STANDARDIZATION OF VEGETATIVE PROPAGATION THROUGH SCION GRAFTING OF BAKAN ON THE ROOTSTOCK OF NEEM

THESIS

Submitted to
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
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By

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DECLARATION OF STUDENT

I hereby declare that the experimental work and its interpretation of the Thesis entitled **"STANDARDIZATION OF VEGETATIVE PROPAGATION THROUGH SCION GRAFTING OF BAKAN ON ROOTSTOCK OF NEEM"** or part thereof has neither been submitted for any other degree or diploma of any University, nor the data have been derived from any thesis / publication of any University or scientific organization. The source of materials used and all assistance received during the course of investigation have been duly acknowledged.

Place : Akola **(KULSANGE KOMAL ANANDRAO)**

Date : **Enrolment No. II/1708**

CERTIFICATE

This is to certify that the thesis entitled **"STANDARDIZATION OF VEGETATIVE PROPAGATION THROUGH SCION GRAFTING OF BAKAN ON THE ROOTSTOCK OF NEEM"** submitted in partial fulfilment of the requirement for the degree of "**Master of Science In Forestry (Argoforestry)"** of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafide research work carried out by **Kulsange Komal Anandrao** under my guidance and supervision.

The subject of thesis has been approved by the Student's Advisory Committee.

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(%) - Percent

/ - Per

i.e - that is

et al. - et alia (and other)

etc. - Etcetera

ºC - Degree Celsius

cm - Centimetre

mm - millimeter

g - gram

m - meter

Km - Kilometre

Km/hr. - Kilo meter per hour

Ha. - hectare

DAG - Days After Grafting

Fig. - Figure

IBA - Indole Butyric Acid

Spp. - Species

Jan. - January

Feb. - February

Jul. - July

Aug. - August

Sept. - September

Oct. - October

Nov. - November

Dec. - December

No. - Number

NS - Non significant

PDKV - Panjabrao Deshmukh Krishi Vidyapeeth

CRD - Complete Randomised Design

CD - Critical difference

SE(m)± - Standerd error of mean

Sig. - Significant

Viz., - Videlicet (Namely)

(E) THESIS ABSTRACT

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ABSTRACT

The present study entitled “Standardization of vegetative propagation through scion grafting of Bakan on the rootstock of Neem” was carried out at Department of Forestry, Nursary and Main garden Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidhyapeeth, Akola with the objective.

The study was taken up with objective, to study the effect of different months on scion grafting of Bakan on rootstock of Neem, to find

out the suitable months for higher success of scion grafting of Bakan on rootstock of Neem and to study the growth performance of graft .

An experimental research design was used in Completely Randomized Design with five treatments viz. T_1 (Aug.), T_2 (Sept.), T_3 (Oct.), T_4 (Nov.) and T_5 (Dec.).

The data record in respect of days require for graft-take, percentage of graft-take, days require for sprouting, percentage of sprouting, number of leaves per graft at 30, 60, 90 DAG were subjected to statistical analysis and interpretation of result obtained in the present investigation revealed that in different months treatment of Bakan grafting. September (T_2) was significantly superior in days require for graft-take, percentage of graft-take, days require for sprouting, percentage of sprouting, number of leaves per graft at 30, 60, 90 DAG, as compare to T_1, T_3, T_4 and T_5. It is indicated that the month September create favourable conditions to enhance the vegetative growth of bakan graft.

CHAPTER I

INTRODUCTION

1.1 Background information

Scientific Name **:** *Melia azedarach*

Common Name **:** Chinaberry

Local Name **:** Ghora nim, Gowdnim, Bakam-limdo.

Melia azedarach (Bakan) was first described by Linnaeus in 1753 (Spec.plant.384) belong to family Meliaceae. The generic name is derived from the Greek word melia-manna ash, referring to the resemblance of the leaves to Fraxinus ornus. The specific name is from the Persian ‘azadarakht’ meaning ‘noble tree’. The type was formally described from an Indian cultivar.

It is native of West Asia. It is commonly cultivated for the sake of its handsome flower and as a road side tree in various part of India. It is also found in Iran, W. Pakistan, Burma, Malaysia and China. *Melia azedarach* have been introduced in Chile for ornamental purpose (*Italo Chiffelle et al.,* 2009).

Melia azedarach is often confused with the neem tree *Azadirachta indica*, to which it is related. *A. indica* easily be distinguished by the absence of stellate leaf hair, pinnate leaves (not bipinnate as in *M. azedarach),* 3-lobed stigma (not 5-lobed) and 1 to 2-seeded drups (not up to 5-seeded).

Melia azedarach is typically a medium-sizes tree to 20 m tall with a diameter to 60 cm (Gupta, 1993*). M. azedarach* var. australasica (white cedar) which occur in Australia grown into a large tree up to 45m tall and 12.2 m in diameter in mist closed forest (Doan and Turnbull,1997). Under drier condition the maximum height is 10-1 m. The most common from has rather long branches, which form a loose open crown and rather a straggly growth habit. Another has a dense, umbrella shaped crown. A third from flowers as seedling and continues flowering at irregular interval for few

years, by which time it has reached about 1.8 m in height and then proceed to die *M. azedarach* has shallow root system. The bark is gray-brown and smooth, becoming thick and longitudinally fissured with age. Branches are brown with prominent leaf scars and reddish-brown lenticles. The leaves are bipinnate, wholly or partly tripinnate, more or opposite 15-23 to 80 cm long, glabrescent; petiol 8-30 cm long, terete, lenticellate, swollen at base; pinnae in 3-7 pairs up to 25cm long, petiolute3-7mm long; leaflets in 3-7 pairs, opposite or nearly so, ovate or oblong- lanceolate to elliptical 2-10cm×0.6-3.8 cm, base slightly unequilateral, acute to rounded, apex acuminate, margin entire to variously serrate (Mabbertely, 1984, Ahmed and Idris, 1997). The inflorescence is an axillary loose panical 10-22 cm long, primary branches 5-7.5cm long and secondary branches up to 2cm long, bearing fascicles of flowers on second- year wood (Cunningham *et al.* 1992). The flower bract are 3-10mm long, filiform, caduous bracteoles similar but smaller pedicel 2-3 mm long; purplish to white, fragrant, bisexual or male. The mature fruit is yellowish- brown globular drupe 2-4cm×1-5 cm, containing up to 5 seed in hard endocarp and surrounded by a thin, succulent outer flesh. The seed are oblong, smooth, brown, ca.3.5×1.6mm (Mabbery, 1984; Ahmed and Idris, 1997).

The tree is usually leafless from about December to March or April. The new leaves appear in February- March. The first flowers also appears about the same time, so that the tree is soon covered with mixture of lilac-colour, honey scented blossom and bright green delicately divided leaves, and they continue to appear up to May. Occasionally the tree flowers in December and some tree produce air is permented by the delightful fragrance of its flowers. The fruits which from after the mansoon are at the first bright green in colour and then ripen to yellow accompaind by gradual shrinking and drying, in the cold season, when the fruits appears conspicuous due to leaf- shedding. Flowering in India appears from March- April with fruit ripening during winter (December - January) and remaining on the tree in yellow clusters during the next flowering season (Troup, 1921; Gupta, 1993).

M. azedarach is highly adaptable and tolerates a wide range of climatic and soil condition whether natural or cultivited, and is generally found in tropical, sub-tropical and warm-temperate climates mostly associate with seasonally dry conditions. (Ahmed and Idris,1997) gives climatic indicators for this species: mean maximum temperature of the hottest month may reach 39°C, the mean minimum of the coldest month -5°C. The species is drought hardy with an annual rainfall ranging from 600 to 2000m. In India, rainfall is mainly during the mansoon season (Gupta, 1993).

The species grow on wide range of soil, but best growth is obtained on well-drained, deep, sandy loam while shallow gravelly soil stunt the growth (National Academy of Science, 1983; Gupta, 1993). *M. azedarach* tolerates shallow soils, saline and strongly alkaline soils, but not very acid soils. In India, it generally occure in the Himalayas up to 1800m elevation but 2700m in Himachal Pradesh (Troup and Joshi,1981).

The timber is soft, pinkish to yellow-brown resembling mahogany, with prominent growth ring which give it fairly decorative a (Anderson,1993). The wood is relatively strong, easily worked and light in weight (Keating and Bolza, 1982). Person and Brown (1932) note that the timber air season exceptionally well, is durable, easy to saw and peet. A description of the wood structure for both *M. azedarach* and *M. composita* is also given by Person and Brown (1932). The wood lasts from 1 to 15 years in the ground and rarely attacked by termites through the sapwood is susceptible to susceptible to Lyctus borer.

Melia azedarach L. has long been recognized for its medicinal and insecticidal properties. It has fungicidal, bacterial, antitumor and other medicinal properties. *Melia azeradarach* is traditionally been used as anthelmintic, antilithic, diuretic, emmenagouge, astringent and stomachic (Antara Sen, 2012). It also improve fertility of soil (Nandal and Ravikumar, 2010). Group of cultivars have been selected from these two centers of domestication and introduced to other warm parts of the world. It is one of the most widely cultivated of all tropical trees, sometime become naturalized, notably in west Africa. It has been difficult to separate

naturalized cultivars and wild specimens and as Mabberley (1984) ha pointed out, with widespread cultivation of the tree and destruction of the original forest, it may now be impossible to reconstruct this history anyway.

The wood is extensively used for toys, small boxes, sporting requisites, musical instruments, furniture, veneer, plywood and interior carpentry (Turnbull, 1986). It is also a good fuel wood species (Salim *et al*., 2010) with calorific value of 5043-5176 k cal/kg. It is profitable species for saw and shuttle making. Vercoe (1987) has demonstrated its leaf fodder potential and it is fairly tolerant to salinity (Zwar, 1975). It is often planted as an ornamental shade tree. Several compounds from Cinaberry have been isolated for medicinal for medical purposes. Meliacine, a peptide isolated from leaves of *M. azedarach*, exhibits potent activity against herpes simplex type 1 (HSV-1) (Villimil *et al*., 1965). *M. azedarach* has also been used as an abortifacient, an antiseptic, a purgative, a diuretic, an insect repellent, etc. (Anonymous, 2000). It has some limitation in that its fruit may be toxic to man and pigs (Everist, 1969) and it has potential to become a weed.

1.2 Importance and need of Study:

Melia azedarach L. is short rotation, fast growing species and cylindrical crown when planted in blocks can be selected in Agroforestry. So that it can be used to manufacture life time termite free plywood. But due to its shallow roots system, it can compete with agriculture crops in agroforestry so that attempt was to replace its root system by *Azadirachta indica* to suite in Agroforestry system. It is expected that by using *Azadirachta indica* root stock for grafting scion of *Melia azedarach*, the root competition with agriculture crop will be reduce.

