www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(10): 564-571

www.thepharmajournal.com
Received: 04-07-2021
Accepted: 17-09-2021

R Praveen
Department of Plantation, Spices, Medicinal and Aromatic Crops, Bidhan Chandra Krishi Viswa Vidyalaya (BCKV), Mohanpur, West Bengal, India

A Bandyopadhyay
Department of Plantation, Spices, Medicinal and Aromatic Crops, Bidhan Chandra Krishi Viswa Vidyalaya (BCKV), Mohanpur, West Bengal, India

DK Ghosh LKN
Department of Plantation, Spices, Medicinal and Aromatic Crops, Bidhan Chandra Krishi Viswa Vidyalaya (BCKV), Mohanpur, West Bengal, India

P Dutta
Department of Fruit Science, Faculty of Horticulture, Bidhan Chandra Krishi Viswa Vidyalaya (BCKV), Mohanpur, West Bengal, India

Corresponding Author:
R Praveen
Department of Plantation, Spices, Medicinal and Aromatic Crops, Bidhan Chandra Krishi Viswa Vidyalaya (BCKV), Mohanpur, West Bengal, India

Performance and economics of soft wood grafts in cashew nut (*Anacardium occidentale* L.) by the application of different types of degradable grafting tapes

R Praveen, A Bandyopadhyay, DK Ghosh LKN and P Dutta

Abstract
The study focused on cashew nursery by evaluating different types of degradable grafting tapes to obtain the quality growth in cashew nut planting material. The production of cashew grafts involves labour and single use polythene at different stages. An assessment of grafting performance of cashew nut was carried in a field study for two consecutive years during 2018-19 and 2019-20 using degradable grafting tapes to replace use of polythene tape in grafting. The results showed that, 180 days after grafting (DAG) among the different types of treatments maximum length of new scion growth (8.36 cm), higher number of scion leaves (15.76), highest incremental girth of graft joint (0.570 cm), highest incremental girth of scion (0.578 cm), highest incremental girth of root stock (0.584 cm), highest ratio of incremental girth of scion to root stock (0.990), maximum length of tap root (21.07 cm), maximum root diameter (1.21 cm), maximum root volume (6.15 ml), highest dry weight of total shoot biomass (10.73 g) and highest dry weight of total root biomass (2.11 g) were obtained with treatment buddy tape (T_3) followed by natural rubber grafting tape (T_1) which is on par with polythene grafting tape (T_5). Whereas, the treatment T_4 (Cotton grafting tape) resulted in significantly minimum growth rate for all the above studied parameters. Among the different treatment combinations, maximum gross income Rs985.00 was recorded in Buddy tape (T_3), maximum net returns of Rs 197.00 was recorded in treatment T_1 with the benefit cost ratio of 1.25 on account of higher graft survival percentage and lower cost of cultivation. Present study clearly indicated that, use of buddy tapes resulted in overall better performance with respect to growth and development but cost is high needs import. Whereas, natural rubber grafting tapes shows superior results over control for all above parameters with reduced graft care, readily locally available at lower cost, reduced environmental pollution and could be recommended for complete replacement of single use polythene tape in grafting process.

Keywords: Grafting tapes, sustainability, soft wood grafting, growth and development, scion growth, B:C ratio

Introduction
Cashew nut (*Anacardium occidentale* L.) a native species to Brazil was introduced into India by the Portuguese travelers in 16th century for afforestation and soil conservation. India was the first country to exploit international trade in cashew kernels in the early part of 20th century. At present, it is cultivated in more than 32 countries and occupied a significant share in the global agricultural commodity trading. In India, it is grown in more than 17 states in 10.62 lakh ha with a total production of 8.17 lakh MT (Hubbali, 2019). India exported cashew kernels worth of Rs. 5870 crores and cashew nut shell liquid worth Rs. 32.63 crores during 2017-18 which made Indian global share in cashew export to around 30-33% (Hubbali, 2019). Development of cashew in India was mainly established through the use of seedling progenies in the early part of its introduction. However, advancement of the softwood grafting technique became the milestone in the area expansion approach in the lateral period of its introduction. The average global productivity of cashew is about 500 kg/ha, while in India it is about 772 kg/ ha, as the high yielding varieties was multiplied through soft wood grafting and distributed to the growers in India. Cashew has gained status of a commercial crop through technological advancements with respect to propagation, production, management and mechanized processing. Presently, the research on propagation is focused on pre curing time, scion storage (Khan *et al.*, 1989) [8], length of scion sticks (Kadam *et al.*, 1995) [7], different propagation structures (Vishnuvardhana *et al.*, 2004) [18], seasonal influence and age of root stock (Nath 2010), biofertilizers (Rani and Jeeva 2010), PGR's (Singh and Pariari 2013) [16] on grafting success in cashew nut.

