Effect of different time and methods of budding on bud take success of Nectarine on Peach (*Prunus persica* L.) seedling rootstocks

Thesis

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By

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Place: Bharsar, Pauri Garhwal ` Manuj Awasthi
Date: …… (Author)

CERTIFICATE

This is to certify that the thesis entitled **"Effect of different time and methods of budding on the bud take success of Nectarine on Peach (*Prunus persica* L.) seedling rootstocks"** submitted in partial fulfillment of the requirements for the degree of **Master of Science (Horticulture)**with major in **Fruit Science** of the College of Horticulture, VCSG Uttarakhand University of Horticulture and Forestry, Bharsar, is a record of ***bona fide*** research carried out by **Mr. Manuj Awasthi, Id. No. 14101**, under my supervision, and no part of the thesis has been submitted for any other degree or diploma.

The assistance and help received during the course of this investigation have been acknowledged.

(Dr. B. P. Nautiyal)
Chairman
Advisory Committee

CERTIFICATE

We, the undersigned, members of the Advisory Committee of Mr. **Manuj Awasthi, Id. No 14101,** a candidate for the degree of **Master of Science (Horticulture)** with major in **Fruit Science** agree that the thesis entitled "**Effect of different time and methods of budding on the bud take success of Nectarine on Peach (*Prunus persica* L.) seedling rootstocks**"may be submitted in partial fulfillment of the requirements for the degree.

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Dr. Nidhika Thakur
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Dr. Pankaj Bahuguna
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ABBREVIATIONS

et al.	and others
Cm	centimeter
^{0}C	degree in Celsius or Centigrade
C.D.	critical difference
cv.	cultivar
^{0}E	degree East
^{0}N	degree North
^{0}B	degree brix
d.f.	degree of freedom
EMS	error mean of square
Fig.	figure
FRBD	factorial randomized block design
Max.	maximum
Min.	minimum
Mm	millimeter
Ms	mean Square
S. Em.	standard error of mean
Mg	milligram
M	meter

m^2	square meter
MSL	mean sea level
No.	number
Ns	non-significant
%	per cent
/, $^{-1}$	per
spp.	species
cm^2	square centimeter
S.S.	sum of square
i.e.	that is
TSS	total soluble solids

CHAPTER-1

INTRODUCTION

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CHAPTER -1
Introduction

Peach (*Prunus persica* L.) is a member of family Rosaceae. It was originated in China, where its culture dates back at least to 3000 years. Three wild species are still commonly found there *Prunus davidiana* is an ornamental tree growing wild in northern China and is used as rootstock. The Romans were cultivating the peach since time of Christ and spread it throughout their empire in Europe; from there it was disseminated over the world into all countries of the temperate zones. Peach is now commercially grown around the world between 250 and 450 latitudes above and below equator (Childers, 1975). Peach is an important stone fruit grown in warm temperature zones of the world. Two horticultural races are also grown in sub-tropical regions. However, the peaches produced in the sub-tropics are of inferior quality. The attractive colour of the fruit with excellent quality and taste make peach a most popular fruit in the world. It is commercially cultivated in countrieslike- USA, Italy, France, Japan, Argentina, Australia, Mexico, Korea, USSR, West Germany, Portugal, New Zeeland, Spain, Greece, South Africa, Turkey, Canada, Yugoslavia, Chile, India and Austria with an area of about 44,000 million hectares with production of 6, 20,000 metric tons. India having an area of about 18.10 million hectare and production of 93.52 metric tons (National Horticulture Board, 2015). Now-a-days, it is grown in mid- hill zone of Himalayas extending from Jammu and Kashmir to Khasi hill at an altitude of 1000-2000 meter above mean sea level. Low chilling Peaches are grown in sub-tropical region of Uttarakhand, Punjab, Haryana, Himanchal Pradesh and in limited hilly areas of South India. Rajgarh area of Sirmour district of Himanchal Pradesh and Ramgarh area of Nainital, Uttarakhand are known for quality peach production. In Uttarakhand major growing districts - Pauri, Almora, Nainital, Uttarkashi and Udham Singh Nagar having an area of 9022 hectare with annual production of 49682 metric tons per hectare (Jyoti and Kumar, 2015).

India is having a diverse agro climatic conditions, which other tremendous potential to grow a wide range of fruit rest from sub-tropical to temperate. This is the reason; India is the second largest producer of peach after China (Food Agricultural Organization, 2015). After apple, the peach occupies a prominent place in India. They are grown commercially, particularly

in hilly regions of north western Himalayas between 1000 to 2000 meter's altitudes. Peach is a prime saline fruit with excellent appearance and quality.It occupies a higher place among the temperate fruit of India due to its valuable dessert and carrying quality. Bearing an early season fruit of summer, it is preferred by the consumers as fruit due to its attractive colour and pleasant aroma.

The peach along with its smooth skin mutant, the nectarine, is a temperate juicy fruit of excellent appearance and quality. It comes in the market early in season, particularly from low chilling cultivars grown in warmer regions. The grower can benefit from the relatively higher market price at this juncture due to the scarcity of other fruits. The first good crop of peach is obtained within 4-5 years of planting, which is sooner than majority of the other temperate fruits. Peach culture is, therefore, expending on a faster pace in many countries and its fruit production is highest among all the stone fruits (Childers, 1975).

The peach has a single large seed encased in hard wood (called stone or pit), yellow or whitish fleshed with delicate aroma and velvety skin that bruises easily. Peaches can be red, pink, yellow, white or a combination of these coloures, are divided into two categories; clingstone in which the fruit flesh clingswith the pit and free stone in which flesh pulls away from the pit. Peach fruit contains vitamin A, B_1, B_2, C, E and fiber. They also contain the minerals like- calcium, phosphorus, iron and potassium. Working together these strive to protect our body from daily cell damage and many chronic diseases. Vitamin A plays a crucial role in maintaining the skin, internally and externally as well as protecting the eyes, building strong teeth and bones and healthy hairs. Nutritionally peaches are good source of sugar, vitamins and minerals. The principle edible portion of peach contains (86 to 90 %) of water, (8 to 13 ^{0}B) of total soluble solids (TSS), (8 %) total sugar, (0.6 to 1.2 %) malic acid, (0.8 %) minerals, (6.0 to 13 mg) ascorbic acid, (1.0 mg) oxalic acid), (0.50 mg) niacin and (0.4 mg) riboflavin, (Bhattacharya and Baruah, 2000).

Prunacin is the principle glycoside present in the Pulp while the glycoside, amygdalin is present in the Seeds of peach (Voldrick and Kyzlink, 1990). Various processed products are prepared from peaches. Principle products are canned peach, dried, frozen preserves, jams, nectar, juice and beverages, marmalade with citrus juice and pickles. Peach kernel oil is utilized in food, cosmetics, cattle feed and pharmaceutical preparations as well as in the manufacture of bio-fertilizers. The peach flowers and leaves are purgative and anthelmintic (Joshi and Bhutani,

1995). The outstanding medicinal properties of peaches are well recognized. Common therapeutic uses of peach are in ailment of urinary stone, kidney function, urinary blood accumulation, and indigestion. Crussed peaches are an excellent beauty aid in facial care. The flowers of peach tree have sedative, anti-spasmodic and laxative properties, the leaves combat intestinal parasites. A poultice of peach leaves has been used on ulcered cancers (Jean, 1976).

Nectarine (*Prunus persica var. nucipersica* L.) this is a stone fruit in warm temperate climate also grown in sub-tropical regions. It is most popular because of its attractive colour, excellent quality and taste, grown in warm temperate zone of Europe, North America, South Africa, Asia and Australia. Nectarines are smooth skin mutants, with fuzziness allied to peach; it is non-pubescent peach of smaller size. Nectarine kernel contains 39-55 % Fat, 23-30 % Proteins, 14.8 % crude fiber and 2.7 percent Minerals.

Deciduous fruits such as peach must be propagated asexually because they do not come true to type from seed. Budding and grafting are the most common asexual propagation techniques for tree fruits. The interest of most growers are bestserved by thoroughly examining the strengths and weaknesses of each potential rootstock and scion combination before obtaining trees from a well-regarded fruit tree nursery. Always insist on varietal true to type and freedom from viruses and nematodes. Peach is generally propagated by shield or ring budding, when selection of a bud from a desired cultivated variety. The stock trained in to single stem should be budded when the sap flow is at the peak. Budding during September was reported to be superior in May to June in the western hills of India (Srivastava, 1966). Ring budding during April to May and T- or shield budding from June to September has good success (Thapar, 1966). However, under sub-tropical conditions maximum percentage of success was observed in January (Sharma and Singh, 1979).

Historically, seedlings have been used as rootstock and need little attention paid to their characteristics other than compatibility with scion. Peaches are generally propagated on their own rootstock however, other rootstocks like- plums, apricots have also been used (Dewan, 1962; Nautiyal, 1967; Singh and Gupta, 1974).

Budding makes very efficient use of a bud stick, as only a single bud is needed to propagate a new tree this reduces both the number of trees required to supply bud stick and the labor to maintain the tree and bud sticks. Budding also makes efficient use of plant material in case when a bud stick of a particular rootstock is limited. Budding may also result in a

stronger union. The simplicity and speed of budding especially the T-budding and chip budding techniques, makes these useful for amateur horticulturists. A single, well learned method can be used in a wide variety of applications.

T-budding, the pre-dominant propagation technique for southeastern peaches, is done beginning in early summer (June budding). June budding is done as soon as the seedling rootstocks are large enough to bud (late May to early June), and continues through mid to late June. Buds for dormant budding may be taken in midto late summer. Dormant budding can be practiced from mid-July to early September, as long as the bark on the rootstock separates cleanly from the woody tissue beneath it, and the bud shield separates cleanly from the bud stick. Buds are not forced until the following spring. In March following dormant budding, cut the rootstocks off about two inches above the bud, forcing the bud to grow.

Although peach is a very popular fruit crop, yet its cultivation in our country has remained in state of neglect. The non-availability of the quality planting materials (rootstock and bud-wood) and lack of efficient propagation techniques and other information on the performance of cultivars under different agro-climatic condition of temperate region are the major constraints in the expansion of peach cultivation in India. In peach no systematic work has so far been done on their survivability and morphological performance in relation to propagation method (budding) with suitable time of propagation under hilly conditions of Garhwal. Therefore, keeping in view the above points into consideration, the present investigation have been under taken on **"Effect of different time and methods of budding on the bud take success of Nectarine on the Peach (*Prunus persica* L.) seedling rootstocks"** with following objectives:

- To find out suitable time of budding.
- To evaluate appropriate budding method for Nectarine in hilly condition of Garhwal Himalaya.