1.3 Objective

1. To study the effect of different months on scion grafting of Bakan on rootstock of Neem,
2. To find out the suitable months for higher success of scion grafting of Bakan on rootstock of Neem.
3. To study the growth performance of graft.

1.4 Hypothesis

While employing the grafting operation, it is necessary to know the appropriate time of grafting, influence of various climatic parameters, source of scion and even the nature of scion material. Adoption of appropriate grafting method in view of different time of operation and nature of scion viz., green terminal shoot may become potential solution for new emerging hurdles related to bakan propagation and multiplication of best quality planting materials, which will be the foundation for a good orchard. The appropriate rootstock for grafting is an important factor considering the root system which will be complete with agriculture crops is essential for competition. Under Agroforestry system, the deep root system rootstock can pave the way for fruit tree competition with Agricultural crop and Agroforestry species for better sustainable result.

1.5 Scope and limitation

M. azedarach L. is short rotation, fast growing species and cylindrical crown when planted in blocks can be selected in agroforestry. The wood is extensively used to manufacture plywood industries. So to encouraging the farmers to the plantation of trees in farm and also maintained the ecological balance. It is cultivated for the sake of its handsome flower and as a side of farm or rode side tree to increasing additional income to the farmer. As result of this, the demand for quality and true to type planting material is increasing. The prime important is to meet the growing demand of planting material of the same, hence it is felt necessary to undertake the studies to determine the most promising rootstock for commercial propagation of bakan.

The softwood grafting method involves separation and severing of the organ from a mother plant, intensive collection of planting material may damage a mother plant. The propagation material cannot be stored for longer period of time under room conditions, the part used to quite often fleshy. Since the new plants raised from this method are not capable of developing strong tap root system, they are more prone to wind damage.

CHAPTER II

REVIEW OF LITERATURE

Success in grafting, subsequent growth of scion shoot and development of the successful graft depend on a number of factors including time of grafting, method of grafting, selection and preparation of scion, rootstock material and environmental conditions (Hartmann *et al*.1997). The work so far done on the effects of nature of scion and grafting time on graft success in bakan are not adequate and conclusive. Nevertheless, some of the important works that are most potential to this thesis works done at different locations have been reviewed in this chapter with appropriate heading and sub heading.

2.1 Effect of Nature of Scion

During the process of grafting, graft wood selection has got vital important in terms of maximum graft success and survivability. Great difficulty was found in selecting scion containing bub in proper stage of maturity which ultimately impair the success rate and survivability of grafts. The performance of graft largely depends on scion condition such as nature, length, vigour, node number per scion and method of grafting rather than time.

The available information on various aspect of effect of nature of scion on growth parameters, graft success and survivability in bakan are very scanty. Hence the relevant literature on other major fruit crops, propagated under similar manner also have been reviewed to strengthen the foundation of this investigation. For better understanding, the information is under the following sub-headings.

2.2.1 Effect of nature of scion on growth parameters

2.2.1.1 Effect of nature of scion on scion growth characteristics

Gunjate *et al.* (1982) working at KKV, Dapoli achieved 55.0 to 64.9 percent success during the period from June to October in mango.

Khalil *et al.* (1983) reported that may to september period as the best time for veneer grafting of Guava, when the success rate was as high as 82-92 percent.

Blashnikov (1984) had reported in trials in the Krasnodar region, scions were cut, seedling rootstocks were lifted and grafting was done all on the same day, in four winter month (Nov., Dec., Jan., and Feb.). Data were tabulated on grafting success, and it is shown that Nov. and Dec. were the best times. The best method of storing scions cut early was in boxes in a cellar at an air temperature of 2-6 ^{0}C, in layers of moist sawdust treated with fungicide compared to soft wood grafting in jack. The maximum success rate recorded was 83.3 percent.

Balabushka (1984) observed short-needled pines gave best graft survival, but long-needled pines gave best height Increment. The presence of cone lets did not affect graft survival or growth. The site condition of the parent trees affected graft survival and growth. Survival was best with graft on the E. side, while growth was best with graft on the S. side grafts survival was similar on the axial and side shots. Grafts on the upper part of stock were best.

Gonchar *et al*. (1984) studied that the winter grafting of *Corylus maxima* on to 2-yr seedling rootstocks of *C. avellana*. Grafts were made from Dec. to March in a heated room. Apical grafts and side grafts gave similar results, and were better than whip-and-tongue grafts. Early grafting (Dec. to Feb.) was better than grafting in March.

Haldankar *et al.* (1985) reported that October month was the best period for softwood grafting in kokam under Dapoli condition, which gave a success of 86 percent.

Desai *et al*. (1984) revelated that the softwood grafting in Jack recorded the highest success (69.33%) in April followed by May (56.0%) at Dapoli (MH).

Tayade *et al*. (1988) Softwood grafting in mango gave higher success (70-100%) during July to September at Akola (MH).

Sarada *et al.* (1991) studied softwood grafting in cashew and obtained 65.43 percent success rate on one month old rootstock in August month at Bapatla conditions.

Gowda and Melanta (1991) at University of Agricultural Sciences, Bangalore, vigorously growing scion sticks of cashew were wedge grafted to the selected rootstocks during September-October, December, January, March-April and June-July. In the June-July grafting, 23.3 percent of scions sprouted, while only 3.3 percent of scion have sprouted from September-October grafting and complete failure was observed in the December-January and March-April grafts.

Madalageri *et al.* (1991) reported that propagation of Jamun by softwood grafting gave 97.5 percent success during June and 50.00 percent during August.

Swamy *et al.* (1993) reported that February and March were the most congenial months for softwood grafting in Jack.

Lenka *et al*. (1993) in their studies on softwood grafting in cashew under Orissa conditions for three years reported significant differences of graft success in different months of grafting. Average monthly (for all 3 years) success ranged from 21.70 percent in December to 72.30 per cent in August. Graft success was positively correlated with minimum temperature and afternoon relative humidity.

Kumar and Mitra (1994) in their studies on standardization of time and propagation techniques in mango cv. Himsagar, found better success rate for all techniques of grafting between June and August and then declined drastically.

Basavaraja (1996) in mango highest average graft success (50.33%) was achieved with grafts made in the first fortnight of August, followed by those made in second fortnight of July. Graft success which is lower in 1989-90 than in other two seasons, possibly due lower humidity and higher temperature.

Sulkeri *et al.* (1997) obtained higher percentage of graft union success in Sapota (80%) under mist house condition.

Krishnakumar (2000) recorded highest percentage of graft success during the month of August in case of softwood grafting in mango at ARS, Arasikere.

Chovatia and Singh (2000) reported that propagation of Jamun by softwood grafting gave 68.8 percent success during June and 64.15 percent success during July month.

Ram and Akhilesh (2005) revealed that the growth of shoot and number of leaves per shoot were maximum in six bud scion stick, showed maximum days for bud burst in aonla softwood grafting under Lucknow condition.

Mulla *et al.* (2009) studies on softwood grafting in jamun. The result revealed that open condition, during June less (26.67) day taken for sprouting.

Raghavendra *et al.* (2011) revealed that multiplication of wood apple plant by softwood grafting among different age of rootstock under poly mist house condition found to be better than open condition, In ten month old rootstock (A_6) less (23.8) days were required for sprouting.

Gehlot *et al.* (2014) in their studies to obtained clone of *Azadirachta indica*, such as the processes of vegetative (micro) propagation and present prospective and future trends for application of new cloning technique aiming for large scale for plant production.

Pohare *et al.* (2014) revealed that in different month of mahua grafting, October (T_4) was significantly superior in days require for graft take, percent of graft take, days require for sprouting, percentage of sprouting, number of sprouting, number of sprout per graft, number of leaves per graft and survival percentage at 60 DAG as compare to other month of treatment and vegrtative growth of mahua graft was also observed maximum when the grafting was done in month of October.

Singh and Singh (2015) revealed that, softwood grafting of mahua and khirni was carried out monthly interval commerncing from July to June during both the year. Sprouting was found to be the earliest in March (26 days in mahua and 27.4 days in khirni). Maximum time for bud

sprouting was taken in the month September (34.00 days) and November (33.50 days) in mahua and khirni respectively.

Chander *et al*. (2016) in their studies to standardize the season and propagation environmental for softwood grafting in jamun under open and mist chamber condition. Among the different months 2 undertaken grafting performed during September recorded minimum number of days (23.28) for sprouting, maximum leaf area (32.45cm^2), graft of diameter (0.48cm) and graft height (33.13cm).

Gohil *et al.* (2016) in their studies on effect of season and growing environmental on success of soft wood grafting in chironji. The maximum number of graft (7.1/10) and sprouting percentage (72.42) was recorded when grafting was done in the month of August under in situ condition.

Ullah *et al.* (2017) in their studies on field experiment was carried out to find the response of Dashehari mango to time (25th July, 10th August and 25th August) and technique (Veneer, softwood and Epicotyl) of grafting. Studies revealed that epicotyl grafting performed on 10th August recorded minimum time (14.46 days) for bud sprouting where as veneer grafting performed on 10th August was found to be best technique in terms of sprouting percentage after one (89.62%) and six (82.30%) month of grafting.

2.1.1.2 Effect of nature of scion on rootstock growth characteristics

Gohil *et al.* (2016) revealed that effect of season and growing on success of soft wood grafting in chironji. Graft girth (0.87cm) was recorded with treatment combination (S_3E_3) in month of August under in situ condition.

Karna *et al.* (2017) in their studies on standardization of grafting time and height success of softwood grafting in mango (*Mangifera indica* L.). While, maximum stock girth and leaves were recorded in 30th August with 60cm (T_2H_3) followed by (T_3H_3). Likewise, maximum scion was noted in treatment combination of 30th August with 40 cm, October with 20 cm (T_6H_1). Whereas, lowest shoot length was noted in 15th October with 20

cm (T_5H_1) and lowest stock girth was also reported in 30th October with 40cm (T_6H_2).

2.1.2 Effect of nature of scion on graft compatibility parameters

Jagirder and Bhatti (1968) conducted an experiment to determine the effect of scion wood and age of stock on the success of veneer grafting in mango under Pakistan condition. They achieved an average of 95% success with mature wood scion while immature gave 74.16% graft success.

Negawekar *et al.* (1984) studied the effect of various factors on survival of mango under stone grafting and recorded survival (63%) and subsequent growth when terminal part of shoot were used as scion.

Srivastava (1985) reported that temperature and humidity were the main limiting factors for the success of mango propagation by softwood grafting. Further he observed 95% success in graft prepared during the last week June, when the mean temperature and humidity were 33.5°C and 88 percent respectively.