Though the soft wood grafting technique is well standardized, the survival percentage of saleable grafts is relatively low (65-70%) (Nayak, 2015) [11]. Use of polythene tapes for securing the graft union needs special attention i.e., after 4-5 months of grafting these tapes must be removed (Nayak, 2015) [11]. However, due to the shortage of labour, most of the farmers are not removing these tapes which lead to poor grafting success due to the girdling at graft joint. The requirement of cashew grafts at national level could not be fulfilled due to the less survival percentage of (65-70 per cent) saleable grafts (Nayak, 2015) [11], which prompted to review on the techniques moderating the grafts growth and maintaining the physiological condition of the graft union. Moreover, use of each polythene tape cover per graft consumes about 2 grams of polythene. At a current production level of 15 million grafts per year (Hubbali 2019) it may accounts to addition of 30,000 tonnes of polythene in to the environment.

Several attempts were made across the globe to find out a suitable alternative material to the polythene tapes. In Algarrodo (*Prosopis alba)*, the maximum success of grafting was obtained under the tunnel with a combination of parafilm for the graft union and black mastic to seal the distal end of the scion (Ewens and Felker, 2003) [3]. Oliveira *et al.,* (2004) [12] studied the effect of plastic and degradable tapes on the budding efficiency and scion development of citrus. The buds were tied to the rootstocks using either one of two types of tape: plastic polyethylene transparent tape or parafilm degradable tape and reported that, shoot development was sensibly higher with degradable tape than plastic tape. Crasweller (2005) [2] observed that, when rubber strips are used to wrap graft union of fruit trees, no further attention usually needed but use of adhesive tapes care must be taken to split the tape vertically about 4 to 6 weeks after growth to prevent girdling. Zenginbal *et al.,* (2006) [2] studied the effect of tying and wrapping materials on budding success in kiwifruit with raffia (black), cannabis fiber, leathery polyethylene band (white), soft rubbery poly ethylene tape (white), paper tape, cotton yarn and plastic string (white) and reported that, soft rubbery plastic tape gave the highest graft-take (100%). Zhang *et al.,* (2015) [21] studied the effect of two self-adhesive grafting tapes *i.e.,* buddy tape, a paraffinic tape that can be stretched over the whole bud after grafting and medical tape, a silky, breathable on grafting success in pecan seedlings and recorded higher grafting success with paraffinic tape than medical tape. Husain *et al.,* (2016) reported that softwood grafts of Jamun tied with degradable tape recorded significantly lowest number of days for sprouting of grafts against control of polythene strip. Many research workers studied the degradable grafting tape influence on graft take and success percentage but meagre review available on growth and development of grafts in cashew nut. In view of these facts, present investigation was designed to explore the possibility of replacing the use of polythene tape with degradable grafting tape and study their performance in growth and development in cashew nut soft wood grafting.

Materials and Methods

Healthy cashew nut seeds weighing 6-7gms were selected from single variety block. The nuts were pre soaked in water to raise the root stock. The healthy seedlings of 60 days were used for grafting as root stock. Scion sticks aged 2-3 months were selected from the cultivar BPP-8. The softwood grafting technique described and reported by Amin (1978) was followed. At the time of grafting, the terminal growth of stock plant was decapitated up to the soft wood portion of the main stem. All the leaves except the lower most one or two pairs were removed from the stock plant. The stem was split vertically in the form of cleft to a length of 4 - 6 cm downward with a sharp knife. Scion stick of about same thickness was used for grafting.