CHAPTER-2

REVIEW OF LITERATURE

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CHAPTER 2

Review of literature

The present investigation entitled "**Effect of different time and methods of budding on bud take success of Nectarine on Peach (*Prunus persica* L.) seedling rootstocks**" was conducted under the field conditions of Fruit Nursery, Department of Fruit Science, VCSG Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri, Garhwal, Uttarakhand, India, during the year 2014-15. The literature available with respect to the present study has been reviewed as under:

Different budding methods are used for the commercial propagation of peach crops. The ring, patch and shield methods also popularized and widely use in advanced countries, among these the T- or shield budding are most popular and successful. The present scenario of propagation programme of deciduous fruit trees has been shifted to quality based nursery development, which is widely used in commercial production of peach cultivars providing the advantage of higher bud success. The success of propagation method, however, depends on time of budding or budding depending upon the prevailing environmental condition.

Pathak and Srivastava (1973) obtained 80-90% bud take and 60.00 to 70.00% budding success in the month of July in apple.

Howerd and skene (1974) observed the use of chip budding to grafts, four apples cvs. on to a range of commercially important rootstocks in various combinations produced large and more uniform one year old plants with more and large lateral branches, compared with these raised by traditional shield budding using an upright t- incision in the rootstock at both east Malling and Long Ashton research station. Chip budded plants showed the greatest amount of growth and shield budded plants exhibits the least in term of plant height, number of lateral and length of lateral produced. Patch budding done during the period from May to august gave good success in Ber (84.00% to 96%) however, may to August appeared to be favorable. Further lesser time for bud sprouting (19.8 to 37.5 days) was reporting during May and June (Dhār and Chaturvedi, 1976).

Anyuka and Othiono (1982) compared the techniques splice grafting and chip budding. Splice grafting, resulted in only 1.5 per cent survival after 6 months in the nursery. Chip budding, in which the bud and leaf of both scion and rootstock were left intact, gave 81 and 50 per cent survival after 6 and 10 months, respectively. In another trail with modifications of each method, splice grafting in which rootstock bud was excised at planting resulted in 96 per cent survival after 4 months. Chip budding with the rootstock bud excised or planted intact resulted in 94 per cent survival.

Skene (1983) studied the effect of chip budding in various fruit and ornamental trees and found that the chip budding gave a greatly improved bud- take as compared to T- budding further, a superior number and length of laterals in apple cv. Cox and pear cv. Conference, while in Tilia, high bud-take and proportion of tall maiden trees at the end of the following growing season were reported after chip budding compared to T-budding. Anatomically, the bud take percentage was high in chip budded plants due to the formation of excessive new xylem and better cambial activity as compared to other methods.

Kurbanova and Mujjaffar (1988) reported that the dates and methods of plum budding cultivars Reine Claude d'Althan, Vengerka Obyknovennaya and Anna spath were budded on seedlings of plum cultivars or on wild myrobalan rootstocks, at 10 days intervals, from 2 July to 20 September. Bud take on the myrobalan was 72.6-85.3% and on the plums 58.0-79.3%.

Gautam (1990), Dimri and Kamboj (2005) respectively found that with walnut and apple budding late February and March produced the highest successes for chip budding. Devy *et al*. (1991) studied the effect of budding and grafting on the propagation success and growth in peach. The results of experiment indicated that chip budding resulted in better growth than the cleft grafting especially for shoot height, number of internodes and number of leaves. But the cleft grafting gave higher percentage of propagation success compared with chip budding method.

In a study carried out by Kuden and Kaska (1991) the highest percentage of bud-take and the maximum length of shoot were reported in chip budding than T-grafting in temperate - zone fruit nursery plants grown in subtropical areas. Gautam (1991) conducted the trail on plant propagation methods of fruits of shield budding in august gave (33%) success rates and T- budding (65%) was more successful of four peach cultivars. Ponchia *et al.* (1995) also found chip budding to be more successful for apple cv. Golden Delicious, Fuji and Florina

grafted on M-9 13 or M-26 rootstocks over other methods used, i.e. triangular grafting, simple cleft grafting and T-budding. The study of Bhardwaj and Awasthi (1992) included two methods each of budding (patch and ring budding) and observed that patch budding in May gave (74.00%) bud take in comparison to 38 and 20 % in July and August, respectively. Bud take in ring budding was 10.00%.

Kuden and Kaska (1995) studied that seedlings were used as the rootstock material and Yellow Spur and Amasya Granny Smith apple varieties were used as bud sticks In the experiment Chip budding and English grafting methods (in spring growing season) and T-budding (in mid -August and September and at the beginning of October) budding methods were used. During the period between 20 October and 10 November, when bark cannot slip away easily, chip budding was used. At the end of the experiment, the best budding periods and methods were determined.

Negi (1995) obtained the maximum proportion of saleable plants in apple, almond and plum with chip budding, which may be attributed to greater linear and radial growth of grafted plants due to quick union formation, early bud sprouting and longer period of growth as compared to shield and angular budding at Solan condition.

Ponchia *e.t al*. (1995) also found chip budding to be more successful for apple cvs. Golden delicious, fuzi and florina grafted on m-9 rootstocks over other method used i.e. triangular grafting, simple cleft grafting and t- budding. Boyhan *et al*. (1996) studied the budding method affects transmission of *Xylella fastidiosa*in Plum, the slip-budded trees had lower readings than those that were chip budded; however, the scion method interaction was significant. Further comparison of slip vs. chip budding indicated that the lower absorbance value of slip budding occurred in plums only there was no difference between budding methods in peach.

Boyhan *et al.* (1996) observed that plums had higher absorbance values than peaches. The slip-budded trees had lower readings than those that were chip budded; however, the scion of budding method interaction was significant. Further comparison of slip vs. chip budding indicated that the lower absorbance value of slip budding occurred in plums only; there was no difference between budding methods in peach.

Kuden and Kaska (1997) reported that more than 70 percent bud sprouting for both chip budding and whip grafting in temperate fruit crops at with the plant height after one year

ranging from 91.3 to 118.2 cm for chip budding and 74.5 to 115.2 cm for whip grafting. Chandel *et al.* (1998) founded highest mean sprouting (98.00%) and bud-take success (96.00%) were recorded with tongue grafting, followed by chip budding with mean sprouting and bud take success 97.00 and 95.00%, respectively. However, thereafter very less bud take success was observed in all the methods. The maximum linear (3.02 cm) and radial growth (1.30 cm) of grafts were recorded with chip budding.

Aulakh (1998) reported that the maximum percentage of successful plants (95.60%) and shoot length was obtained when patch budding was done of 14 June closely followed by budding on 29 June in guava cv. Allahabad Safeda whereas the minimum percentage of budded plants (25%) and shoot length (18.70 cm) was recorded on 29 July by 15th may. Chandel *et al.* (1998) found that the maximum mean sprouting (57.00%) and bud-take success (54.00%) were recorded when budding was done on July, 15, whereas the lowest mean sprouting (15.00%) and bud- take success (12.90%) was found on August 30 with T-budding in kiwi. June 15 gave the maximum linear (1.25 cm) and radial growth (0.98 cm) in the same method of budding. Bogdanov (1976) found that the optimum results for the apple cvs. Ural'skoe and Borovinka were obtained when budding was carried out on 25 July and 15 August.

Ananda *et al.* (1999) observed the highest percentage of bud-take success (96.25%), linear growth (136.48 cm), and radial growth of scion (8.52 mm) and rootstock (9.83mm) during mid-February. While mid- March gave the maximum number of laterals (1.0), whereas the highest number of saleable plants (94.14) was recorded during October month in apple. Chovatia and Singh (2000) observed early sprouting in grafted plants (16 days) as compared to budded plants (18.27 days) and the number of days required for bud sprouting decreased from February to July with the minimum days taken from in June and july.in additional budding gave higher success than grafting with the best performance in June to July.

Husain and Ali (2000) who gave the best results in apricot budding, maximum bud success (100%) was on plants budded on July5 closely followed by 95% on July, 12, while minimum bud success (40%) was on plants budded on June 7. The sprouting of the buds were maximum (64%) by budding on June 21, while least sprouting (25%) was observed on plants budded on 7th June. Budding growth was more (16 cm) on budding date July 12. Maximum

number of leaves per plant (37) were on plants budded on June 28; while leaves per plant (12) were observed on plants budded on 7th June.

Dwivedi *et al.* (2000) found that the highest mean sprouting (88.30%) and bud take (81.60%) in apricot, under cold arid region of Ladakh, were recorded with shield method of budding done on 21,August followed by in same method of budding with mean sprouting and bud-take success of (84.90%) and (81.60%), respectively done on 14, August. The maximum linear growth (24.70 cm) was also found under shield budding whereas maximum radial growth (0.64 cm) was observed under patch budding.

Singh and Srivastava (2001) studied the propagation of Mango by veneer grafting, budding, air layering and inarching at the central mango research station, Lucknow, during 1975 to 1977. More success observed when all operations were conducted during July and August whereas November and December months resulted in to very poor success. The highest success was achieved in inarching (96.00%), followed by veneer grafting (88-92%), whereas budding gave the lowest success.

Dwivedi and Singh (2001) Studied under commercial propagation of apricot of cold arid region of Ladkh to study the performance of chip budding in apricot performed at weekly interval from 7 January till 14 March. Chip budding done on 28 February was most successful, resulted in the highest sprouting, bud-take success, linear growth and the maximum yield of saleable plants.

Misar (2002) observed the significant effect of root stock on bud take success in their experiment of the performance of different stone fruit (peach, plum and apricot) budded on peach rootstock under agro climatic conditions of Peshawar and recorded maximum per cent bud take success (90%) when plum budded on peach rootstock and minimum 50 percent for apricot budded on peach rootstock.

Zeb (2002) observed the maximum bud take success (89.97 %), budding growth (207.73 cm), shoot thickness (1.90 cm), number of leaves per plant (966.87), leaf area (45.26 cm-2), root length (37.70 cm), root thickness (2.66 cm) and number of roots per plant (23.53) were recorded in Florida King, budded on Peshawar Local rootstock of peach. Maximum number of shoots per plant (29.0) was counted in Tex 69 budded on Peshawar Local and maximum days to sprouting (19.97) was recorded in 6A budded on Swat Local. On the basis of overall performance Florida King budded on Peshawar Local had the excellent results.