Desai and Desai (1989) conducted an experiment on softwood grafting of jackfruit and they had been reported varying success rates from 33.33-80%. Matured scion sticks of 6 month old recorded significantly highest survival (68.33%) of the graft.

Singh *et al.* (1992) found that highest survival graft obtained when the grafting done on 15 July in mango cultivar Langra and Dashehari at Kanpur condition.

Sabeky (2005) obtained that the highest percentage of grafting success (67.2%) during month of April. Further, the side and softwood grafting of method for mango produced higher success rates of 65.8 and 63.7 percent respectively.

Prasanth *et al.* (2006) reported that grafting of mango in December month resulted in poor sprouting and survival of graft.

Maske *et al.* (2010) in their studies on effect of season on success of softwood grafting in sapota. The result indicated that significant

higher success in grafting was observed in month of august procured scion (100%) and it was without cured scion (96.67%).

Mulla *et al*. (2011) studies on softwood grafting in jamun (*Syzgium cumini* Skeel). The graft success under open condition was significantly highest (100%) in the months of November (2006) and May (2007). Whereas, under controlled condition significantly maximum (100%) graft take was noticed in month of October, November, and December.

Raghavendra *et al.* (2011) revealed that multiplication of wood apple plant by softwood grafting among different age rootstock under poly mist condition found to be better condition. Eight months old rootstock (A_4) has produced highest (97.1%) success and maximum (96.2%) survival.

Singh and Singh (2015) in their studies to standardization of time of softwood grafting of mahua and khirni under semi-arid environment of western India. The highest percentage of graft success was also noted in March, i.e. 70% in mahua and 76.66% in khirni, it was closely followed by July, August and June.

Chander *et al*. (2016) in their studies to standardize the season and propagation environmental for softwood grafting in jamun under open and mist chamber condition. Among the different months 2 undertaken grafting performed during September recorded highest graft of success (75.24%), graft survival (71.45%).

2.2 Effect of Time of grafting

Time of grafting operation has intense effect on the success grafting. The percentage of graft success of grafting. The percentage of graft success and growth of grafts are influenced by various environmental factors of which temperature and relative humidity are most important. Beside these, rainfall, sunshine and light are also important for growth of grafts. The amount of these element are not same during the summer and winter season. So, differentiations are found in percentage of graft success, survivability and growth of graft during the period of study.

The available fact on effect of grafting time on the graft success and survivability in bakan are very meager. Hence the relevant literature on other fruit trees under similar situation also have been tried to review under following sub-headings to support the present course of investigation and for better understanding of the subject.

2.2.1 Effect of grafting on growth parameters

2.2.1.1 Effect of grafting time on scion growth characteristics

Patel and Amin (1981) noted hundred percent bud sprouting in mango when then the softwood grafting performed during 3rd week of August whereas, 3rd of April found to be best respect with respect to maximum number of leaves, while minimum was recorded during the 1st week of October under Anand (Gujarat) conditions.

Rahime *et.al* (1984) studied on veneer grafting in four cutivars of mango observed that, the highest number of leaves (29.2) and the highest length of scion shoot were found in June grafting under Bangladesh conditions.

Singh *et al.* (1984) revealed that grafting done on mid June and mid July recorded minimum days for bud sprouting, whereas the maximum days for bud sprouting was recorded during mid April. However, mid June gave maximum growth of scion, recorded 90 days after grafting in mango under Varanasi conditions.

Tayade *et al.* (1988) reported that hundred percentage sprouting in mango was recorded during July to September under Akola conditions.

Dhunge *et al*. (1989) stated that season of grafting had significant influence on sprouting of scion in mango. Grafting done on August gave maximum sprouting (88%) whereas, the minimum was observed during May.

Singh and Sengupta (1996) reported that there was no significant effect of grafting time on diameter of scion shoot in mango.

Bharad *et al*. (1999) found that grafting operation done on 15th March required less number of days for bud sprouting and recorded maximum bud sprouting in tamarind under Akola conditions.

Chovatia and Singh (2000) reported that May was the best period for budding and grafting in jamun with respect to length of scion, while minimum length was observed during February. They noticed more number of leaves during May followed by June and July, while lowest number of leaves were obtained during the month of March. Grafting done on June gave the highest bud sprouting and minimum days for bud sprouting.

Haldankar and Jadhav (2001) noted that clove grafted on jamun rootstock during the month of June, July and March were produced more length of shoot. The maximum bud sprouting of grafted plants were observed during July followed by September, whereas minimum bud sprouting was observed during December. More number of leaves obtained during the month of March, whereas the graft produced least number of leaves when grafting was done during December. The month of July, August and March produced the leaves with more length and breadth as compared to grafts those were prepared during the month of November and December, respectively.

Rajput (2006) revealed that grafting and budding operation done during 2nd week of June and 2nd week of January required less number of days for bud sprouting. The 2nd week of March was the best time for grafting with respect to bud sprouting over months and also they noted that, the maximum scion length of graft were observed during 2nd week of September, whereas grafting operation done on 2nd week of May recorded the maximum number of leaves. The grafting done 2nd week of March gave the maximum girth of scion, while minimum girth was noted during 2nd week of September in Jamun under Akola conditions,

Singh *et al*. (2006) carried out an experiment on experiment on propagation of jamun by softwood grafting and observed that, the plant grafted on 15th July recorded minimum days for sprouting, while those grafted on 28th September were recorded maximum days for bud sprouting.

They also noted that, the best time for budding and grafting with respect to highest bud sprouting was recorded in August and May, while lowest bud sprouting was obtained during December and November.

Mulla (2007) reported that June grafted plant recorded minimum days for bud sprouting as well as more number of leaves and they also revealed that, grafting done during the month of May gave the highest leaf area in jamun under Dharwad conditions.

Giri and Lenka (2007) found that the grafting operation performed during June was taken the minimum number of days for sprouting in jamun under Bhuvaneswar conditions.

Wazarkar *et al.* (2009) suggested that plants grafted on 30th July recorded minimum days for sprouting, maximum length of scion, number of leaves, increament in girth of scion and bud sprouting in sapota under middle Gujarat agro climatic conditions.

Bharad *et al.* (2010) revealed that softwood grafting done on 15th March gave maximum leaf area in jamun followed by 1st July, while the minimum leaf area was obtained on 15th February and also the maximum bud sprouting was recorded during March in Jamun.

Gadekar *et al.* (2010) suggested that the maximum length of sprouts observed in graft those were grafted on 15th February, while minimum length was recorded on 1st October. The maximum number of leaves per plant were obtained on 1st February and followed by 15th February in jamun under Akola conditions.

Angadi and Karadi (2012) noted that the minimum number of days for sprouting, maximum number of leaves and highest leaf area were recorded when then grafting operation done during June month in Jamun under Dharwad conditions.

Singh *et al.* (2012) revealed that the graft prepared on 15th July recorded the minimum time for bud sprouting, whereas maximum days for bud sprouting were corded on 15th September. However, the highest scion linear growth was obtained during June and July and the maximum

numbers of leaves were recorded on 30th June in Mango under Sabour conditions.

According to Uchoi *et al.* (2012) the grafts prepared during the month of March recorded maximum number of leaves in jamun under Banglors.

Singh and Singh (2014) found that highest bud sprouting was recorded when grafting done during July, while the lowest bud sprouting was recorded during February. The earliest sprouting was obtained during the month of July and the maximum time for sprouting was recorded during the month of October in Chironji.

Singh and Singh (2015) found that softwood grafting in mahua and khirni was carried out monthly interval commencing from July to June during both month of year. Sprouting was found to be the earliest in March (26 days in mahua and 27.4 days in khirni). Maximum time for bud sprouting was taken in the month September (34.00 days) and November (33.50 days) in mahua and khirni respectively.

Ullah *et al.* (2017) found that, field experiment was carried out to find the response of Dashehari mango to time (25th July, 10th August and 25th August) and techniques (Veneer, Softwood and Epicotyl) of grafting. Studies revealed that epicotyl grafting performed on 10th August recorded minimum time (13.46 days) for bud sprouting; wheras veneer grafting performed on 10th August was found to be the best technique in terms of sprouting percentage after (89.62%) and six (82.30%) month of grafting.

2.2.1.2 Effect of time of grafting on rootstock growth characteristics

Rahim *et al.* (2004) studied the effect of grafting date (15th April, May, June, July, August or September) and method (veneer grafting, cleft grafting and modified cleft grafting) and their interaction on the propagation of mango cultivar Amprapali and Gopalbhog. The rootstock growth was most pronounced (44.57cm) on April 15th grafting. With regard to the grafting method, modified cleft grafting showed highest rootstock diameter (2.74 cm).

2.2.2 Effect of time of grafting on graft compatibility parameters

Patel and Amin (1981) found that softwood grafting performed during 3rd week August and 1st week of June gave hundred percent graft take in mango under Anand conditions.

Singh *et al*. (1986) on modified veneer grafting in mango at Varanasi, India. They reported that the maximum success of graft were obtained with mid-June grafting operation..

Upadadhyay and Prasad (1988) conducted an experiment of grafting on one year old seedling rootstock of mango. Grafting success was recorded highest in June (85%), followed by July, August and September, each with 80% and October with 70% and poorest result were from between November (18-25%).

Tayde *et al.* (1988) found that percent graft survival was observed in mango when grafting operation performed during 1st week of July to 1st week of September.

Islam *et al.* (2004) revealed that propagation of mango by modified cleft grafting during 15th June showed higher percentage of survival in campare with cleft and veener grafting irrespective of varieties.

Ghojage *et al.* (2011) suggested that the highest graft survival recorded from the the grafts which were prepared during the month of February, June, October, September, respectively. Whereas, the lowest grafts survival was obtained during December under Bagslkot (Karnataka) conditions.

Hasan (2011) carried out an experiment on the effect of growing condition and time on the success and survivability of cleft grafting in sapota. Percentages of success and survivability (both as 96.39%) were achieved at 90 DAG in poly tunnel condition when grafting operation done first the week of June.

Rahman (2011) carried out an experiment on the effect of cleft grafting, growing condition and rootstock growing containers on the success, survivability and growth of mango grafts. The result showed that, February grafting operation in earthen pot growing rootstock under poly

tunnel condition can be followed with the highest success (86.67%) and survivability (88.33%) and growth of mango graft in off-season.

Mukta (2013) conducted an experiment on the effect of variety and time cleft grafting on the success, survivability and growth in aonla (*Phyllanthus emblica* L.). The highest success (90.71%) and survivability (88.10%) were recorded on 25th May and lowest success (73.73%) and survivability (71.90%) was recorded on 25th August.

