42.19	44.51	46.81	44.50	57.98	59.61	61.84	59.81
T_8	33.72	36.16	38.88	36.25	42.51	44.51	46.42	44.48	57.21	59.85	61.23	59.43
Mean	34.81	37.92	39.99	37.57	44.70	46.59	48.44	46.58	60.30	62.21	64.37	62.29
	S.E.m (±)	S.E.d (±)	CD 5%	F-test	S.E.m (±)	S.E.d (±)	CD 5%	F-test	S.E.m (±)	S.E.d (±)	CD 5%	F-test
T	0.091	0.129	0.259	SIG	0.064	0.090	0.182	SIG	0.032	0.045	0.090	SIG
M	0.048	0.067	0.135	SIG	0.033	0.047	0.095	SIG	0.017	0.023	0.047	SIG
T X M	0.158	0.223	0.449	SIG	0.111	0.157	0.315	SIG	0.055	0.078	0.157	SIG

Table 3: Effect of different propagation methods, months of propagation and their interaction on days required for initiation of sprouting

	M_1	M_2	M_3	Mean
T_1	11.57	11.22	10.82	11.20
T_2	11.27	10.79	10.24	10.76
T_3	11.05	10.70	10.04	10.60
T_4	12.04	11.35	10.76	11.38
T_5	12.13	11.48	10.88	11.50
T_6	12.15	11.74	11.02	11.64
T_7	12.24	11.82	11.12	11.73
T_8	12.32	11.80	11.18	11.77
Mean	11.85	11.36	10.76	11.32
	S.E.m (±)	S.E.d (±)	CD 5%	F-test
T	0.014	0.020	0.041	SIG
M	0.008	0.011	0.021	SIG
T X M	0.025	0.035	0.071	SIG

Table 4: Effect of different propagation methods, months of propagation and their interaction on days required for completion of sprouting

	M_1	M_2	M_3	Mean
T_1	40.21	39.80	39.30	39.77
T_2	40.05	39.90	39.23	39.73
T_3	40.05	39.56	39.02	39.55
T_4	40.25	40.01	39.49	39.92
T_5	40.87	40.24	39.70	40.27
T_6	40.89	40.34	39.69	40.31
T_7	41.01	40.26	39.71	40.33
T_8	40.99	40.38	39.74	40.37
Mean	40.54	40.06	39.49	40.03
	S.E.m (±)	S.E.d (±)	CD 5%	F-test
T	0.018	0.025	0.050	SIG
M	0.009	0.013	0.026	SIG
T X M	0.031	0.043	0.087	SIG

Table 5: Effect of different propagation methods, months of propagation and their interaction on number of leaves

	M_1	M_2	M_3	Mean
T_1	2.55	3.70	6.02	4.09
T_2	2.74	3.84	6.05	4.21
T_3	2.93	4.09	6.07	4.36
T_4	2.48	3.67	5.97	4.04
T_5	2.44	3.40	5.95	3.93
T_6	2.37	3.35	5.94	3.89
T_7	2.27	3.32	5.99	3.86
T_8	2.26	3.27	5.87	3.80
Mean	2.51	3.58	5.98	4.02
	S.E.m (±)	S.E.d (±)	CD 5%	F-test
T	0.063	0.090	0.180	SIG
M	0.033	0.047	0.094	SIG
T X M	0.110	0.155	0.312	NS

Table 6: Effect of different propagation methods, months of propagation and their interaction on Leaf area

	M_1	M_2	M_3	Mean
T_1	99.46	101.17	103.48	101.37
T_2	102.45	103.24	104.82	103.50
T_3	104.62	105.13	107.83	105.86
T_4	98.02	100.47	102.58	100.36
T_5	97.58	98.08	99.19	98.28
T_6	96.54	97.54	99.62	97.90
T_7	96.81	97.05	99.11	97.66
T_8	95.07	96.53	98.94	96.85
Mean	98.82	99.90	101.95	100.22
	S.E.m (±)	S.E.d (±)	CD 5%	F-test
T	0.186	0.263	0.530	SIG
M	0.097	0.138	0.277	SIG
T X M	0.323	0.456	0.918	SIG

Table 7: Effect of method of propagation month of propagation and their interaction on root length

	M1	M2	M3	Mean
T1	30.22	30.39	32.83	31.15
T2	32.03	32.10	33.61	32.58
T3	34.13	34.28	35.82	34.74
T4	29.02	29.20	30.70	29.64
T5	28.51	28.64	30.22	29.12
T6	28.29	28.34	29.97	28.87
T7	28.13	28.20	29.69	28.67
T8	27.10	27.38	28.61	27.69
Mean	29.68	29.82	31.43	30.31
	S.E.m (±)	S.E.d (±)	CD 5%	F-test
T	1.061	1.500	3.020	SIG
M	0.554	0.784	1.577	SIG
T X M	1.838	2.599	5.231	NS

Conclusion

The above investigation helps to conclude that in grafting method T3 (Grafted seedling) recorded high survival percentage as compared to all other propagation methods with better performance in all parameters under studied. In case of month of propagation, the treatment M3 (June) recorded highest survival percentage as compared with M1 (April) and M2 (May) and recorded highest values in all parameter under studied. Thus, it is evident that propagation in month of June gives better performance in bush pepper. The best treatment combination effect for obtaining higher survival percentage and good growth of bush pepper was recorded in T3M3 (Grafted seedling in month of June).

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