Khattak *et al.* (2002) investigated the performance of chip budding in Guava cvs. Safeda at monthly intervals from 15th April to 15 the September and recorded maximum sprouting (81.00%) and survival rate (73.30%) from 15 June operation while the maximum shoot length (23.30 cm)was obtained with 15 April.

Naeem *et al*. (2002) carried out an experiment on the performance of different stone fruit (peach, plum and apricot) budded on peach rootstock at the data revealed that there was a significant difference in number of branches and budding girth of peach, plum and apricot on peach rootstock while there is no significant differences in percent bud take success, sprouting percentage and number of leaves. Maximum percent bud take success (90.0%), bud sprouting percentage (87.5%), budding growth (92.2cm), number of branches(18.52), number of leaves(443.42), and budding girth (0.97) were recorded by plum budded on peach rootstock. Minimum percent bud take success (50%), bud sprouting percentage (43.7). minimum number of leaves (119.2), and budding girth (0.42), were recorded by apricot budded on peach rootstock. So, plum should be budded on peach rootstock under the agro climatic conditions of Peshawar.

Kumar and Ananda (2004) observed the four methods of propagation, as; tongue grafting, chip budding, shield budding and annular budding in spur types cultivars of apple, tongue grafting showed maximum linear and radial growth of the scion as well as rootstock. The effect of propagation methods in respect of production of feather, tongue grafting resulted in to the maximum number and length of feather and height of feather emergence in both the cvs. Red-spur and Well-spur.

Eisenman and Thomas (2006) observed that the budded plants highest successful take (96%) was obtained when temperatures were 12-23^{0}C. Temperature ranges from 10-21^{0}C provided a decent take as well, being 78% and 71%, respectively. However when they chip budded at 8-20^{0}C, graft take was only 6%. The first chip budding experiment was performed at temperatures of 22-33^{0}C, which were too warm for budding. Chip budding of walnut and apple in India resulted in low successes during June and July (Gautam 1990) and (Dimri *et al*. 2005).

Sitarek and Jakubowski (2006) conducted experiment on effectiveness of apricot budding was high and varied from 88.8% to 97.2% depending on rootstock/cultivar combinations. However rootstock had no significant influence on the number of budded trees produced in the

nursery. Apricot seedlings A.4 and M.46 gave very high quality maidens. The one year old apricot trees budded on this rootstock were significantly higher and thicker than trees on (*P. divaricata*).

Zenginbal *et al*. (2006) we studied the soft rubbery plastic tape gave the highest graft-take (100%), sprouting rate (96.67% and 100%, respectively to the years), graft shoot diameter (7.58 mm and 7.62 mm, respectively to the years) and length (70.43 cm and 78.01 cm, respectively to the years). Paper tape gave the lowest results. In the second trial, the white raffia gave the best results on graft success (96.67% and 93.33%, respectively to the years) and graft shoot length and diameter and finally concluded the soft rubbery plastic tape could be effectively used for tying the kiwifruit bud-grafts and white wrapping material increased the bud success. The conventional wraps like cannabis fiber, plastic string, cotton yarn or paper tape are not suitable for kiwifruit budding.

Zenginbal *et al.* (2007) showed that Bud take rate, bud sprouting rate, graft shoot diameter and graft shoot length were determined as experimental parameters after grafting. All budding methods and budding times were found to be suitable for kiwifruit propagation. However, the highest mean percent of bud take and sprouting rate were obtained with chip budding performed on 1st May, 15th May, 1st September and 15th September. The highest mean shoot diameter and shoot length were obtained with chip budding performed on 15th August, 1st September and 15th September.

Kviklys (2007) carried out experiment with apple cv. Auksis' on two different rootstocks budded at heights of 0, 10, 20 and 30 cm. There were no significant differences between rootstocks during the first growing season when tree height, stem diameter, shoot number or total shoot growth were estimated. The differences between rootstocks were evident in the second year, where trees on P-60 grew stronger. Stronger growth of trees was also observed at lower compared with higher budding heights. Total shoot growth, stem diameter and tree height were significantly different on trees budded at 0 and 10 cm compared with trees budded at 20 and 30 cm. The first crop was the same on both rootstocks and there were no significant differences among budding heights. In the following two years, significant differences occurred for both rootstocks and budding height. Rootstock B-396 gave higher yields and trees on it were smaller. Significant differences were found with B-396 budded at different heights. Less pronounced differences were

found with P60 rootstocks. Trees that were budded higher had smaller stem diameter compared with trees that were budded lower.

Ali *et al.* (2012) a study was conducted the maximum value of the percentages of budding success (68.20%) was recorded when pipe-budding was done on mid May, followed by pipe budding on early-June (65%) and then pipe budding on mid-June (55.00%). Budding time and method interaction also resulted in the occurrence of significant differences in the length of bud shoots, and the number of leaves per bud shoot. Pipe budding performed on mid May gave higher values of bud shoot length and the number of leaves per bud shoot (8.6 cm, and 7.03), respectively. No significant differences were observed in bud shoot diameter due to budding time and method interaction.

An experiment was conducted by Suleiman *et al*. (2012) to study the effects of growth regulators on budding of three peach cultivars. The highest budding success percentage (99.05%) was achieved from the interaction between the cultivars and 2, 4, 5-T (20 mg/l). Silver King cultivar gave the highest average length of transplants, branch length and chlorophyll content in leaves with the use of IBA and 2,4,5-T. While the highest number of branches was found in Silver King and the highest transplant diameter in Coronet both with the use of kinetin.

Baryla and Kaplan (2012) reported that on effect of sour cherry budded on seedlings rootstock of mahaleb cherry (*Prunus mahaleb* L.).Mahaleb cherry performed on the two August dates (1^{st} and 15^{th}) had a more beneficial effect on the growth and branching of trees than the budding done on 15^{th} July and 1^{st} September. The quality of maiden cherry trees in the nursery was primarily dependent on weather conditions in a given growing season, which is evidenced by the significant differences between production cycles, high variation in the quantitative results in individual years. Jamil *et al.* (2012) found least significant difference was used for mean separation. The maximum value of the percentages of budding success 68.20% was recorded when pipe-budding was done on mid-May, followed by pipe-budding on early- June 65% and then pipe-budding on mid-June 55.00%. Budding time-method interaction also resulted in the occurrence of significant differences in the length of bud shoots, and the number of leaves per bud shoot. Pipe-budding performed on mid-May gave higher values of bud shoot length and the number of leaves per bud shoot 8.6 cm, and 7.03, respectively. No

significant differences were observed in bud shoot diameter due to budding time-method interaction.

Ahmad *et al.* (2012) the experiment was conducted and showed that budding time had no significant effect on bud take success and bud sprouting, while it significantly affected the budding growth, number of branches and number of leaves per plant. Maximum bud take success 85.0% was recorded for plants budded on 5th and 25th of June. Bud sprouting 86.5% was maximum for the plants budded on 5th July. Maximum budding growth 127.9 cm, number of branches per plant 14.8) and number of leaves per plant 292 were observed for the plants budded on 15th June. Minimum bud sprouting 64%, budding growth 85.5 cm, number of branches/plant 8.3, and number of leaves/plant 111.0 were recorded for the plants budded on 5th June. Bud take success 80.0% was minimum for the plants budded on 5th July.

Lipecki *et al.* (2013) reported that not significant differences were found in such features as tree height, apical dominance and the percent of the number of shoots suitable for tree training. Studies on spatial configuration of lateral shoots and their length did not show any essential differences in the shape of canopy between both tree types. However, lateral shoots of budded trees were significantly longer than those of grafted trees. Linear correlations between different quality characteristics in both types of trees demonstrated greater strength of either positive or negative correlations in grafts compared with budded trees. We have not found any essential differences between buds and grafted trees in nursery tree.

McMahon and Elizabeth (2013) initial bud survival was 10%, as only 16 buds out of the 150 took at both locations. Buds did not emerge by June 2012 and as of January 2013 none of these buds remained. Buds visually appeared to be being forced out of T-cuts. Weather conditions and technique may have contributed to the low success.

Shah *et al.* (2013) reported that significant differences were found in plant healing after 11 days, sprouting after 51 and 65 days, bud take success, number of shoots per budding, shoot length, shoot girth, number of leaves on primary shoots and number of branches per budding, while no significant differences were observed in length (106.02 cm) was observed in plum. Plum and peach (both) also showed maximum percentage of bud take success i.e. 90. On the other hand, peach showed minimum number of leaves (34.05) but almond showed maximum number of leaves (117.45), minimum number of shoots per budding (20.25), shoot

girth (0.51cm) and plant sprout after 65 days (68%). Likewise, in apricot bud take success (57%) and plant healing (95%) were recorded minimum.

Yazdani *et al*. (2015) studied three budding methods (T-budding, T with wood budding and Chip budding) at three different height (10-12, 20- 25 and 30-35 cm) above ground in native cultivar of sweet cherry on Mahaleb seedling rootstock. The highest mean percent of bud take and sprouting rate were obtained from Black sweet cherry scion with T-budding with wood performed at 10-12cm above ground. The highest mean shoot diameter were obtained in both scions with chip budding at 20-25 cm above ground and the highest shoot length were obtained from Black sweet cherry scion with T-budding with wood performed at 10-12 cm above ground. Use the Black sweet cherry (cultivar Ghaheri) as scion with T with wood budding at 10-20 or 20-25 cm height was minimum for the plants budded on 5th July.

Vatankhah *et al.* (2015) conducted an experiment on different methods for asexual propagation of sour cherry. Budding is performed on seeding rootstocks (Mahaleb) at private nursery located in Marbin, Isfahan. In order to determine the most appropriate time and method of budding to achieve the maximum bud take (compatibility) success**.** Treatments included two different scions (Guissi and Hungry sour cherries), two different times (August and early march) and three budding methods (T- budding, chip budding and T- without budding). Results of the study revealed that in both Guissi and Hungry scions, the chip budding in August had the maximum effect on such characteristics as growth bud length, number of leaves, number of lateral shoots and percentage of bud take. Results of this research revealed that in both Guissi and Hungry sour cherry scions, the most appropriate time for budding is in August and the best method is chip budding on Mahaleb rootstocks.

Janseri and Jaffarpur (2015) studied that August has known the most appropriate time of budding and the best method was 10 cm, T-budding which has notable effect on growth of scion, and enhances the growth rate and other traits of scion growth such as diameter and length of the branch, the number and intervals of internodes and leafs. 8 days after budding and sprouting after 36-42 days. Maximum healing after 11 days of budding (100%), sprouting after 65 days (90%), shoot girth (0.73cm) and number of branches (61) were found in peach. Similarly, maximum number of shoots per budding (37.75) and shoot.