Pohare *et al.* (2014) studies on survival percentage of softwood grafting in mahua (*Madhuca indica* Gmel. J.F.) by using khirni (*Manilkara hexandra* Roxb.) as a root stock. The interpretation of result obtained in present investigation revealed that in different month of mahua grafting, October (T_4) was significantly superior survival percentage at 60 DAG as compare to other month of grafting.

2.3 Effect of nature of scion and grafting time

The evidence on subsequent growth, graft success and survivability of various grafts in combination with different nature of scion and various grafting time has been reviewed under the following headings.

2.3.1 Effect of nature of scion and grafting time on growth pamameters

2.3.1.1 Effect of nature of scion and grafting time on scion characteristics

Islam *et al*. (2004) studies on standardization of time and grafting technique in mango during june by modified cleft grafting showed highest scion growth with number of leaves highest.

Hasan *et al*. (2008) revealed that grafting mango cultivar with cleft method especially on April produced a higher percent of successful graft and gave highest scion growth with longer, thicker shoot and more number of leaves on seedling than those taken in September.

Raghavendra *et al*. (2011) studies on the soft wood grafting in wood apple. The result pertaining to open and poly mist condition on number of leaves were observed after 15th days graft success showed significantly maximum (4.7) number of leaves.

Pohare *et al*. (2014) revealed that in different month of mahua grafting, October (T_4) was significant superior in number of leaves per graft and vegetative growth of mahua graft was also observed maximum when the grafting was done in the month of October.

Singh and Singh (2015) revealed that softwood grafting plant of mahua had higher number of leaves than khirni graft, whereas it was found to be highest in the month of March in both the crop.

2.3.1.2 Effect of nature of scion grafting and grafting time on rootstock characterisics

Karna *et al.* (2017) studies on Standardization of grafting time and height on softwood grafting in mango (*Mangifera indica* L.), maximum scion girth was noted in treatment combination of 30th August with 40 cm (T_2 H_2). Likewise, maximum scion girth was noted in treatment combination of 30th August with 40cm (T_2 H_2). Similarly, poor result in plant height, number of leaves and scion girth were reported in 30th October with 20 cm (T_6H_1).

2.3.2 Effect of nature of scion and grafting time on graft compatibility characteristics

Kalabandi *et al.* (2014) revealed that the propagation of sapota var. kalipatti by softwood grafting using 15 days prior defoliated scion stick of 8 cm length and 8mm in diameter on 18 month old uniform khirni seedling stock undertaken in months of August and September in 50% shadenet house gave maximum graft success percentage, graft survival percentage, number of leaves per graft, sprout length and early bud sprout 50% shadenet house under Marathwada condition.

Vaghela and Sharma (2015) revealed that maximum number of leaves per graft (5.47), graft height (23.05 cm), girth of graft (0.87cm) at 90 days after grafting and highest percentage of survival (60.03)) at 120 days after grafting respectively, was recorded when grafting was done in month of August under in situ condition (S3E3) as compared to open condition and net house raised rootstock in Chashewnut under south Gujarat agro-climatic condition.

Chander *et al*. (2016) in their studies to standardize the season and propagation environmental for softwood grafting in jamun under open and mist chamber condition. Among the different months 2 undertaken grafting performed during September recorded highest graft of success (75.24%), graft survival (71.45%), minimum number of days (23.28) for sprouting, maximum leaf area (32.45cm^2), graft of diameter (0.48cm) and graft height (33.13cm).

Purushotham and Narasimharao (2017) found that propagation of tamarind by veneer and softwood grafting. Graft success was recorded in April and 68% for softwood graft and 49% veneer graft.

CHAPTER III

MATERIAL AND METHOD

The experiment entitled “Standardization of vegetative propagation through scion grafting of Bakan on the rootstock of Neem." Was conducted at Department of Forestry Nursery and Main garden, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the year 2017-2018. The detail about material used and methods adopted during the course of investigation are described here under the following headings.

3.1 Experimental site

The experiment was carried out at Department of Forestry Nursery and Main garden, Department of Horticulture, Dr**.** Panjabrao Deshmukh Krishi Vidyapeeth, Akola.

3.2 Climate and Weather Conditions

Akola is geographically situated at 307.4 m above mean sea level at 20.42º N latitude, and 77.02 º E longitudes. The altitude of the place is 307.42m from MSL. The climate of Akola is semi arid and characterized by three distinct season viz., hot and dry summer from March to May, warm humid and rainy monsoon from June to October and mild cold winter from November to February. The annual rainfall is 850-900 mm and the recorded minimum annual rainfall was 366.50 mm. The rains are received from South West monsoon from June to September.

During the experimental period i.e. from August 2017 to December 2017 the average maximum temperature during month April was 42,1ºC, whereas average minimum temperature in the coldest month (December) was 10.8ºC respectively. The bright sunshine hours and wind speed were ranges between 4.1 to 10.2 percent day and wind speed 3.6 to 10.0 km/hr.

The metrological data in respect of rainfall, humidity, minimum and maximum temperature recorded at University Campus during

the period of investigation i.e. August 2017 to December 2017 are presented in Appendix-I.

3.3 Rootstock seedling used for grafting:

Neem *(Azadirachta indica)* seedling of 8-10 months old having pencil size thickness, vigorous growth and uniform size were selected as rootstock for grafting.

3.4 Selection of scion wood for grafting

The mother plant of Bakan (*Melia azadarach*) at Department of Forestry, Dr. PDKV Campus, Akola was selected for scion material. The scion trees were healthy and yielding. Scion sticks were defoliated with sharp secateur during last week of July 2017. The scion was monthly collected monthly from mother trees in the morning time on the day of grafting and wrapped in wet cloth immediately after separating and kept put in polythene bag. The scion wood of past season's growth and about 15 cm in length with 8 -10 greenish bud with gray spot was used as scion. The scion so prepared was further used for grafting on the same day.

3.5 Method of grafting

Softwood grafting was done as reported in mango by Amin (1974). The rootstock was cut transversally about 20 cm about the collar, than cut vertically about 3 to 4 cm deep from the center of the stem.10-15 cm long scion was taken at base cut with a sharp knife from side obliquely to make wedge shaped the length of scion cut and stock must be similar. The wedge- shaped scion was inserted into the vertical cut of the stock dovetail and the cambium layer both stock and scion were found properly to each other. The graft was properly tied with polythene strips from to upper part as recommended by P. Jalil and M.K. Kashyap (2006).

3.6. After care of the grafts

The grafts in polybag were watered on alternate days. Weeds were removed from the polythene bags. The sprouting of rootstock were nipped off whenever it employed. During watering, the care was taken that tide strips were not wetted.

3.7. Layout details

The trial was laid out in Complete Randomized Design with four replication. In five treatments grafting was carried out in August 2017. 20 plants in each treatment formed a unit. The trial was initiated from August 2017 and observations were recorded up to December, 2017 i.e. until the graft success stage has not been reached.

3.7.1. Experimental details

1. Scion : Bakan (*Melia azedarach)*
2. Name of root stock : Neem (*Azadirachta indica*)
3. Year of the start : 2017
4. Experimental Design : Complete Randomized Design
5. Number of treatments : 5 (Five)
6. Number of replications : 4 (Four)
7. Plants per treatment : 5 (Five)

8.Location : Department of Forestry, Nursary and Main garden, Department of Horticulture, Dr. P.D.K.V.,Akola.

3.7.2 Treatment Details

Treatment	Month
T_1	August (2nd week)
T_2	September (2nd week)
T_3	October (2nd week)
T_4	November (2nd week)
T_5	December (2nd week)

3.8 Details of observations

3.8.1. Days require for graft-take

After grafting operation, the buds were observed periodically for its greenness till short emergence.

3.8. 2 Percentage graft takes (%)

After grafting operation, the bud were observed periodically for its greenness till short emergence and computing the mean, by calculated as graft take in percentage as follows -

$$\text{Graft take per cent} = \frac{\text{Total number of scion grafted}}{\text{Total number of rootstocks}} \times 100$$

3.8.3 Days required for sprouting

The days required for graft sprouting in each treatment were recorded till cessation of graft sprouting and the mean number days were worked out.

3.8. 4 Percentage of sprouting (%)

Short emergence percentage was obtained from total number of grafts sprouted and total number of plant grafted plants in each treatment.

$$\text{Sprouting per cent} = \frac{\text{Total number of grafts sprouted}}{\text{Total number of plant grafted plant}} \times 100$$

3.8. 5 Number of Sprouting Per Graft

The numbers of short emergence were recorded by counting the sprouts (shoot) on scion. The mean was calculated.

3.8.6 Number of Leaf per Graft

The numbers of leaves on scion after grafting were recorded on all successful graft and mean was calculated.

3.8.7 Survival percentage at 30, 60, 90 DAG (%)

Success percentage was obtained from the number of sprouted grafts and the total number of plants grafted in each treatment after 30, 60, 90 days of grafting.

3.9 Statistical analysis

Completely randomized design was employed to analyse the standardization of softwood grafting. The data in percentage were transformed to arc sin value for statistical analysis. The data were subjected to ANOVA as suggested by Panse and Sukhatme (1967).

CHAPTER IV

RESULTS AND DISCUSSION

The present investigation entitled “Standardization of vegetative propagation through scion grafting of Bakan on the rootstock of Neem” was conducted at Department of Forestry, Nursery and Main garden, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the period of August 2017 to December 2017. The observations in respect of after softwood grafting were recorded and statistically analyzed. The summarized data, statistical parameters and results obtained are presented in this chapter under appropriate headings. with following objective.

1) To study the effects of different months on scion grafting of Bakan on rootstock of Neem.
2) To find suitable months for higher success of scion grafting of Bakan on rootstock of Neem
3) To study the growth performance of grafts.

The observation were recorded on various aspect viz., days require for graft-take, percentages of graft take, days require for sprouting, percentage of sprouting, number of sprout per graft, number of leaves per graft, survival percentage at 30, 60, 90 days. The observation recorded during the course of investigation are presented and discussed in this chapter under appropriate heading and sub heading.

4.1 Effect of different months on grafting in Bakan on days required for graft-take

The data pertaining to the number of days required for graft take as influenced by different month are presented in Table (1) and graphically shown in Fig (1).