Four different types of degradable grafting tapes T_1 (natural rubber grafting tape); T_2 (parafilm grafting tape) T_3 (buddy tape) T_4 (cotton grafting tape) were used in the present study along with the polythene tape (2 cm wide X 30 cm length and 100 guage thickness) (T_5) which is a common nursery practices followed by farmers. The materials used in the present study were procured from the e-commerce website (Amazon.com) which are available in sufficient quantity. The characteristics of all the grafting tape materials used in the present study are given in table 1. The grafting was practiced for two consecutive seasons during the third week of July 2018 -19 and 2019 - 20.

The field studies were conducted at the experimental plot, Faculty of Horticulture, BCKV, Mohanpur, Nadia, West Bengal for two consecutive years during 2018-19 and 2019-20 in a completely randomized design (CRD) with four replications. Observations were recorded on length of new scion growth (cm), number of scion leaves (nos), incremental girth of graft joint (cm), incremental girth of scion (cm), incremental girth of root stock (cm), ratio of incremental girth of scion to root stock, length of tap root (cm), root diameter (cm), root volume (ml), dry weight of total shoot biomass (g) and dry weight of total root biomass (g) per graft at 180 days after grafting (DAG). The data were analysed by following the Complete Randomized Design according to the procedure described by Panse and Sukhatme (1967) and treatments mean were compared by means of critical differences at 5% probability.

Results and Discussion

Application of different types of degradable grafting tapes exhibited significant differences for all the parameters studied in both years and pooled data (Table 2 to Table 5). Pooled analysis at 180 DAG revealed that, highest length of new scion growth (8.36 cm) and maximum number of scion leaves (15.76) were recorded with treatment buddy tape (T_3) followed by natural rubber grafting tape (T_1) which is on par with polythene grafting tape (T_5). Wazarkar (2009) observed higher incremental length of scion with degradable grafting tapes might be due to less moisture loss which saved the scion stick from drying results in callus development more easily for healing of wound on the cut surface which leads to higher cambial connectivity between stock and scion set in custard apple. The better cambial connectivity results in higher water and nutrient supply via rootstock (Hartmann *et al.* 1990). Khopade and Jadav (2013) reported higher growth and development of scion in degradable grafting tapes compared to the polythene tapes is due to early callus formation through moisture conservation fom graft union in custard apple.

Highest incremental girth of graft joint (0.570 cm), highest incremental girth of scion (0.578 cm), highest incremental girth of root stock (0.584 cm) were recorded in the treatment buddy tape (T_3) followed by natural rubber grafting tape (T_1) and is on par with the polythene grafting tape (T_5). Zenginbal *et al.,* (2006) [2] observed maximum incremental girth of graft union with soft rubbery degradable grafting tape might be due to early healing of graft union, which lead to the faster physiological development of graft that might have

accelerated meristamatic activities near the graft union. It leads to the rapid accumulation of stored metabolites at the graft union in kiwi. Maximum incremental girth of root stock in treatment T_3 (buddy tape) and treatment T_1 (natural rubber grafting tape) might be due to early healing of graft union, early graft take and higher number of scion leaves. All these incremental growth attributes demands more water and nutrients for photosynthetic activity that might have accelerated the meristamatic activities and further increase in girth (Skene *et al.*, 1983; Hartmann *et al.*, 1990).