CHAPTER-3

MATERIALS AND METHODS

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CHAPTER 3

Materials and Methods

The present investigation entitled **"Effect of different time and methods of budding on bud take success of Nectarine on Peach (*Prunus persica* L.) seedling rootstocks"** was conducted at field conditions of fruit nursery, department of fruit science, VCSG Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal, Uttarakhand, India, during the year 2014-15. The experiment was conducted to find out suitable, time of budding and to standardize appropriate budding method for Nectarine in hilly conditions of Garhwal Himalaya. The detail of materials used and methods followed during the course of present investigation are described in this chapter.

3.1 Location of experimental site

The present investigation was carried out in the field of fruit nursery, Department of Fruit Science, VCSG Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal. The site is located at an altitude of 1950 meters above mean sea level at a longitude of 78.99 ºE and latitude of 30.056 ºN. (IMD, 2015).

3.2. Climate

The climate of Bharsar is mild summer, higher precipitation and colder or severe cold prolonged winter. The South-east monsoon commences towards the end of June while, the North-east monsoon causes occasional winter showers during November-February. During winter, snow fall is common in this region. The experimental site received average rainfall of 962.8 mm (February 2015 to December 2015) with average minimum and maximum temperature of 8.5 °C and 11.4 °C respectively during the period of investigation. Minimum and maximum rainfall was received during the month of February 2015 (13.5 mm) and December 2015 (3102 mm) respectively. The minimum and maximum temperature was recorded during December 2014 to January 2015 (4.7^{o}C) and May 2015 (17.6^{o}C) respectively.

3.3 Experimental details

The experiment was laid out in a RBD (Factorial) with three replications. The experimental plan is given below:-

A. Time of budding –

20th August, 2014	:	T_1
5th September, 2014	:	T_2
20th September, 2014	:	T_3

B. Type of budding -

Shield Budding	:	M_1
Chip Budding	:	M_2
Patch Budding	:	M_3

Bud stick used for budding	**:**	Nectarine cv. Red June
Seedling Rootstock	**:**	Local seed of Peach
Experimental design	**:**	Randomized block design (Factorial)
Number of replications	**:**	3
Number of budding per replication	**:**	8
Number of budding per treatment	:	8 × 3 = 24
Number of treatment combinations	**:**	3 × 3 = 9
Total number of budding	**:**	8 × 3 × 9 = 216

3.4. Treatment combinations:-

1.	T_1M_1	20^{th} August + Shield budding
2.	T_1M_2	20^{th} August + Chip budding
3.	T_1M_3	20^{th} August + Patch budding
4.	T_2M_1	5^{th} September + Shield budding
5.	T_2M_2	5^{th} September + Chip budding
6.	T_2M_3	5^{th} September + Patch budding
7.	T_3M_1	20^{th} September + Shield budding
8.	T_3M_2	20^{th} September + Chip budding
9.	T_3M_3	20^{th} September + Patch budding

3.5 Rootstock selection

One year old pencil thickness seedling rootstock of uniform size and vigor were selected for experiment. These rootstock were procured and planted in the bed having 2.5 x 1.5 meter size at a spacing of 0.15 x 0.15 meter leaving a space of 0.50 meter after every thirdrows. The other cultural operations were similar in all the treatments.

3.6 Bud stick collection

The bud sticks were obtained from young trees of mother block section of Nectarine cv. Red June, having healthy buds from one year old branch, during the time of budding.

3.7 Time and methodology applied

Budding was started in the month of August, as the standard practice for propagation of temperate fruits like- Nectarine. For this purpose one year old shoots having healthy buds were collected as bud stick from cv. Red June, budding operation was performed at 15 days interval as 20^{th} August, 5^{th} September and 20^{th} September using shield, chip and patch budding methods. These buds were tied by an alkathene tape in order to avoid desiccation of the bud union. Regular pinching was done to control the unwanted growth of shoots from the seedlings, below bud union. Various cultural

operations were followed in this field like- weeding, hoeing and control of insect, pest and disease time to time.

3.7.1 Methodology

Budding is a method in which only one bud is inserted in the rootstock. As soon as the bark starts slipping both on the stock and scion. This is considered to be the optimum time for budding. This shows that the cambium, which is the tissue responsible for union is active. The common methods of budding are- shield, patch and chip budding.

3.8 Detail of observations:-

Observations were recorded during the first growing season in 2015 for the various budded plants started from the month of February, 2015 to December, 2015 for shield, chip and patch budding on various parameters viz., days taken to first sprouting, length of longest sprout(cm), diameter of sprout(cm), number of branches, number of leaves, leaf area (cm^2), dead budded plants without sprouting(%), dead budded plants after sprouting(%), survival of budded plants(%) and total saleable plants(%). Six representative plants were taken for the purpose and mean was recorded for each parameters.

The final observations were recorded in December 2015, pertaining to shield, chip and patch budded plants. The budded plants got the desired saleable height and was therefore; ready to sell for planting in the subsequent winter or onwards. The budded plants showing the undersized height in the year was needed heading back about 5cm to 10 cm above the bud union. The procedures used and methodology followed for taking the various observations are described below:-

3.8.1 Days taken to first bud sprouting

The days taken to bud sprouting in each treatment was recorded from the date of budding to date of first bud sprout.

3.8.2 Length of longest bud sprout (cm)

The Length of sprouts(cm) was measured in each treatment with the help of scale in each previously tagged budded plants at 30 days interval and the mean length of sprouts were calculated.

3.8.3 Diameter of bud sprout (cm)

The diameter of randomly selected sprout was measured in centimeter by Vernier Calipers or micro meter at 30 days interval and average was worked out.

3.8.4 Number of branches per bud sprout

Number of branches was counted on the budding growth in each treatment and average number of branches per plant was worked out.

3.8.5 Number of leaves per bud sprout

The total number of leaves was counted on newly emerged shoots of buds at 30 days interval and average number of leaves on sprouted buds was calculated.

3.8.6 Leaf area (cm^2)

The leaf area was recorded by means with a digital leaf area meter, ten leaves were selected randomly from each of the tagged budded plants and their average leaf area was calculated and multiplied with average number of leaves per plants to obtain the total leaf area.

3.8.7 Dead budded plants without sprouting (%)

The percent of dead budded plantswas recorded in each treatment at 270 days after budding. It was calculated with the help of following formula:

$$\text{Dead budded plants \%} = \frac{\text{Number of dead budded plant}}{\text{Total budded plants}} \text{ X } 100$$

Diameter measuring by screw gauge

3.8.8 Dead budded plants after sprouting (%)

The percent of dead budded plants after sprouting observed in each treatment at 270 days after budding was calculated with the help of following formula:

$$\text{Dead budded plants after sprouting \%} = \frac{\text{Number of dead plant after sprout}}{\text{Total budded plants}} \text{X100}$$

3.8.9 Total survival of budded plants (%)

The survival of budded plants was recorded in each treatment after 8 to 10 months at the termination of experiment and the survival percentage of buds was calculated by following formula:

$$\text{Total survival \%} = \frac{\text{Number of survived budded plants}}{\text{Total budded plants}} \text{ X 100}$$

3.8.10 Total saleable plants (%)

The plants attaining good height and vigor in growth were considered as saleable plants. The number of such saleable plants were recorded at the end of growing season and expressed under:

$$\text{Saleable plants \%} = \frac{\text{Number of saleable plants}}{\text{total survived budded plants}} \text{ X 100}$$

3.9 Statistical analysis

The data obtained for different season during the investigation were analyzed by using standard statistical procedure in the Factorial Randomized Block Design (FRBD). Standard errors of mean's (S.EM.±) were computed in each case and the critical differences (C.D.) at 5 percent level of significance were calculated only for significance results **(Gomez and Gomez, 1983).** The experimental results are presented with the help of tables, diagrams, and photographs wherever found necessary

Shield, chip and patch budded plants

Length measuring by scale

CHAPTER-4

EXPERIMENTAL RESULTS

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CHAPTER- 4
Experimental results

The present investigation entitled **"Effect of different time and methods of budding on bud take success of Nectarine on Peach (*Prunus persica* L.) seedling rootstocks"** was conducted under the field condition of Fruit Nursery, Department of Fruit Science, VCSG Uttarakhand University of Horticulture and Forestry Bharsar, Pauri Garhwal, Uttarakhand, India, during the year 2014 -15. The findings of the present study are being presented in this chapter under the following headings:

4.1 Days taken to first bud sprouting

A perusal of Table. 4.1 indicated that the days taken to first bud sprout were significant with respect to different time and methods. It is evident from the data that earliest bud sprout (167.04 days) was observed when budding was practiced on 20th August (T_1 treatment), while budding on 20th September take maximum time (177.66 days) to sprout. Among various method of budding, shield budding (M_1) rank first in bud burst which take only 167.09 days to sprout, whereas chip budding (M_2) with 175.69 days obtained second position and patch budding (M_3) take longest period (177.34 days) to sprout.

Table. 4.1 Effect of different time and methods of budding on days taken to first bud Sprout

Method of budding / Time of Budding	Days taken to bud sprout(No. of days)			
	Shield budding(M_1) ±S.E.(m)	**Chip budding(M_2) ±S.E.(m)**	**Patch budding(M_3) ±S.E.(m)**	**Mean (A)**
20th August (T_1)	161.12 ±0.46	169.97±0.46	171.36±0.50	167.04
5th September(T_2)	169.15±0.22	177.94±0.30	179.33±0.31	175.43
20thSeptember(T_3)	170.94±0.39	179.79±0.28	181.18±0.35	177.66
Mean(B)	167.09	175.69	177.34	
	A	**B**	**A×B**	
SE(d)	0.10	0.10	0.17	
C.D. (0.05)	0.21	0.21	0.37	

A close perusal of the observation presented in Table 4.1 and Appendix. II, pertaining to days taken to first bud sprout showed significant effect for different time and methods among all treatment combination T_1M_1 (20th August with shield budding) treatment combination showed the earliest bud sprout (161.12 days) followed by (5th September with shield budding) T_3M_2 treatment

combination. While T_3M_3 (20^{th} September on patch budding) treatment combination take longest period (181.18 days) to bud sprout.