The data presented in Table (1) indicated that an effect of different months on grafting in Bakan on days required for graft-take were found significant. Significantly less number of days require for graft take of

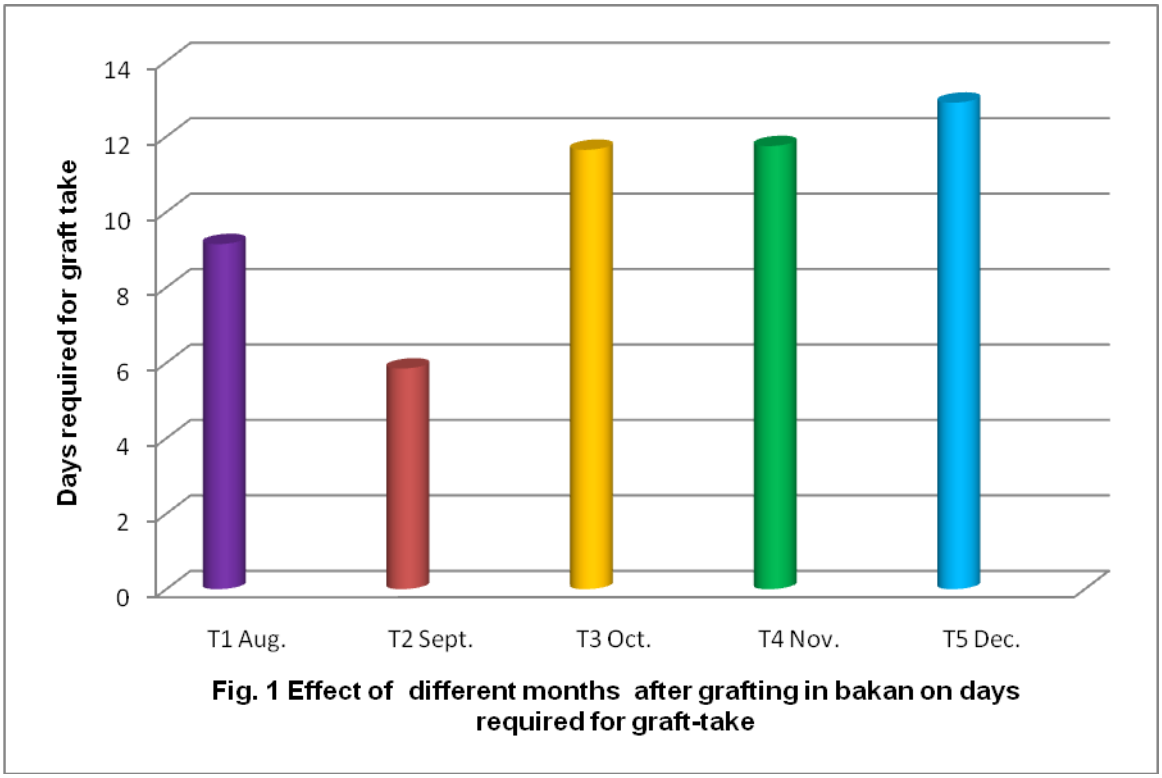

Fig. 1 Effect of different months after grafting in bakan on days required for graft-take

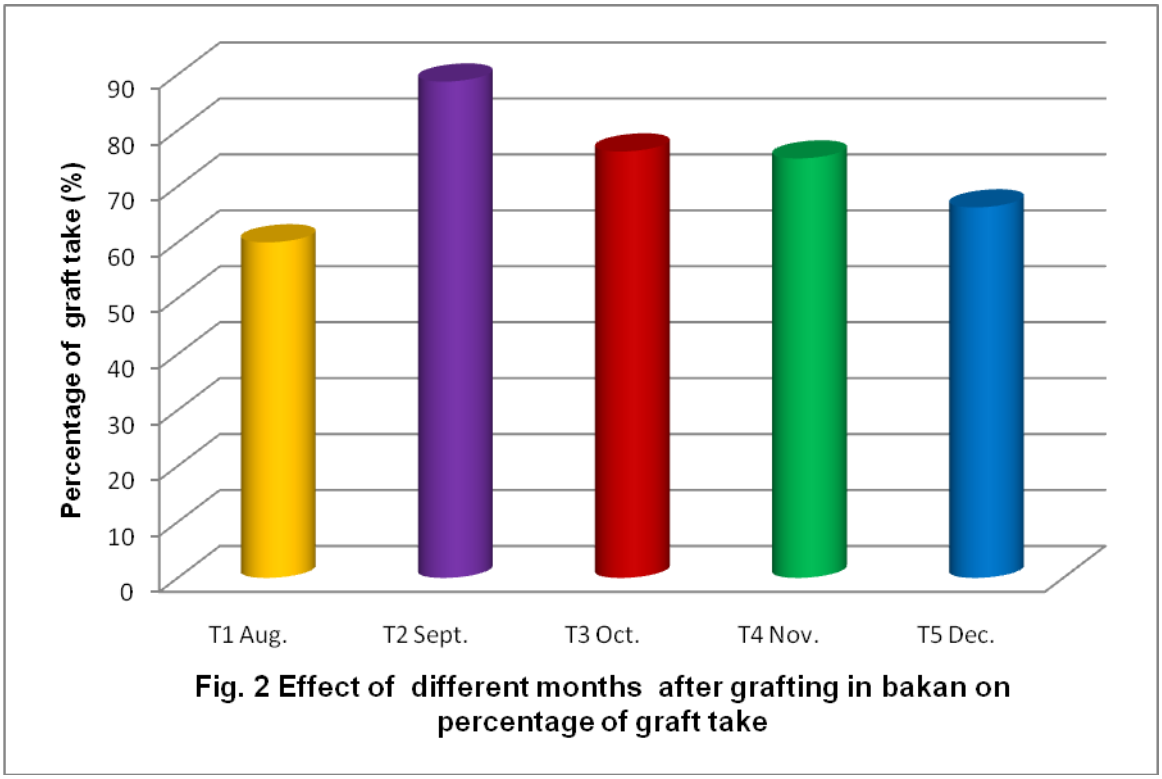

Fig. 2 Effect of different months after grafting in bakan on percentage of graft take

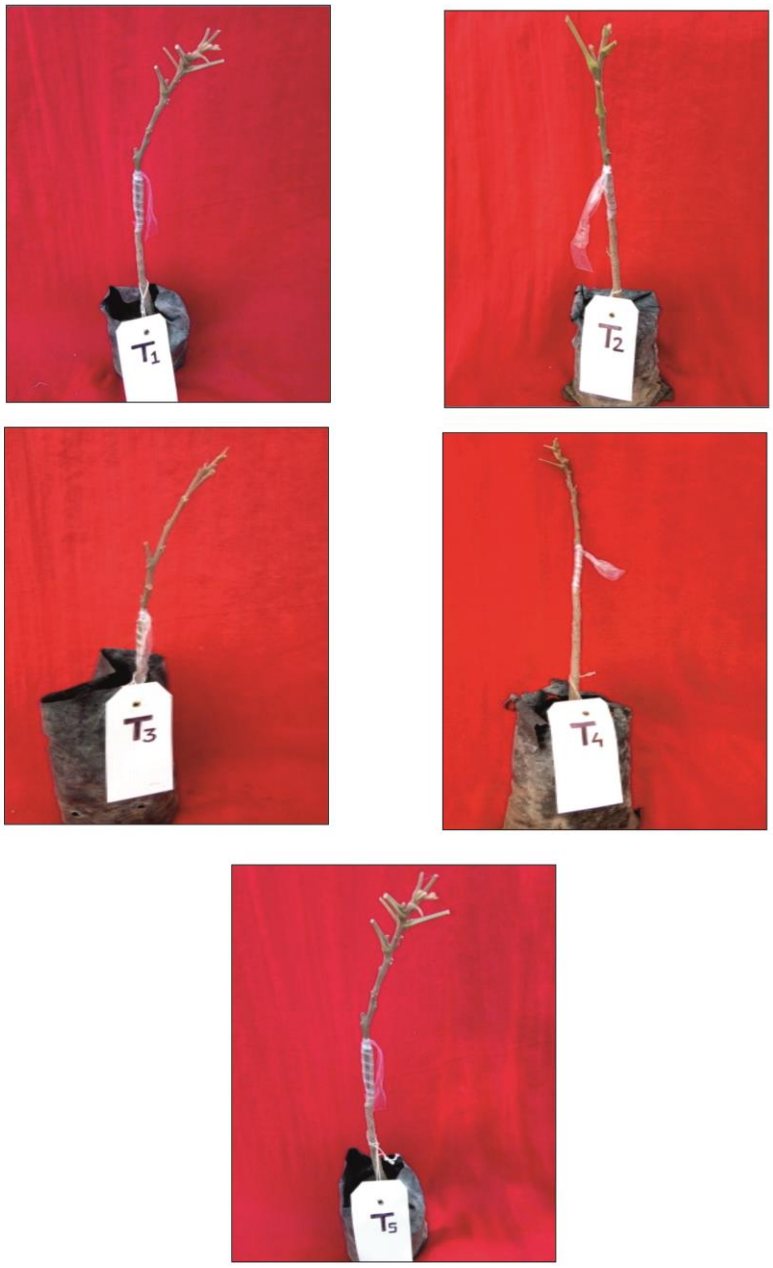

Plate 1. Percentage of graft- takes

treatment in T_2 (5.85) (September) which was found significantly superior with T_1 (9.15) (August) and T_3 (11.65) (October), whereas more number of Days require for graft-take under treatment T_5 (12.90) (December).

The late graft-take observed in may be due to lower temperature and humidity which delayed the callus formation and took more days for graft-take. These finding were supposed to be similar with those of Joolka *et al*. (2001) and Hartmann and Kester, (1979).

Table 1: Effect of different months on grafting in Bakan on days require for graft-take

Treatments	Days required for graft-take
T_1 August	9.15
T_2 September	5.85
T_3 October	11.65
T_4 November	11.75
T_5 December	12.90
‘ F’- test	Sig
S.E.(m) ±	1.03
C.D.(5%)	3.11

4.2. Effect of different months on grafting in Bakan on percentage of graft-take

The data regarding graft take as influence by different months are presented in Table 2.

The data in respect of graft-take percentage presented in Table 2 showed the significant effect on time of grafting. The maximum graft take percentage (88.75%) was observed in the treatment T_2 which were grafted during in September month followed by T_3 October month recorded (76.25%). Whereas the minimum graft-take obtained in treatment T_1 August month (60.00%).The earlier and good contact of cambial layer of

Plate 2. Percentage of Sprouting

stock and scion, resulting in early callus formation, ultimately results into more vegetative growth of Bakan grafting which might be helpful in high graft- takes in Bakan grafts. These observations were similar with findings reported by Harshavardhan *et.al*. (2011) in grafting of jackfruit, Pohare *et.al* (2016) in mahua.