Ratio of incremental girth of scion to root stock (SRR) close to 1 provides a strong graft union as well as uniform exterior surface (Craig and Dan, 2011). The treatments with SRR ratio of 1 and close to 1 indicate good graft union at respective intervals. The treatment T_3 at 180 DAG recorded higher SRR (0.990) followed by natural rubber grafting tape (T_1). Higher SRR may be due to early healing of graft union, early graft take develops uniform callus growth and regular translocation of nutrients resulted in uniform girth of union. Similar findings were also reported by Craig and Den (2011) in pistachio and Peter and Emmanuelli (2006) in grapes. Maximum length of tap root (21.07 cm), maximum root diameter (1.21 cm), maximum root volume (6.15 ml) were recorded in the treatment buddy tape (T_3) followed by natural rubber grafting tape (T_1) which is on par with polythene grafting tape (T_5). The maximum length of tap root with treatment T_3 (buddy tape) and treatment T_1 (natural rubber grafting tape) may be due to need of more water and nutrients for faster vegetative growth which might have forced the higher root activity that might have resulted into better length of tap root. Highest dry weight of total shoot biomass (10.73 g) and highest dry weight of total root biomass (2.11 g) were recorded in the treatment buddy tape (T_3) followed by natural rubber grafting tape (T_1) which is on par with the polythene grafting tape (T_5). Husain *et al.*, (2016) [6] observed that degradable grafting tape results in early graft take through good callus development leads to more fresh and dry weight of shoot and root biomass in jamun.

Benefit: Cost Ratio

Among the different graft tapes used in the present study, treatment T_3 had recorded the highest gross income per treatment (Rs 985/-) followed by treatment T_1 (Rs 973/-) mainly on account of higher graft survival percentage and healthy graft growth (Table 5). Whereas, the highest net income (Rs197/-) was recorded with T_1 owing to lower cost of cultivation followed by treatment T_3 (Rs 160/-). Negative net income recorded with treatment T_4 and T_2 is due to the lower graft survival percentage coupled with poor growth of grafts and increased cost of production. Further, the treatment, T_1 has recorded highest B:C ratio of 1.25 followed by treatment T_3 (1.19).

Table 1: Characteristics of the grafting tapes used in the present study

Treatments	Type of the grafting type	Manufacturing Country	Technical specifications	Elastic nature	Permeability	Bio-degradability	Self-adhesion	Water-Proofing
T_1	Natural rubber tape	India	Available in colour Black, 0.38mm (thickness) × 16 mm (width) in cut pieces	High	Selective permeability to gases	Yes	No	Yes
T_2	Parafilm tape	United States of America	Available in clear tape in 1" wide rolls with 30 Meters length rolls	High	Selective permeability to gases	Yes	Yes	Yes
T_3	Buddy tape	Japan	Tapes are available in 25mm (width) x 60m (length) with 50 mm perforations rolls	High	Selective permeability to gases	Yes	Self-adhesive When stretched	Yes
T_4	Cotton grafting tape	United States of America	Tape is available in 2 cm (Width) by 450 cm (Length) rolls	Low	Selective permeability to gases	Yes	Yes	Yes
T_5	Polythene tape	India	The tape is available in 100 gauge thickness white colored sheet	Medium	No	No	No	Yes

Table 2: Effect of different types of degradable grafting tapes on length of new scion growth (cm) and number of scion leaves (no) of cashew nut soft wood grafts (*Anacardium occidentale* L.) at 180 days after grafting.

Treatments	Length of new scion growth (cm)			Number of scion leaves (no)		
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
T_1	8.08^{bc}	7.96^{bc}	8.02^{bc}	15.10^{bc}	14.80^{bc}	14.95^{bc}
T_2	7.52^{d}	7.44^{d}	7.48^{d}	12.70^{d}	12.95^{d}	12.82^{d}
T_3	8.42^{a}	8.30^{a}	8.36^{a}	15.93^{a}	15.60^{a}	15.76^{a}
T_4	6.58^{e}	6.42^{e}	6.50^{e}	10.80^{e}	11.20^{e}	11.00^{e}
T_5	7.88^{c}	7.74^{c}	7.81^{c}	14.90^{c}	14.45^{c}	14.67^{c}
S.Em +	0.107	0.105	0.075	0.194	0.192	0.137
CD (0.05)	0.323	0.317	0.217	0.585	0.580	0.395

Table 3: Effect of different types of degradable grafting tapes on incremental girth of graft joint (cm), incremental girth of scion (cm), incremental girth of root stock (cm) and ratio of incremental girth of scion to root stock of cashew nut soft wood grafts (*Anacardium occidentale* L.) at 180 days after grafting.