4.2 Length of bud sprout (cm)

Table. 4.2 Effect of different times and methods on length of bud sprout (cm)

Method of budding / Time of Budding	Length of bud sprout (cm)			Mean (A)
	Shield budding(M_1) ±S.E.(m)	Chip budding(M_2) ±S.E.(m)	Patch budding(M_3) ±S.E.(m)	
20^{th} August(T_1)	84.68±0.63	79.67±0.65	68.20±0.28	77.78
5^{th} September (T_2)	82.51±0.45	77.45±0.43	66.03±0.23	75.51
20^{th} September(T_3)	71.42±0.29	66.36±0.49	54.94±0.33	64.26
Mean(B)	80.22	74.42	62.91	
	A	B	A×B	
SE(d)	0.11	0.11	0.20	
C.D. (0.05)	0.25	0.25	0.43	

The data presented in Table. 4.2 indicated that the different time and methods of budding were significantly affect the length of bud sprout. It is evident from the data that the maximum average length of bud sprout (77.78 cm) was recorded under T_1 (20^{th} August) followed by T_2 treatment (75.51 cm) and minimum length of bud sprout (64.26 cm) was observed under T_3 (20^{th} September) treatment. Shield budding (M_1) gave maximum length of bud sprout (80.22 cm) followed by chip budding (M_2 treatment) while minimum average length of bud sprout (62.91 cm) was recorded with patch budding (M_3) treatment. The effect of interaction between different time and methods of budding were also found significant with respect to length of longest bud sprout (Table.4.2 and Appendix. II). The longest sprout (84.68 cm) was obtained when shield budding was practice on 20^{th} August (T_1M_1 treatment combination) which was followed by T_2M_1 treatment combination (5^{th} September with shield budding). 20^{th} September with patch budding (T_3M_3 treatment combination) was recorded to gave the shortest sprout with 54.94 cm length of sprout.

4.3 Diameter of thickest sprout (cm)

Data of table. 4.3 indicated that different time and methods was found significant, regarding diameter of thickest sprout. Budding on 20^{th} August (T_1 treatment) recorded to produce thickest sprout with a diameter of 0.85 cm while, 5^{th} September budding (T_2) treatment obtained second position. The diameter 0.65 cm was found lowest when budding was done on

20^{th} September (T_3 treatment). When different methods of budding were practiced the maximum average diameter (0.84 cm) was recorded with shield budding (M_1 treatment) followed by chip budding (M_2 treatment). The minimum average diameter (0.67 cm) was recorded from patch budding (M_3 treatment).

Table.4.3 Effect of different time and methods on diameter of thickest sprout (cm)

Method of budding / Time of Budding	Diameter of sprout(cm)			Mean (A)
	Shield budding(M_1) ±S.E.(m)	Chip budding(M_2) ±S.E.(m)	Patch budding(M_3) ±S.E.(m)	
20^{th} August(T_1)	0.93±0.05	0.89±0.05	0.74±0.03	0.85
5^{th} September(T_2)	0.87±0.03	0.83±0.06	0.70±0.01	0.80
20^{th} September(T_3)	0.73±0.06	0.69±0.06	0.54±0.03	0.65
Mean(B)	0.84	0.80	0.67	
	A	**B**	**A×B**	
SE (d)	0.01	0. 01	0.02	
C.D. (0.05)	0. 02	0. 02	0.03	

The interactions between different time and methods of budding were significant on the diameter of thickest sprout (Table 4.3 and Appendix. II). The budding on 20^{th} August with shield budding (T_1M_1 treatment combination) was found to gave maximum average diameter of thickest sprout (0.93cm), followed by T_2M_2 (5^{th} September with chip budding) and T_2M_1 (5^{th} September with shield budding) treatment combination. The minimum average diameter of thickest sprout (0.54cm) was observed under T_3M_3 (20^{th} September with patch budding) treatment combination.

4.4. Number of branches per budded plants

The results present in Table.4.4 indicate that average number of branch per budded plants was found significant with respect to different time and methods of budding. T_1 treatment (20^{th} August) with maximum average number of branch per budded plants (29.21) was recorded to obtained first rank, while budding on 5^{th} September (T_2 treatment) obtained second rank. However, the minimum average number of branch per budded plants (21.41) was recorded when budding was done on 20^{th} September. Among different methods, shield budding (M_1 treatment) gave maximum average number of branch per sprout (30.55) followed by chip budding (M_2 treatment). The minimum average number of branch per sprout (21.30) was recorded from patch budding (M_3 treatment).

Table.4.4 Effect of different time and methods of budding on number of branches per budded plant

Method of budding / Time of Budding	Number of branch			Mean
	Shield budding(M_1) ±S.E.(m)	Chip budding(M_2) ±S.E.(m)	Patch budding(M_3) ±S.E.(m)	
20th August (T_1)	34.18±0.12	27.55±0.22	25.19±0.14	29.21
5th September(T_2)	29.89±0.36	23.27±0.84	20.90±0.30	24.87
20th September(T_3)	26.43±0.28	19.81±0.21	17.44±0.36	21.41
Mean	30.55	23.64	21.30	
	A	B	A×B	
SE(d)	0.08	0.08	0.14	
C.D. (0.05)	0.18	0.18	0.31	

It was again observed that the interaction between different time and methods of budding significantly affect the average number of branches (Table.4.3 and Appendix I). The maximum number of branches (34.18) was recorded under T_1M_1 treatment combination (20th August with shield budding). The minimum number of branch per budded plant (17.44) was produced by (5th September with patch budding) T_3M_2 treatment combination.

4.5 Number of leaves

Data on average number of leaves are presented in Table. 4.5, the data showed that the different time and methods of budding have significant effect on average number of leaves.

Table.4.5 Effect of different time and methods of budding on number of leaves of per budded plant

Method of budding / Time of Budding	Number of leaves			Mean (A)
	Shield budding(M_1) ±S.E.(m)	Chip budding(M_2) ±S.E.(m)	Patch budding(M_3) ±S.E.(m)	
20th August (T_1)	134.82±0.35	121.98±0.20	108.68±6.11	121.82
5th September(T_2)	122.45±0.20	109.61±0.33	102.47±0.02	111.51
20th September (T_3)	115.95±0.51	103.11±0.27	95.97±0.31	105.01
Mean(B)	124.40	111.56	102.37	
	A	B	A×B	
S E(d)	1.71	1.71	2.96	
C.D. (0.05)	3.66	3.66	6.27	

The number of leaves on budded plant (121.82) was maximum under (20^{th} August) T_1 treatment followed by (5^{th} September) T_2 treatment. The number of leaves on budded plant (105.01) was minimum under (20^{th} September) T_3 treatment. When different methods of budding were practiced the maximum number of leaves on budded plant (124.40) was recorded from shield budding (M_1 treatment) followed by chip budding (M_2 treatment). While minimum number of leaves on budded plant (102.37) was observed from patch budding (M_3 treatment). In the present study the interaction between different time and methods of budding was not found to gave any significant effect on average number of leaves per budded plant (Table. 4.5 and Appendix. II). 20^{th} August with shield budding (T_1M_1 treatment combination) was found to gave maximum number of leaves on new sprouts (134.82) followed by 20^{th} August with chip budding (T_1M_2 treatment combination). While patch budding practiced on 20^{th} September was recorded to gave minimum (95.97) number of leaves on new sprouts.

4.6 Leaf area (cm^2)

The data presented in Table. 4.6, indicated that with respect to leaf area the different time and methods of budding were found significant. The leaf area (22.34 cm^2) was found highest when budding was done on 20^{th} August (T_1 treatment) followed by 20^{th} September (T_3 treatment). The lowest leaf area (18.57 cm^2) was recorded on 5^{th} September (T_2 treatment). Among various methods of budding practiced the maximum leaf area (22.11 cm^2) was recorded under shield budding (M_1 treatment) followed by patch budding (M_3 treatment). The minimum average leaf area (18.39 cm^2) was obtained from chip budding (M_2 treatment).

Table. 4.6 Effect of different time and methods of budding on leaf area (cm^2)

Method of budding / Time of Budding	Average leaf area(cm^2)			Mean (A)
	Shield budding(M_1) S.E.(m)	Chip budding(M_2) ±S.E.(m)	Patch budding(M_3) ±S.E.(m)	
20^{th} August(T_1)	24.20±0.09	20.48±0.16	22.35±0.25	22.34
5^{th} September(T_2)	20.43±0.14	16.71±0.17	18.58±0.27	18.57
20^{th} September (T_3)	21.71±0.29	17.99±0.16	19.86±0.22	19.85
Mean(B)	22.11	18.39	20.26	
	A	B	A×B	
SE(d)	0.12	0.12	0.22	
C.D. (0. 05)	0.27	0.27	0.46	

Data of present in Table 4.6, investigation revealed that the interaction between different time and methods of budding do not have significant effect on the leaf area per budded plants

(Table.4.6 and Appendix. II). Shield budding on 20th August (T_1M_1 treatment combination) was found to gave maximum leaf area (24.20 cm^2) followed by 20th August with patch budding (T_1M_3 treatment combination). The minimum average of leaf area (16.71 cm^2) was observed when chip budding was practiced on 5th September (T_2M_2 treatment combination).

4.7 Dead budded plants without sprouting (%)

The result of present study (Table. 4.7) revealed that the percentage of dead budded plants was found significant with respect of different time and methods of budding. The percentage of dead budded plants (26.38%) was observed lowest under T_3 treatment (20th September) followed by T_1 treatment (20th August). When budding was practiced on 20th September (T_1) it was gave highest (43.05%) of dead budded plant. Among various method of budding practiced the minimum percentage of dead budded plants (29.16%) was observed with shield budding (M_1 treatment) followed by chip budding (M_2 treatment). While patch budding (M_3) produce maximum percentage of dead budded plants without sprouting (48.61%).