Table 2. Effect of different months on grafting in Bakan on percentage of graft-take

Treatments	Percentage of graft-take
T_1 August	60.00 (50.76)
T_2 September	88.75 (70.44)
T_3 October	76.25 (60.83)
T_4 November	75.00 (60.03)
T_5 December	66.25 (54.47)
" F"- test	Sig
S.E.(m) ±	1.61
C.D.(5%)	4.86

*(Figures shown in parenthesis are transform value)

4.3. Effect of different months on grafting in Bakan on days required for sprouting

The data pertaining to the number of days required for sprouting as influenced by different month are presented in Table 3 and graphically shown in Fig 3.

The data presented in Table 3. Indicated that, an effect of different months on grafting in Bakan on days required for sprouting were found to be significant. The plants grafted in treatment T_2 September took shortest duration for bud sprouting (17.50 days) which was significantly

superior over all the treatment. Whereas, the longest duration for bud sprouting were taken in the plant grafted in treatment T_4 of December (24.90 days).

Table 3: Effect of different months on grafting in Bakan on days required for sprouting

Treatments	Days required for Sprouting
T_1 August	22.35
T_2 September	17.50
T_3 October	24.00
T_4 November	21.45
T_5 December	24.90
" F"- test	Sig
S.E.(m) ±	1.62
C.D.(5%)	4.90

The above result might be due to the fact that congenial weather condition like optimum temperature and relative humidity helped in early sprouting and better graft success because of fast vascular tissues of rootstock and scion (Hartmann and Kester, 1993).

The similar finding have also been reported by Bharad *et al.* (1999) in tamarin, Mulla (2006) in jamun, Rajput (2006) in jamun and Gadekar (2007) in jamun.

4.4 Effect of different months on grafting in Bakan on Percentage of Sprouting

The data regarding percentage of sprouting in Bakan after grafting operation influence by time are presented in Table 4 and graphically demonstrated in Fig.4.

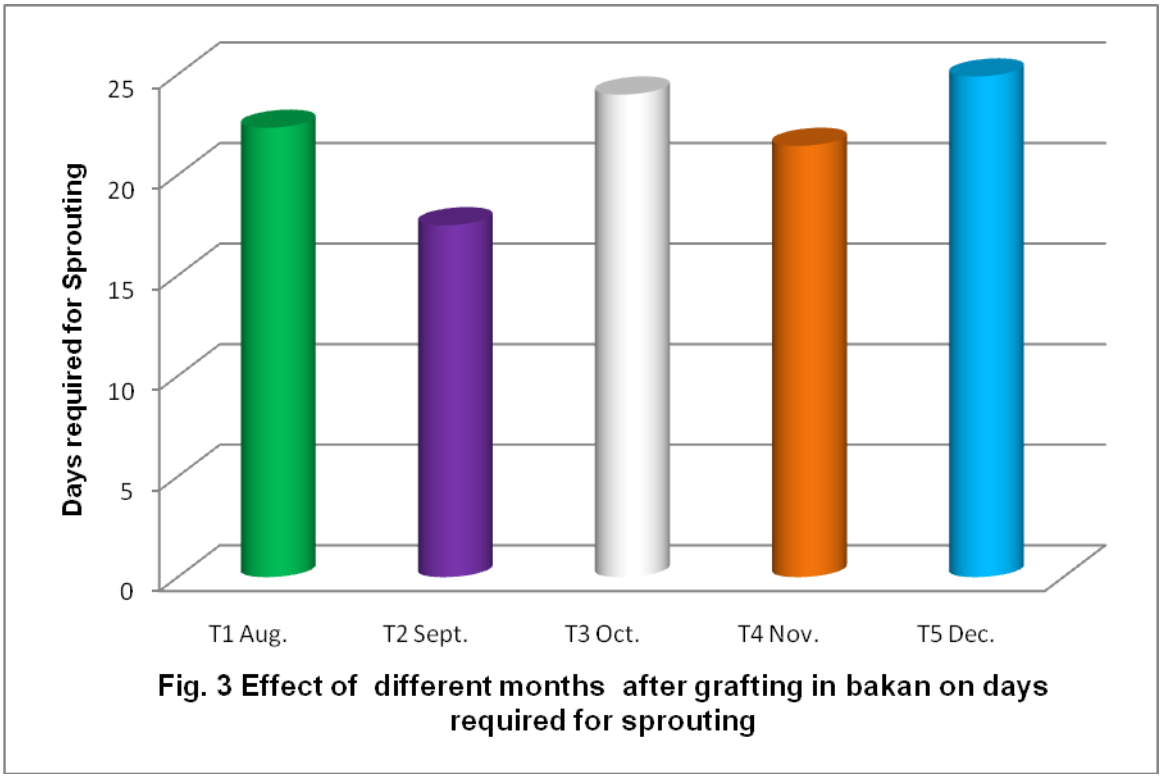

Fig. 3 Effect of different months after grafting in bakan on days required for sprouting

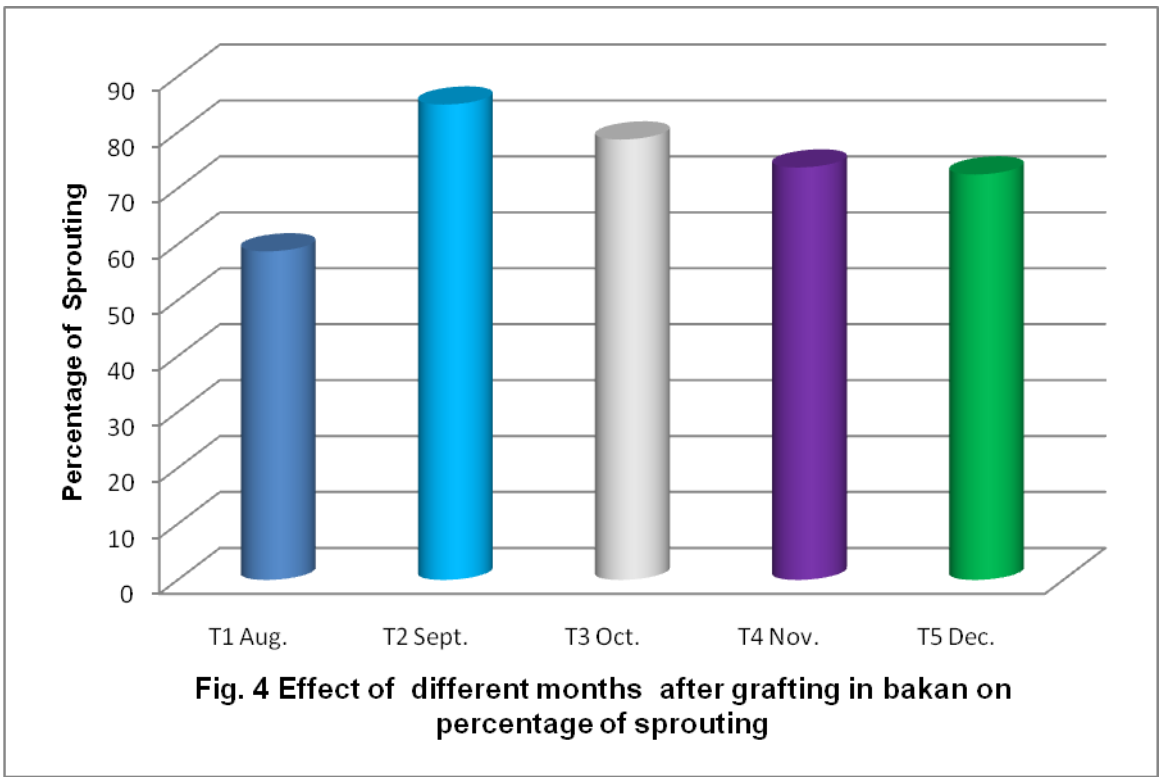

Fig. 4 Effect of different months after grafting in bakan on percentage of sprouting

The data presented in Table 4 revealed that, the percentage of sprouting significantly influence by different treatment of month. The maximum percentage of sprouting was recorded in treatment T_2 September month (85.00%) followed by T_3 in October month recorded (76.25%). However minimum percentage of sprouting (58.60%) was observed under treatment T_1 in August month.

Table 4: Effect of different months on grafting in Bakan on Percentage of Sprouting

Treatments	Percentage of Sprouting
T_1 August	58.75 (50.08)
T_2 September	85.00 (67.33)
T_3 October	78.75 (62.69)
T_4 November	73.75 (59.17)
T_5 December	72.50 (58.60)
" F"- test	Sig
S.E.(m) ±	2.15
C.D. (5%)	6.54

*(Figures shown in parenthesis are transform values)

This could be attributed to the fact that present study the maximum bud sprouting was observed when grafting operation done during September which might due to fact that there is establishment of itimate contact of considerable amount of cambium region of both stock and scion under favourable condition (Hartmann and Kester, 1993).

These obseravation are in agreement with finding of Rajput (2006) in jamun, Gadekar (2007) in jamun, Prasantha *et al*. (2007), Bharad *et al*. (2011) in jamun.

4.5 Effect of different months on grafting in Bakan on number of sprout per graft

The data regarding number of sprout per graft in Bakan after grafting operation influence by treatment of month are presented in Table 5 and graphically demonstrated in Fig.5.

Table 5: Effect of different months on grafting in Bakan on number of sprout per graft

Treatments	Number of sprout per graft
T_1 August	2.20
T_2 September	6.60
T_3 October	5.35
T_4 November	4.80
T_5 December	3.60
" F"- test	Sig
S.E.(m) ±	0.57
C.D.(5%)	1.74

The data presented in Table 5 indicated that, effects of different month on grafting in Bakan on number of sprout per graft were found significant. The maximum number sprout per graft was recorded in treatment T_2 September month (6.60) followed by T_3 in October month recorded (5.35). Whereas, the minimum number of sprout per graft was observed under treatment T_1 August (2.20). Number of sprout per graft comes early and increased significantly. This might due to the fact that, it could be attributed to weather condition at the time of regarding season leading to more accumulation of food materials and stored metabolites. These observations are in agreement with the finding of Jacob *et al*. (2004) in mango, Santosh (2004) in mango, Pohare *et al*. (2016) in mahua.