Treatments	Incremental girth of graft joint (cm)			Incremental girth of scion (cm)			Incremental girth of root stock (cm)			Ratio of incremental girth of scion to root stock		
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
T_1	0.486^{bc}	0.502^{bc}	0.494^{bc}	0.490^{bc}	0.506^{bc}	0.498^{bc}	0.498^{bc}	0.513^{bc}	0.506^{bc}	0.984	0.986	0.985

T_2	0.366^{d}	0.384^{d}	0.375^{d}	0.373^{d}	0.388^{d}	0.381^{d}	0.385^{d}	0.398^{d}	0.392^{d}	0.969	0.975	0.972
T_3	0.558^{a}	0.582^{a}	0.570^{a}	0.566^{a}	0.590^{a}	0.578^{a}	0.572^{a}	0.596^{a}	0.584^{a}	0.990	0.990	0.990
T_4	0.312^{e}	0.295^{e}	0.304^{e}	0.292^{e}	0.292^{e}	0.303^{e}	0.318^{e}	0.298^{e}	0.308^{e}	0.942	0.936	0.939
T_5	0.475^{c}	0.490^{c}	0.483^{c}	0.478^{c}	0.498^{c}	0.488^{c}	0.490^{c}	0.506^{c}	0.498^{c}	0.979	0.984	0.981
S.Em +	0.006	0.006	0.004	0.006	0.006	0.005	0.006	0.007	0.005	NA	NA	NA
CD (0.05)	0.019	0.019	0.013	0.019	0.019	0.013	0.019	0.020	0.013	NA	NA	NA

Table 4: Effect of different types of degradable grafting tapes on length of tap root (cm), root diameter (cm), total root volume (ml), dry weight of total shoot biomass (g) and dry weight of total root biomass (g) cashew nut soft wood grafts (*Anacardium occidentale* L.) at 180 days after grafting.

Treatments	Length of tap root (cm)			Root Diameter (cm)			Total Root Volume (ml)			Dry weight of total shoot biomass (g)			Dry weight of total root biomass (g)		
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
T_1	19.60^{bc}	19.20^{bc}	19.40^{bc}	1.10^{bc}	1.06^{bc}	1.08^{bc}	5.80^{bc}	5.68^{bc}	5.74^{bc}	9.16^{bc}	8.98^{bc}	9.07^{bc}	1.83^{bc}	1.78^{bc}	1.80^{bc}
T_2	14.80^{d}	15.55^{d}	15.17^{d}	0.93^{d}	0.97^{d}	0.95^{d}	5.15^{d}	5.05^{d}	5.10^{d}	7.40^{d}	7.56^{d}	7.48^{d}	1.51^{d}	1.60^{d}	1.55^{d}
T_3	20.85^{a}	21.30^{a}	21.07^{a}	1.18^{a}	1.24^{a}	1.21^{a}	6.12^{a}	6.18^{a}	6.15^{a}	10.61^{a}	10.86^{a}	10.73^{a}	2.07^{a}	2.16^{a}	2.11^{a}
T_4	13.27^{e}	12.70^{e}	12.98^{e}	0.85^{e}	0.81^{e}	0.83^{e}	4.24^{e}	4.10^{e}	4.17^{e}	6.78^{e}	6.86^{e}	6.82^{e}	1.23^{e}	1.15^{e}	1.19^{e}
T_5	19.20^{c}	18.85^{c}	19.02^{c}	1.07^{c}	1.04^{c}	1.05^{c}	5.65^{c}	5.58^{c}	5.61^{c}	8.85^{c}	8.66^{c}	8.75^{c}	1.80^{c}	1.76^{c}	1.78^{c}
S.Em +	0.247	0.246	0.174	0.014	0.014	0.010	0.075	0.074	0.053	0.120	0.120	0.085	0.024	0.024	0.017
CD (0.05)	0.743	0.743	0.503	0.043	0.043	0.029	0.227	0.224	0.153	0.362	0.363	0.246	0.072	0.072	0.049

Table 5: Economic analysis of different types of degradable grafting tapes on growth and development of soft wood grafting in cashew nut.