Table 4.7 Effect of different time and methods of budding on dead budded plant percentage

Time of budding / Method of budding	Shield budding(M_1) ±S.E.(m)		Chip budding(M_2) ±S.E.(m)		Patch budding(M_3) ±S.E.(m)		Mean	
	No. of dead Plant	Dead plant %	No. of dead plant	Dead plant %	No. of dead plant	Dead plant %		
20th August(T_1)	1.33(±0.66)	16.67	4.33(±0.33)	54.17	4.66(±0.33)	58.33	3.44	43.05
5th September(T_2)	3.66(±0.33)	45.83	3.33(±0.33)	41.67	4.33(±0.66)	54.17	3.77	47.22
20th September(T_3)	2.00(±0.57)	25.00	1.66(±0.88)	20.83	2.66(±0.33)	33.33	2.11	26.38
Mean(B)	2.33	29.16	3.11	38.89	3.88	48.61		
	A		B		A×B			
SE(d)	0.41		0.41		0.72			
$C.D_{(0.05)}$	0.88		0.88		1.54			

The data presented in Table.4.7 and Appendix. III, indicated that the percentage of dead budded plant were found significantly affect by the interaction between different time and methods of budding. It is evident from the data that the minimum percentage of dead budded plants (16.67%) was produced by T_1M_1 and T_2M_1 treatment combination (20th August with shield budding and 5th September+shield budding) followed by T_1M_2 and T_1M_3 treatment combination (5th September on shield budding and 20th August + patch budding). While the maximum percentage of dead budded plants (58.33%) was produced byT_1M_3 treatment combination (20th August with patch budding).

4.8. Dead budded plants after sprouting (%)

A perusal of Table. 4.8, reveals that the percentage of dead budded plants after sprout was found non-significant with respect to different time of budding, while different method of budding to gave significant effect on dead budded plants after sprout. It is evident from the data that the minimum number of budded plants were become dead (26.38%) when budded on 20th August (T_1 treatment) followed by 5th September (T_2 treatment). While the percentages of dead budded plants after sprout (34.72%) was the maximum with 20th September (T_3). Among various methods of budding, the minimum dead budded plants (22.22%) was recorded under M_1 treatment (Shield budding) followed by chip budding (M_2 treatment). While the maximum

Table.4.8 Effect of different time and methods of budding on dead budded plants after sprouting percentage

Time of budding / Method of budding	Shield budding(M_1) ±S.E.(m)		Chip budding(M_2) ±S.E.(m)		Patch budding(M_3) ±S.E.(m)		Mean	
	No. of dead Plant after sprout	Dead plant after sprout %	No. of dead plant after sprout	Dead plant after sprout %	No. of dead plant after sprout	Dead plant after sprout %		
20th August(T_1)	1.66(±0.33)	20.83	2.00(±0.57)	25.00	2.66(±0.33)	33.33	2.11	26.38
5th September(T_2)	3.33(±0.33)	16.67	3.00(±0.57)	37.50	3.00(±0.00)	37.50	2.44	30.55
20th September(T_3)	2.33(±0.33)	29.17	2.33(±0.33)	29.17	3.66(±0.66)	48.83	2.77	34.72
Mean(B)	1.77	22.22	2.44	30.55	3.11	38.88		
	A		B		A×B			
SE(d)	0.28		0.28		0.49			
C.D. (0.05)	0.59		0.60		1.04			

The percentage of dead budded plants after sprout was not affected significantly by the interaction between different time and methods of budding (Table 4.8 and Appendix. III). Under the treatment combination T_2M_1 (5th September + shield budding) minimum number (16.67%) of plants become dead after sprout, while T_1M_1 treatment combination (20th August + Shield budding) obtained second rank. The highest dead budded plants (48.83%) were determined from patch budding practiced on 20th September (T_3M_3 Treatment combination).

4.9 Total survival of budded plants (%)

The result presented in Table. 4.9, indicates that budded plant survival percentage was found significant with respect to different time and methods of budding. The maximum survival percentage (38.88%) was obtained with 20th September (T_3 treatment) while the 20th August (T_1 treatment) obtained second position. However, the minimum survival percentage (22.22%) was

recorded under 5th September (T_2 treatment). Among different method, shield budding (M_1 treatment) gave maximum survival percentage (48.61%) followed by chip budding (M_2 treatment). The minimum survival percentage (12.49%) was recorded under patch budding (M_3 treatment).

Table. 4.9 Effect of different time and methods of budding on survival percentage

Time of budding / Method of budding	Shield budding(M_1) ±S.E.(m)		Chip budding(M_2) ±S.E.(m)		Patch budding(M_3) ±S.E.(m)		Mean	
	No. of survive Plant	survive %	No. of survive plant	Survive %	No. of survive plant	Survive %		
20th August(T_1)	5.00(±0.66)	62.50	1.66(±0.33)	20.83	0.66(±0.33)	8.33	2.44	30.55
5th September(T_2)	3.00(±0.33)	37.50	1.66(±0.33)	20.83	0.66(±0.66)	8.33	1.77	22.22
20th September(T_3)	3.66(±0.57)	45.83	4.00(±0.88)	50.00	1.66(±0.33)	20.83	3.11	38.88
Mean(B)	3.88	48.61	2.44	30.55	1.00	12.49		
	A		B		A×B			
SE(d)	0.44		0.44		0.76			
C.D. (0.05)	1.94		0.94		1.63			

A close analytical of data indicates that the survival percentage were influence significantly by different time and method of budding (Table. 4.9 and Appendix. III). The plant budded on 20th August had the maximum survival percentage (62.50%) with shield budding (T_1M_1 treatment combination). While the minimum survival percentage (8.33%) was recorded under 20th August with patch budding (T_1M_3 treatment combination) and 5th September with patch budding (T_2M_3 treatment combination).

4.10 Total saleable plants (%)

Table. 4.10 Effect of different time and methods of budding on total saleable plants (%)

Time of budding / Method of budding	Shield budding(M_1) ±S.E.(m)		Chip budding(M_2) ±S.E.(m)		Patch budding(M_3) ±S.E.(m)		Mean	
	No. of saleable plant	Saleable plant %	No. of saleable plant	saleable plant %	No. of saleable Plant	saleable plant %		
20th August(T_1)	4.66(±0.66)	91.97	1.33(±0.33)	88.67	0.33(±0.33)	50.00	2.11	65.67
5th September(T_2)	2.33(±0.33)	75.00	1.33(±0.33)	88.67	0.66(±0.66)	33.33	1.44	65.66
20th September(T_3)	3.33(±0.57)	88.67	2.00(±0.88)	83.00	1.00(±0.33)	16.67	2.55	73.89
Mean(B)	3.44	85.11	2.44	86.78	0.66	33.33		
	A		B		A×B			
SE(d)	0.52		0.52		0.90			
C.D. (0.05)	1.10		1.11		1.90			

Statically data for the different time and methods also depicts significant effect on saleable plant percent (Table. 4.10). The plants budded on 20th September (T_3 treatment) gave a maximum saleable plants (73.89%) while the 20th August (T_1 treatment) with 65.67% saleable plants obtained second rank. However, the minimum saleable plants (65.66%) were obtained from budding of 5th September (T_2 treatment). Among different method, chip budding (M_2 treatment) gave maximum saleable plants (86.78%) followed by shield budding (M_1 treatment). The minimum percent of saleable plants (33.33%) was recorded from patch budding (M_3 treatment). Data pertaining to the percentage of saleable plant are represented Table. 4.10 and Appendix. III. The effect of interaction between different time and methods of budding on the saleable plant was found significant. the best result was obtained as high as 91.97% with the shield budding practiced on 20th August (T_1M_1) followed by (88.67%) plant budded on 20th August and 5th September with chip budding (T_1M_2 and T_2M_2 treatment combination) which were ready for sale at end of December. While the minimum saleable plants (16.67%) were recorded on 20th September with patch budding (T_3M_3 treatment combination).

CHAPTER-5

DISCUSSION

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Discussion

The present investigation entitled **"Effect of different time and methods of budding on bud take success of Nectarine on Peach (*Prunus persica* L.) seedling rootstocks"** was conducted at field conditions of Fruit nursery, department of fruit science VCSG, Uttarakhand University of horticulture and Forestry, Bharsar, Pauri(Garhwal) Uttarakhand, during the year 2014-15.

In this chapter the results obtained during the present investigation have been discussed critically in order to find out the best time for shield, chip, patch and its relative performance with the standard time of shield budded plants. In this chapter, result obtained during the course of investigation have been discussed. The experimental observations, results have been recorded and efforts are made to support it with scientific relationship and heading to discuss following main outline:

5.1 Days taken to bud sprout

Data recorded from the present study showed that the earliest bud sprout (167.04 days) was taken by the plants budded on 20th August (T_1 treatment). It may be due to favorable environmental condition. Among various methods of budding, shield budding (M_1 treatment) take only 167.09 days to first bud sprout. Good sap flow in the bark and high temperature might be the factors which favored callusing and proliferation at the bud union. The interaction among different time and methods were also found significant with respect to days taken first bud sprouting with least (161.12 days) taken to first bud sprout 20th August + shield budding (T_1M_1 treatment combination). Due to, when maximum saps flow in rainy season for suitable time and method of budding. In accordance to our present investigation, Ahmad *et al.* (2012) observed that the significant effect of budding method and time on number of days to sprouting showed that maximum number of days to sprouting (199.14) were observed in plants produced through T-budding with September while minimum number of days to sprouting (194.29) were recorded for chip budding with August in Guava.

5.2 Length of bud sprout (cm)

The present study indicates that the different time and methods was significant result effect on average length of longest bud sprout. The longest length (77.78cm) was recorded from T_1 (20^{th} August) treatment. The reason is that the bud sprout resulted from budding during the growth season had a longer time available for its growth. Shield budding gave (M_1 treatment) longest length of bud sprout (80.22cm). This is due to rapid formation of strong bud union and longer growth period in shield budding. The interactions among different time and methods of budding were also found significant with respect to length of longest bud sprout (84.68 cm) was recorded from 20^{th} August with shield budding (T_1M_1 treatment combination). The increase average length of bud sprout is due to, favorable climatic conditions, presence of greater number of leaves, that elevated the rate of photosynthesis and hence carbohydrate formation increased. These results confirm the results drawn by Dwivedi *et al.* (2000) indicate that the 14 and 21 August have given the best results in terms of linear growth (24.70 cm) in apricot under cold arid condition of Ladakh.

5.3 Diameter of thickest sprout (cm)

Statistical analysis of the data revealed that different time and methods and their interaction had significant effect on sprout thickness. Budding on 20^{th} August (T_1 treatment) recorded thickest sprout with an average diameter of 0.85cm. The obtained results could be related to high precipitation and high summer temperatures (including August) which created in good conditions for budding growth and development of the stem. Among various methods thickest sprout (0.84 cm) was recorded under M_1 (shield budding) treatment. Because of the earliest and good wound tissue formation on cut surfaces, cambial connectivity between stock and bud take set rapidly. While 20^{th} August + shield budding (T_1M_1 treatment combination) were obtained thickest sprout (0.93 cm), might be due to the maximum budding growth in those plants budded under T_1 treatment (20^{th} August). It is clear from the mean data that plants budded through (shield budding) have maximum budding growth which results in maximum stem thickness due to having more photosynthetic. Ahmad *et al*. (2012) Statistical analysis of the data revealed that budding dates, methods and their interaction had significant effect on stem thickness in guava budding. Maximum stem thickness (584.25 mm) was recorded on plants budded on September with T- budding, while minimum stem thickness (531.50mm) was observed in plants budded on August+ chip budding.