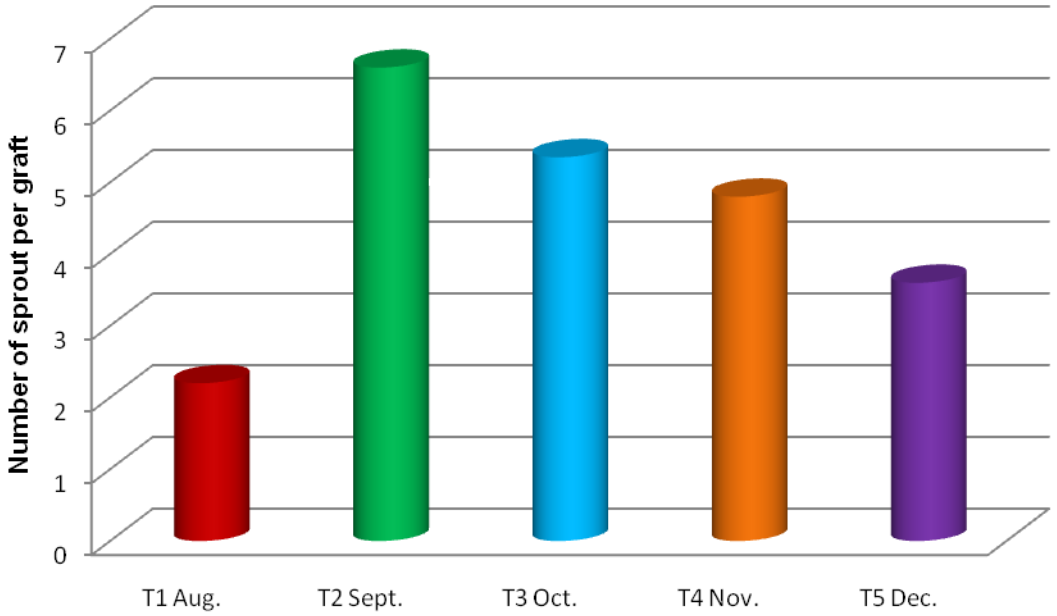

Fig. 5 Effect of different months after grafting in bakan on number of sprout per graft

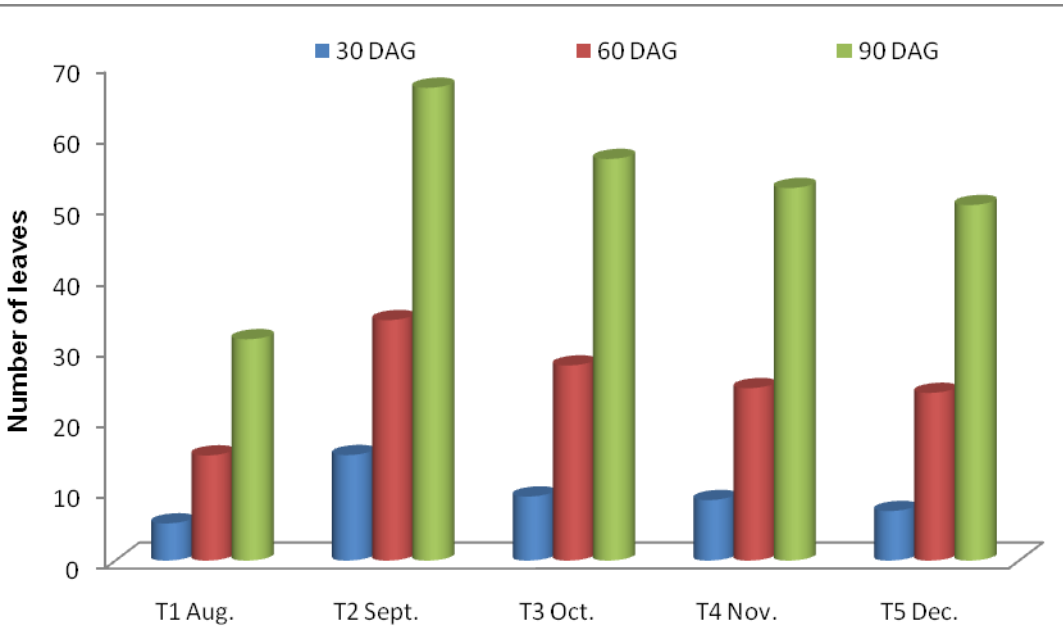

Fig. 6 Effect of different months after grafting in bakan on number of leaves in Bakan after 30, 60, 90 days

Plate 3. Number of Sprouting per graft

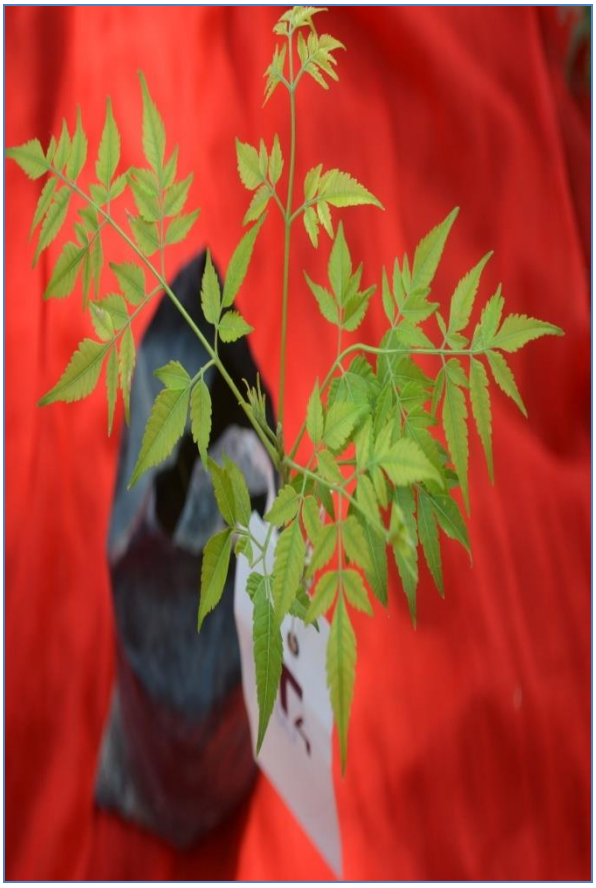

Plate 4. Number of leaves per graft at 60 DAG

4.6 Effect of different months on number of leaves per graft at 30, 60, 90 days

The data in respect of number of leaves as influence by different month of grafting are presented in Table 6.

The data presented in Table 6 indicate that, an effect of different treatment of month on number of leaves per graft after 30, 60, 90 DAG was found significant. The maximum number of leaves per graft at 30, 60, 90 DAG was recorded in treatment T_2 September month (14.90), (33.95), (66,75) followed by T_3 in October month recorded (9.05), (27.55), (56.70). Whereas, the minimum number of leaves per graft were observed under treatment T_1 August (5.25), (14.85), (31.25). The high relative humidity promotes the low rate of transpiration, keeps the gourd cells turgid and the stomata open which may have resulted in earlier production and accumulation of carbohydrates, protein and earlier completion of other physiological processes involved in development of rapid callus formation between the stock and scion. These lines were similar with finding of the Haldankar (1985) in Kokam and Dhungana (1989) in mango under Dapoli condition.

Table 6: Effect of different months on number of leaves per graft at 30, 60, 90 days

Treatment	Number of leaves		
	30 DAG	**60 DAG**	**90 DAG**
T_1 August	5.25	14.85	31.25
T_2 September	14.90	33.95	66.75
T_3 October	9.05	27.55	56.70
T_4 November	8.55	24.35	52.60
T_5 December	7.00	23.68	50.20
'F'- test	Sig	Sig	Sig
S.E.(m)±	0.86	2.27	5.06
C.D.(5%)	2.59	6.86	15.27

4.7 Effect of different months on grafting in Bakan on survival percentage at 30, 60, 90 days

Effect of different months on grafting in Bakan on survival percentage at 30, 60, 90 days of graft are showed in Table 7 and graphically shown in Fig, 7.

Table 7: Effect of different months after grafting in Bakan on survival percentage at 30, 60, 90 days

Treatment	Survival percentage (%)		
	30 DAG	60 DAG	90 DAG
T_1 August	60 (50.76)	57.50 (49.31)	56.25 (48.57)
T_2 September	80 (63.49)	77.50 (61.77)	77.50 (61.69)
T_3 October	73.75 (59.17)	71.25 (57.56)	68.75 (56.03)
T_4 November	75.00 (60.03)	71.25 (57.60)	63.75 (53.07)
T_5 December	63.75 (52.96)	60.00 (50.77)	57.50 (52.22)
'F'- test	Sig	Sig	Sig
S.E.(m)±	1.15	1.49	1.49
C.D.(5%)	3.50	4.54	4.55

*(Figures shown in parenthesis are transform values)

The data presented in Table 7 indicate that, an effect of different treatment of month on grafting in Bakan on survival percentage at 30, 60, 90 days was found to be significant. The maximum number of leaves per graft at 30, 60, and 90 DAG was recorded in treatment T_2 September month (80%), (77.50%), (77.50%) followed by T_3 in October month recorded (73.75%), (71.75%), (68.75%). Whereas, the minimum number of leaves per graft were observed under treatment T_1 August (60%), (57.50%), (56.25%).

Hartmann and Kester (1972) reported that the thin walled parenchyama cells, at a very high relative humidity and temperature, will provide favourable condition for the growth of certain fungi and bacteria which are exceedingly detrimental to the successful healing of the graft union. These observations were in conformity with those of Chipojola *et al.* (2008) in cashew nut and Amin (1974) in mango under Anand condition.

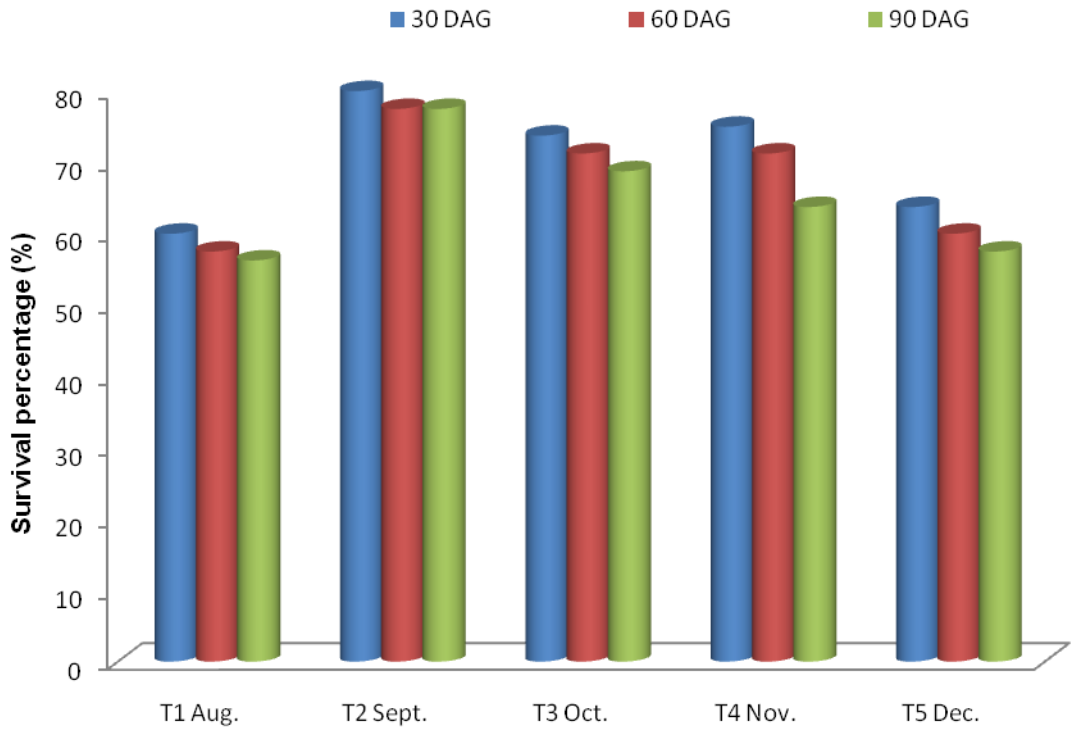

Fig. 7 Effect of different months after grafting in bakan on survival percentage at 30, 60, 90 DAG

Plate 5. Survival percentage of graft at 90 days

CHAPTER V

SUMMARY AND CONCLUSION

The present investigation entitled “Standardization of vegetative propagation through scion grafting of Bakan on rootstock of Neem” was conducted at Department of Forestry, Nursery and Main Gardern, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the period of August 2017 to December 2017 with following objectives.