Treatments	Cost of grafting tape/piece (Rs)	Cost of Graft * (Rs)	Number of plants grafted	Success (%)	Number grafts ready for sale	Cost of production (Rs) / treatment	Gross income (Rs) / treatment	Net income (Rs) / treatment	B:C ratio
	(A)	(B)	(C)	(D)	(E = C X D)	(F = C X B)	(G = E X 40/-*)	(H = G-F)	(I = G/F)
T_1	0.85	25.85	30	81.07	24	776	973	197	1.25
T_2	2.25	27.25	30	43.98	13	818	528	(-) 290	0.65
T_3	2.50	27.5	30	82.1	25	825	985	160	1.19
T_4	3.50	28.5	30	13.87	04	855	166	(-) 689	0.19
T_5	0.20	25.2	30	69.2	21	756	830	74	1.10

* Basic cost of soft wood grafts @ 25/- + degradable tape price.
* Basic cost per graft (Polybag Rs1/-, Seed Rs2/-, potting mixture and filling Rs3/-, cost of scion and precuring charges Rs4/-, grafting charges Rs3/-, labour cost for weeding, irrigation, removal sprouts from root stock Rs7/- and insecticides Rs5/-).
* Price of saleable graft is Rs40/-. * Above data calculated on the basis of pooled data.

Plate 1 A: Natural rubber grafting tape

Plate 1B: Parafilm grafting tape

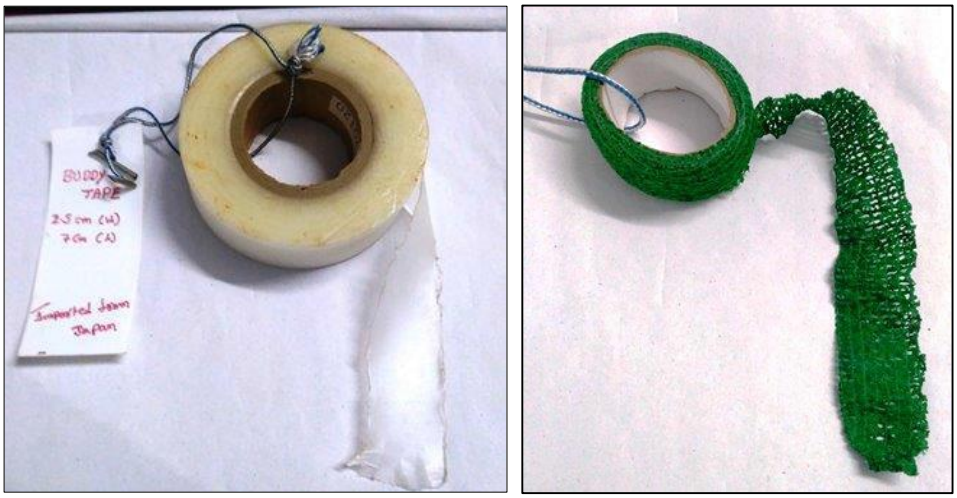

Plate 1C: Buddy Tape **Plate 1D:** Cotton grafting tape

Plate 1: Different types of degradable grafting tapes

Plate 2: Performance of natural rubber grafting tape at different growth stages of cashew nut grafting

Plate 3: Performance of parafilm grafting tape at different growth stages of cashew nut grafting

Plate 4: Performance of Buddy tape at different growth stages of cashew nut grafting

Plate 5: Performance Cotton grafting tape at different growth stages of cashew nut grafting

Plate 6: Performance of polythene tape at different growth stages of cashew grafting

Plate 7: Effect of different types of degradable grafting tapes on growth of cashew nut grafts at 180 DAG

Plate 8: Effect of different types of degradable grafting tapes on root development of cashew grafts at 180 DAG

Conclusion

Present study clearly indicated that, use of buddy tapes resulted in overall better performance with respect to growth and development but cost is relatively higher and not available in the local market. Whereas, natural rubber grafting tapes shows superior results over control for all above parameters with reduced graft care, readily locally available at lower cost, reduced environmental pollution and could be recommended for complete replacement of single use polythene tape in grafting process. Studies with respect to natural rubber grafting tapes on performance of import of nutrients and water, insect pest and disease information and performance at different agro climatic conditions for increased survival and growth of grafts needs further research for commercial application in cashew nurseries.