5.4 Number of branches per budded plants

The data recorded for average number of branches showed that different budding time and methods hadalso found significant effect. The mean values for budding time depicted that maximum number of branches (29.21) was recorded from 20th August (T_1 treatment). It might be due to long growing period and active vegetative growth of plants in this time. Among various budding method, shield budding (M_1 treatment) was observerd maximum number of branches (30.55). The highest number of branches might be due to the quick union formation under shield budded plants resulting into the best performance with vegetative characters. The interactions among different time and methods of budding were also not found to gave any significant effect with respect to number of branches. Maximum numbers of branches (34.18) wererecorded under T_1M_1 treatment combination (20th August on shield budding). The better number of branches with optimum time and methods might be due to better bud growth which augmented absorption and translocation of nutrients from soil which take active part in various plant metabolic processes (Singh and Srivastava, 2001). The results are in parallel with Nitransky *et al.* (1987) Peach cv. Red haven was budded on Lovell peach root stocks at different intervals in mid-August (late summer). It had significant effect on the average number of branches.

5.5 Number of leaves

Under present investigation, number of leaves, revealing that budding time and methods had significant effect. The mean values for budding time revealed that higher numbers of leaves (121.82) were observed on the plants budded on 20th August (T_1 treatment). It may be due to increased growth of plants resulting into more number of leaves, long growth season and active growth period. While various methods under shield budded plants was produced higher number of leaves (124.40). It may be due to wood maturity of budding which probably reserves high starch and sugar. The interactions among different time and methods of budding were also found significant with respect to the number of leaves. Higher number of leaves (134.82) were observed under T_1M_1 treatment combination (20th August +shield budding). The higher number of leaves with optimum time and methods might be due to better bud growth and more number of branches. This augmented absorption and translocation of nutrients from soil which take active part in various plant metabolic processes.These results matched the result drawn by Akhtar *et al.* (2000) they observed that maximum number of leaves (292.54) occurred on peach plants budded on 28th August with chip budded, it's may be due to maximum number of branches and maximum budding growth.

5.6 Leaf area (cm^2)

The data recorded for leaf area shows maximum ($22.34cm^2$) noted in plants budded on 20th August (T_1 treatment). It is due to vigorous growth of plant as it is capable of absorbing more nutrients and prepares more photosynthetic resulted in maximum leaf area. Similarly maximum leaf area ($22.11cm^2$) was recorded under M_1 treatment (shield budded plants). It is due to stronger bud union and development of normal vascular tissues at the bud union which regulates the transport of water and nutrients and there by increases the leaf area. The interactions among different time and methods of budding were also not found any significant with respect to leafarea. Maximum leaf area (24.20 cm^2) was taken from 20th August with shield budding (T_1M_1 treatment combination). It might be due to the fact that shield budded plants early sprouting under this time, leaf emergence and rapidly vegetative growth as compared to chip and patch budded plants. The results are in parallel with in apple by Kumar and Ananda (2004) reported that the leaf area to be maximum with chip budded on August; leaf area is directly related to the maximum number of leaves.

5.7 Dead budded plants without sprouting (%)

The percentage of dead budded plants (43.05%) was maximum showed from 20th August (T_3). This may be due to unfavorable climatic conditions for bud growth and high temperature also inhibits bud bursting and causes even death of buds. Among different method dead budded plants 48.61% were recorded from patch budded plants (M_3 treatment). It's may be due to not proper cambium formation with translocation of food material through xylem and phloem topatch bud to stock plants. The interactions among different time and methods werealways found maximum (58.33%) found under T_1M_3 treatment combination, when plants budded on (20th August with patch budding). Poor shooting of the buds were planted during cooler time of the season may be due to the fact that these budding might have been carrying higher inhibitors to promote ratio or it may be due to higher nitrogen to carbohydrate ratio.

5.8 Dead budded plants after sprouting (%)

The dead budded plants after sprouting (34.72%) was maximum under T_3 treatment (20th September). This may be due to sometime temperature flactuation also inhibits bud growth and causes even death of bud sprout. The highest percentage of dead budded plants after sprouting (38.88%) was produced from patch budding (M_3 treatment), Because not properly translocation of carbohydrates, starch and other factors. The interactions among different time and methods of budding were also found significant. Maximum dead budded plants after sprout (48.88%) were plants budded on 20th September with practice on patch

budding (T_3M_3 treatment combination). Poor shoot formation were planted during this season may be due to higher nitrogen to carbohydrate ratio.

5.9 Survival of budded plant (%)

Data regarding percent plant survival showed that different time and methods of budding had significant effect the plant survival. Maximum plant survival (38.88%) was recorded when plants budding practiced in 20th September (T_3 treatment). This may be due to affected by season and several factors such as temperature, light and nutrient availability to the survival percentage. Significantly, highest plants survive (48.61%) was observed when budding practiced in M_1 treatment (shield budding). As requires more cell sap for union and thus scion is held more tightly in place as compared to patch budding. The interaction among between different time and methods has significant effect on survival percentage. Maximum plant survival (62.50 %) was recorded from 20th August practiced on shield budding (T_1M_1 treatment combination). It is due to the fact that budding in August produce favorable environmental conditions for the healing process of bud wounds and resulted in the development of normal vascular tissues at the bud union which result in maximum plant survival. Similarly, budding late in the growing season contributed to unfavorable conditions for healing process which results in the poor development of normal vascular tissue at the bud union. The findings of the study conducted by, Khattak *et al.* (2002) observed in case of propagation methods (chip budding) of peach gave better survival of budded plants (80.00%).

5.10 Total saleable plant (%)

The saleable plant maximum recorded (73.89%) from (T_3) 20th September. It is due to longer period time available for growth. Among various methods the maximum saleable plant (86.78%) was under M_2 treatment (chip budding). It is due to these plants required heading back for quality and good health growth of next year. The interaction among between different time and methods has significant effect on plant saleable maximum (91.97%) were taken under T_1M_1 (Shield budding practiced on 20th August). Higher percentage of such plant obtained 20th August on shield budding practice is attributed to proper and quick union formation, early bud sprout and longer period time available for growth. Similarly results by, Joolka and Rindhe (2000) obtained the highest proportion of saleable plants (98.32%) in chip budding, followed by T-budding (98.32%) in pecan nut.

CHAPTER-6

SUMMARY AND CONCLUSION

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Summary and conclusion

The present investigation entitled **"Effect of different time and methods of budding on bud take success of Nectarine on Peach (*Prunus persica* L.) seedling rootstock"** was carried at Fruit Nursery, Department of Fruit science, VCSG Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri (Garhwal), Uttarakhand, India during the year 2014-15. The experiment was conducted to evaluate appropriate budding method for Nectarine, and to find out suitable time of budding, under hilly conditions of Garhwal Himalaya with different times (20^{th} August, 5^{th} September and 20^{th} September) which were budded by three methods of budding (shield budding, Chip budding and patch budding) at Fruit Nursery. The experiment was conducted in Factorial Randomized Block Design with three replications. The salient findings of the present investigation are summarized below:

1. Earliest bud sprout was taken under T_1 treatment (20^{th} August) which was recorded only 167.04 days. While budding on 20^{th} September (T_3 treatment) take longest time (177.66 days) to bud sprout. Among various methods of budding, minimum time (167.09 days) was observed under M_1 (Shield budding) treatment. The number of days to first bud sprouting was found maximum (177.34 days) with M_3 (Patch budding) treatment.

2. In the present study treatment T_1M_1 (20^{th} August with shield budding) gave longest sprout (84.68 cm) and diameter of sprouts (0.93 cm) under T_1M_1 was also recorded maximum in comparison to other treatment combinations, while shortest sprout length 54.94 cm and diameter 0.64 cm was recorded from 20^{th} September with patch budding (T_3M_3 treatment combination),

3. Treatment T_1 M_1 (20^{th} August with shield budding) obtained first rank with highest number of branches (34.18). However, T_2M_1 (5^{th} September+Shield budding) treatment combination obtained second position. The average number of branches (21.41) was lowest under T_3M_3 treatment combination (20^{th} September with patch budding).

4. The highest average number of leaves (134.82) was recorded under (20^{th} August with shield budding) T_1M_1 treatment combination and least number of leaves (95.97) was recorded from 20^{th} September+patch budding treatment combination (T_3M_3).

5. Shield budding on 20th August with (T_1M_1 treatment combination) obtained first rank in the leaf area (24.20 cm^2). The minimum leaf area (16.71 cm^2) was shown by T_2M_2 (5th September+chip budding) treatment combination.

6. The percentage of dead budded plants without sprouting (16.67%) was found lowest under T_1M_1 (20th August with shield budding) treatment combination, while the highest (58.33%) was recorded from 20th August with patch budding (T_1M_3 treatment combination).

7. It is evident from the data that dead budded plants after sprouting the lowest (16.67%) was recorded from 5th September with shield budding (T_1M_1 treatment combination), while the highest (48.83%) was recorded under T_3M_3 (20th September with patch budding) treatment combination.

8. Highest survival percentage of budding (62.50%) was observed under T_1M_1 (20th August with shield budding) treatment combination, while the lowest survival percentage of budding (8.33%) from T_1M_3 and T_2M_3 (20th August+patch budding and 5th September with patch budding) treatment combination.

9. For the saleable plant with highest value of 91.97% which was obtained under T_1M_1 treatment combination (20th August with shield budding), followed by T_3M_1, T_1M_2 and T_2M_2 treatment combination (20th September+shield budding, 20th August with chip budding and 5th September with chip budding) was recorded 88.67%. While, lowest percentage of saleable plant (16.67%) was obtained under T_3M_3 (20th September with patch budding) treatment combination.

Conclusion

Conclusions based on experimental results are as:

- In case of budding time interval most of the growth parameters showed good results with highest survivility when the plants are budded on 20th August as compared to 5st September and 20th September.
- Nectarine (Red June) budded on to Peach seedling rootstocks through shield budding showed good results with respect to survivility and most of the plant growth parameters as compared to chip and patch budding.

Recommendation

Based on the above conclusion, the following recommendation is made:

- Shield budding on 20th August is the best for better growth of Nectarine cv. Red June.