1) To study the effect of different months on scion grafting of Bakan on rootstock of Neem
2) To find out the suitable months for higher success of scion grafting of Bakan on rootstock of Neem.
3) To study the growth performance of grafts.

The experiment was carried out by adopting Complete Randomized Design with five treatment and four replications. The softwood grafting was carried out at once Observations on growth parameters and grafting was recorded. The results of the experiment are summarized below.

5.1 Days require for graft-take

The minimum number of days for graft-take was observed treatment T_2 in September month (5.85) high significantly superior with T_1 in August month (9.15) and T_3 October (11.65). However, maximum number of days for graft-take was observed under treatment T_5 in December month (26.43).

5.2 Percentage of graft-takes (%)

The percentage of graft-take significantly influence by different treatment of month. The maximum graft take percentage was recorded in T_2 September (88.75%) followed by T_3 October month recorded (76.25%). The minimum graft-take percentage was observed under treatment T_1 in August month (60.00%).

5.3 Days required for sprouting

The minimum number of days for sprouting was observed under treatment T_2 in September month (17.50) high significantly superior with T_4 in November month (21.45) and T_1 August (22.35). However, maximum number of days for sprouting was observed under treatment T_5 in December month (24.90).

5.4 Percentage of sprouting (%)

The percentage of sprouting significantly influence by different treatment of month. The maximum sprouting percentage was recorded in T_2 September (85.00%) followed by T_3 October month recorded (78.75%) and T_4 November month (73.75%). The minimum sprouting percentage observed under treatment T_1 in August month (58.75%).

5.5 Number of sprout per graft

Significantly maximum number of sprout per graft was recorded in treatment T_2 September (6.60) followed by T_3 October (5.35) and T_4 November (4.80). However, minimum number of leaves per graft (2.20) was recorded in treatment T_1 during the month of August.

5.6 Number of leaves per graft

The number of leaves per graft significantly influence by different treatment of month. The maximum number of leaves per graft after 30 days was recorded in treatment T_2 September (14.90) followed by T_3 October month was recorded (9.05) and T_4 November month (8.55). The minimum number of leaves per graft was observed under treatment T_1 in August month (5.25).

Significantly maximum number of leaves per graft after 60 days was recorded in treatment T_2 September (33.95) followed by T_3 October (27.55) and T_4 November (24.35). However, minimum number of leaves per graft (14.85) was recorded in treatment T_1 during the month of August.

The maximum number of leaves per graft after 90 days was recorded in treatment T_2 September (66.75) significantly followed by T_3

October (56.70) and T_4 November (52.60). However, minimum number of leaves per graft (31.25) was recorded in treatment T_1 during the month of August.

5.7 Survival percentage at 30, 60, 90 DAG (%)

The survival percentage at 30 days after grafting was significantly influence by different treatment of month. The maximum graft take percentage was recorded in T_2 September (80.00%) followed by T_3 October month recorded (73.75%) and T_4 November month (75.00%). The minimum survival percentage observed under treatment T_1 in August month (60.00%).

The survival percentage at 60 days after grafting was significantly recorded in treatment T_2 September month (77.50%) followed by T_3 October (71.25%) and T_4 November (71.25%). However minimum survival percentage at 60 DAG (57.50%) was recorded in treatment T_1 in month of August.

The survival percentage at 90 days after grafting was significantly recorded in treatment T_2 September month (77.50%) followed by T_3 October (68.75%) and T_4 November (63.75%). However minimum survival percentage at 60 DAG (56.25%) was recorded in treatment T_1 in month of August.

CONCLUSION

From the experiment conducted on “Standardization of vegetative propagation through scion grafting of Bakan on rootstock of Neem” concluded that significant results were obtained in treatment T_2 during month of September in relation to various parameters viz., days require for graft-take, percent of graft-take, days require for sprouting, percentage of sprouting, number of sprout per graft, number of leaves per graft and survival percentage at 30, 60, 90 DAG in Bakan

CHAPTER VI

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Appendix

Table: Weekly weather data for the year 2017 recorded at Meteorological Observatory, Department of Agronomy, Dr. PDKV, Akola.																				
		A = Actual of				2017				N = Normal of 40 years						1971 - 2010				
Weeks	Dates	T Max. (^{0}C)		T Min. (^{0}C)		BSH (hrs)		WS (km/hr)		RH I (%)		RH II (%)		Evap. (mm)		RF (mm)		CRF (mm)	Rainy Days	
		N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A		N	A
26	25-1Jul	34.1	34.8	24.2	25.0	5.3	5.1	13.4	7.7	80	75	55	48	7.3	8.6	38.2	10.5	87.8	2.3	2.0
27	2-8	33.5	33.2	24.4	24.3	5.2	3.8	12.9	11.3	81	79	58	51	6.8	7.5	34.7	37.6	125.4	2.4	1.0
28	9-15	32.3	33.9	23.7	24.9	3.8	3.7	12.0	12.6	84	77	62	51	5.5	9.3	52.2	10.8	136.2	2.8	2.0
29	16-22	32.0	29.8	23.9	23.8	3.3	0.6	11.2	6.9	84	88	65	72	5.6	4.2	58.6	101.1	237.3	2.6	4.0
30	23-29	31.7	30.5	23.3	23.0	4.3	2.3	11.9	8.2	85	88	64	65	5.3	4.1	44.2	35.8	273.1	2.6	4.0
31	30-5 Aug	31.1	31.9	23.1	23.6	3.6	6.8	11.7	6.3	88	85	66	58	4.6	6.9	49.3	10.0	283.1	2.5	2.0
32	6-12	30.2	30.7	22.9	24.1	3.5	2.9	11.6	6.0	87	80	69	63	4.2	5.8	59.9	4.4	287.5	2.9	1.0
33	13-19	30.5	32.9	22.8	23.8	4.4	5.4	11.7	7.1	86	83	66	58	4.5	6.2	40.6	18.9	306.4	2.2	1.0
34	20-26	30.5	29.1	22.6	23.4	4.3	2.0	11.0	5.9	88	92	66	76	4.3	2.8	46.7	25.3	331.7	2.0	4.0
35	27-2 Sep	30.4	30.5	22.7	23.3	4.4	3.8	10.6	2.5	86	88	64	68	4.2	3.7	47.1	70.2	401.9	2.4	4.0
36	3-9	31.1	32.3	22.5	23.8	5.7	6.5	9.1	2.7	85	89	61	62	4.7	5.0	28.5	9.7	411.6	1.5	1.0
37	10-16	32.2	31.8	22.4	23.8	7.1	2.6	9.0	0.8	85	93	56	69	5.1	3.5	18.9	27.9	439.5	1.1	3.0
38	17-23	33.4	30.8	22.3	23.0	7.2	2.5	8.5	2.5	83	92	53	69	5.3	3.2	24.6	12.5	452.0	1.4	2.0
39	24-30	33.7	33.8	21.9	22.8	7.6	8.4	5.4	1.6	83	89	50	50	4.9	5.1	24.4	4.1	456.1	1.5	1.0
40	1-7 Oct	33.9	35.6	20.2	21.1	8.1	8.0	7.5	1.2	81	81	45	42	5.5	6.5	21.8	0.0	456.1	1.1	0.0
41	8-14	34.1	31.9	18.7	20.0	4.2	4.3	4.1	0.7	76	91	40	64	5.3	4.2	16.0	57.5	513.6	0.9	4.0
42	15-21	33.9	33.7	18.1	20.5	8.4	6.9	4.4	0.8	74	83	36	43	5.5	5.7	3.1	0.0	513.6	0.4	0.0
43	22-28	33.1	33.9	18.5	16.6	8.4	8.5	4.1	0.6	73	77	36	29	5.3	5.8	10.0	4.5	518.1	0.6	1.0
44	29-4 Nov	33.0	32.7	15.8	14.4	8.7	8.5	4.7	0.6	72	82	31	26	5.3	5.9	2.3	0.0	518.1	0.3	0.0
45	5-11	32.4	31.6	14.8	14.7	8.6	8.5	4.5	1.0	70	81	30	28	5.2	5.4	3.7	0.0	518.1	0.3	0.0
46	12-18	31.7	31.0	13.7	13.7	8.6	7.9	4.6	0.4	70	79	30	37	4.9	4.9	1.1	0.0	518.1	0.3	0.0
47	19-25	31.0	31.8	13.1	17.9	8.6	5.3	4.4	0.9	71	84	30	40	4.6	4.6	10.1	0.0	518.1	0.3	0.0
48	26-2 Dec	30.3	30.6	12.4	11.2	8.8	8.2	4.6	0.9	71	79	31	23	4.3	5.4	6.8	0.0	518.1	0.3	0.0
49	3-9	29.8	29.7	11.2	14.5	8.7	5.6	4.7	1.5	70	78	29	38	4.3	4.8	1.3	0.0	518.1	0.2	0.0
50	10-16	29.4	31.2	10.3	13.7	8.8	7.6	4.5	0.8	70	74	27	27	4.2	5.3	1.3	0.0	518.1	0.2	0.0
51	17-23	29.5	29.7	10.6	10.4	8.7	6.6	4.7	0.8	69	80	29	25	4.3	4.6	0.9	0.0	518.1	0.1	0.0
52	24-31	29.2	29.4	10.7	8.7	8.6	8.2	4.8	1.0	70	72	31	22	4.3	4.3	2.6	0.0	518.1	0.2	0.0
												Total RF June to Dec (N)					768.5			41.2
												Total RF June to Dec (A)					517.3			43.0