References

1. Craig EK, Dan EP. Comparison of scion to root stock growth rates among U.S. Pistachio cultivars. Hortsciences 2011;46(2):197-200.
2. Crasweller RM. Book on Grafting and propagating fruit trees. Chapter wrapping and waxing. The Pennsylvania State Univeristy Publisher 2005;2:4-5.
3. Ewens M, Felker P. The potential of mini-grafting for large-scale production of *Prosopis alba* clones. J Arid Environments 2003;55(2):379-387.
4. Hartman H, Kester D, Davies FT. Book on *Plant propagation principles and practices*. Prentice Hall Carrer and Technology Publisher, New jersey 1990;5:221-223.
5. Hubballi VN. Cashew nut Productivity Enhancement and Value addition for Doubling Farmer's Income. Proceedings of National conference on cashew 2019, 17-26.
6. Husain S, Patel MJ, Sanjay KN, Patel AD. Influence of different propagation methods and wrapping material on bud and graft success in Jamun. The Bioscan 2016;11(3):1729-1731.
7. Kadam SG, Nawale RN, Khandekar RG. Effect of scion storage media and duration on success of in situ softwood grafting in cashew. Cashew 1995;9(1):21-25.
8. Khan MM, Kumar DP, Hiremath IG. Success of stored scion sticks used in soft wood grafts of top worked trees. Indian Cashew Journal 1989;19(1):14-15.
9. hopade R, Jadav RG. Effect of different grafting dates and wrapping material on success of soft wood grafting in custard apple. International Journal of Agricultural Sciences 2013;9(2):806-808.
10. Nath JC. Effect of scion and age of root stock on graft success in cashew under Assam conditions. Journal of Plantation Crops 2010;38(2):154-156.
11. Nayak MG. Propagation and nursery management in Cashew nut. E manual on Advances in Cashew Production Technology by ICAR – Directorate of Cashew Research 2015;24:32-40.
12. Oliveira RP, Scivittaro WB, Vargas JR. Plastic and degradable tape on citrus budding. Brazilian Journal of Fruticulture 2004;26(3):564-566.
13. Panse VG, Sukhatme PV. Book on Statistical methods for Agriculture workers. Indian council of Agriculture, New Delhi, 1967.
14. Peter RC, Emmanuelli DR. An Assessment of root stocks for sunmuscat – a new drying variety of grape. Australian journal of grapes and wine research 2006;12:135-140.
15. Rani MSA, Jeeva S. Biofertilizers for enhancing growth of cashew rootstocks. Annals of Plant Protection Sciences 2010;13(1):31-33.
16. Singh LS, Pariari A. Effect of foliar application of plant growth bio regulators on growth and graft success of cashew rootstocks. Research on crops 2013;14(2):530-534.
17. Skene DS, Shepart HR, Howard BH. Characteristic anatomy of union formation in T and chip budded fruit and ornamental trees. Journal of Horticulture Sciences 1983;58:295-299.
18. Vishnuvardhana R, Lingaiah HB, Khan MM, Raju GT. Economics of production of cashew grafts in different propagation structures under eastern dry zones of Karnataka. Cashew 2004;18(4):39-44.
19. Wazarkar SS. Effect of grafting dates and grafting materials on softwood grafting in Sapota (*Manilkara acharas*) under middle Gujarat agro climatic conditions, Thesis submitted to AAU, Anand, 2009.
20. Zenginbal H, Celik H, Ozcan M. The Effect of Tying and Wrapping Materials and their colour on Budding Success in Kiwifruit. Turk J. Agriculture 2006;30:119-124.
21. Zhang R, Fang RP, Dong LL, Zhuang ZL, Hai YH, Pengp T *et al*. Evaluation of Epicotyl Grafting on 25- to 55-day-old Pecan Seedlings. Horti technology 2015;25(3):392-396-.