CHAPTER-7

LITERATURE CITED

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LITERATURE CITED

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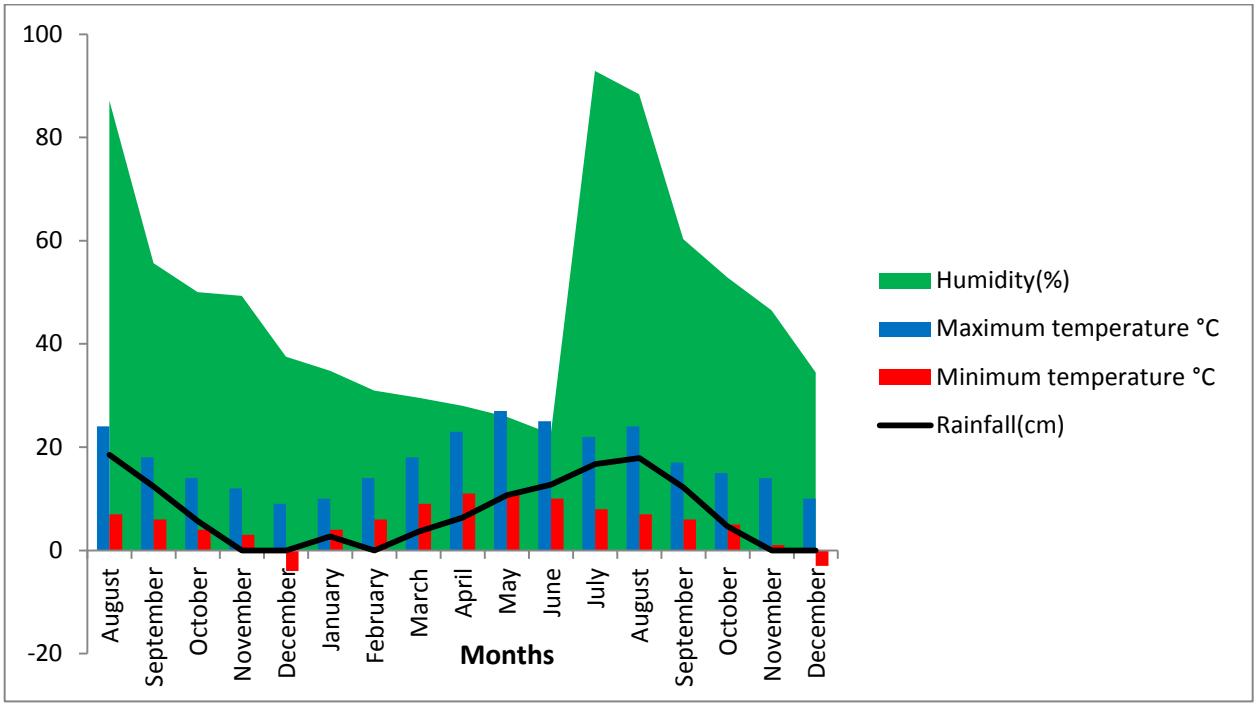
Appendix. I

MONTHLY METEOROLOGICAL DATA DURING THE PERIOD OF INVESTIGATION-AUGUST, 2014 TDECEMBER, 2015



APPENDIX.II.

ANALYSIS OF VARIANCE FOR DIFFERENT CHARACTORS UNDER STUDY

C_1=Days taken to first bud sprout, **C_2**= Length of bud sprout (cm), **C_3**= Diameter of bud sprout (cm), **C_4**= Number of branches per budded plants, **C_5**= Number of leaves per budded plant, **C_6**= leaf area (cm^2)

Source of variation	Degree of freedom	Mean sum of square					
		C_1	C_2	C_3	C_4	C_5	C_6
Replication	2	0.00	0.01	0.00	0.52	0.01	0.58
Treatment (A)	2	249.13	516.74	0.09	135.61	350.58	33.05
(B)	2	268.64	680.42	0.09	195.24	1564.10	31.13
(A×B)	4	0.96	1.58	0.00	0.02	118.21	0.00
Error	16	0.15	0.67	0.00	0.15	0.07	0.07

Appendix. III

ANALYSIS OF VARIANCE FOR DIFFERENT CHARACTORS UNDER STUDY

Source of variation	Degree of freedom	Mean sum of square			
		C_7	C_8	C_9	C_{10}
Replication	2	1.44	2.11	7.00	3.81
Treatment(A)	2	7.00	1.00	4.00	2.81
(B)	2	5.44	4.00	18.77	17.37
(A×B)	4	3.11	0.66	2.778	2.81
Error	16	0.77	0.36	0.875	1.23

C_7=Dead budded plants without sprouting (%), **C_8**=Dead budded plants after sprouting (%),**C_9**= Survival of budded plants (%), **C_{10} =** Total saleable plants (%).

ABSTRACT

2016

Thesis

Manuj

ABSTRACT

Name : Manuj Awasthi **Id. No.** : 14101

Sem. & year of Admission : 1st Semester 2014-15 **Degree** : M.Sc. (Horticulture)

Major : Fruit Science **Deptt.** : Fruit Science

Thesis Title : "Effect of different time and methods of budding on bud take success of Nectarine on Peach (*Prunuspersica* L.) seedling rootstocks"

Advisor : Dr. Manju

The present investigation entitled "Effect of different time and methods of budding on the bud take success of Nectarine on Peach (*Prunus persica* L.) seedling rootstocks" was conducted at Fruit Nursery, department of Fruit science. VCSG Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal, Uttarakhand, India. The combinations of different budding time i.e. 20th August, 5th September and 20th September with three different methods i.e. shield, chip and patch budding were tried to investigate their effects on the bud take success of Nectarine on Peach seedling rootstocks.

In this study peach seedling were used as rootstock in the field conditions. The Nectarine cv. Red June was used for bud take success. Days taken to bud sprouting, sprout length (cm), sprout diameter (cm), number of branch, number of leaves, leaf area (cm^2), percent dead budded plants without sprouting, percent dead budded plants after sprouting, survival percentage and percent total saleable plants were determined as experimental parameters after budding,

All budding time and methods were found suitable for nectarine propagation. However, the maximum sprout length (84.64 cm), diameter (0.93 cm), number of branches (34.18) number of leaves per budded plant (134), leaf area (24.20 cm^2), survival (62.50%), and total saleable plants (91.97%) and minimum days taken to bud sprout (161.12 days), dead budded plants without sprouting (16.67%) were obtained with shield budding performed on 20th August. Minimum dead budded plants after sprouting (16.67%) was obtained from shield budding practiced on 5th September.

(Prof. B. P. NAUTIYAL) **(DR. MANJU)** **(MANUJ AWASTHI)**

CHAIRMAN **CO-ADVISOR** **AUTHOR**

सारांश

नाम : मनुज अवस्थी

परिचय पत्र संख्या : 14101

प्रवेश वर्ष एवं सत्र : प्रथम सत्र 2014–15

उपाधि : स्नातकोत्तर (औद्यानिकी)

मुख्य विषय : फल विज्ञान

विभाग : फल विज्ञान

लधु विषय : मृदा विज्ञान

सलाहकार : प्रो0 बी0पी0 नौटियाल

लेख शीर्षक : ''नेक्ट्रीन की कलिका का आडू (*प्रूनस पर्सिका* एल0) के बीजू मूलवृन्त पर, सफलता पर, कलिकायन की विभिन्न विधियों एवं समय का प्रभाव''

वर्तमान शोध विषय ''नेक्ट्रीन की कलिका का आडू (*प्रूनस* पर्सिका एल0) के बीजू मूलवृन्त पर, सफलता पर, कलिकायन की विभिन्न विधियों एवं समय का प्रभाव'' को वी. च. सिं. ग. उत्तराखण्ड औद्यानिकी एवं वानिकी विश्वविद्यालय भरसार, पौडी गढ़वाल (उत्तराखण्ड) में फल पौधशाला, फल विज्ञान विभाग में सम्पन्न किया गया।

कलिकायन के विभिन्न समय, 20 अगस्त, 5 सितम्बर एवं 20 सितम्बर एवं कलिकायन की तीन विधियाँ, शील्ड़, चिप और पैच कलिकायन का नेक्ट्रीन की कलिका का आडू के मूल रूप बीजू पर सफल होने पर शोध कार्य किया गया। इस अध्ययन में आडू के बीजू पौधे को मूलब्न्त के रूप में प्रयोग में लाया गया। कलिका की सफलता के लिए नेक्ट्रीन (रेड जून) का उपयोग किया गया। कलिकायन के पश्चात् निम्नलिखित प्रायोगिक माप दण्ड को निर्धारित किया गया– कलिका के अंकुरित होने में दिन, कलिका के अंकुरण की लम्बाई (सेमी0), कलिका के अंकुर का व्यास (सेमी0), कलिकायित पौधे में शाखाओं की संख्या, कलिकायित पौधे में पत्तियों की संख्या, कलिकायित पौधे की पत्ती का क्षेत्रफल (सेमी^{2}), बिना अंकुरित हुए मृत पौधों का प्रतिशत, अंकुरित होने के पश्चात् मृत पौधों का प्रतिशत, उत्तर जीवित पौधों का प्रतिशत एवं बेचने योग्य कुल पौधों का प्रतिशत।

वर्तमान शोध में ली गई कलिकायन की विभिन्न विधियाँ और समय को नेक्ट्रीन के रोपण के लिए उचित पाया गया शोध कार्य के दौरान यह पाया गया कि अधिकतम अंकुर की लम्बाई (84.67 सेमी0), व्यास (0.93 सेमी0), शाखाओं की संख्या (34.18), पत्तियों की संख्या (134), पत्ती का क्षेत्रफल (24.20 सेमी^{2}), कलिका के अंकुरित होने में लगे न्यूनतम दिन (161.12), न्यूनतम बिना अंकुरित हुए मृत कलिकायित पौधे (16.67 प्रतिशत), शील्ड कलिकायन जो कि 20 सितम्बर को सम्पन्न किया गया, अंकुरण के पश्चात् न्यूनतम मृत कलिकायित पौधे (16.67 प्रतिशत), शील्ड कलिकायन से प्राप्त हुए, जिसमें कि 5 सितम्बर को कलिकायन की क्रिया की गयी थी।

(प्रो0 बी0 पी0 नौटियाल)	(डॉ0 मन्जू)	(मनुज अवस्थी)
मुख्य सलाहकार	सह–सलाहकार	लेखक

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