# EFFECT OF DIFFERENT WEED MANAGEMENT PRACTICES ON PLUM (*Prunus salicina*) cv. RED BEAUT

*Thesis*

**by**

**RAKESH KUMAR**
**(H-2016-49-M)**

**submitted to**

**Dr. YASHWANT SINGH PARMAR UNIVERSITY OF HORTICULTURE AND FORESTRY**
**SOLAN (NAUNI) HP-173230 INDIA**

**in**

**partial fulfilment of the requirements for the degree**

**of**

**MASTER OF SCIENCE**
**(HORTICULTURE)**
**FRUIT SCIENCE**
**DEPARTMENT OF FRUIT SCIENCE**

**2018**

**Dr DD Sharma**
**Principal Scientist**

**Department of Fruit Science**
**Dr. Yashwant Singh Parmar University of Horticulture and Forestry, (Nauni) Solan (HP) – 173 230, India**

# CERTIFICATE-I

This is to certify that the thesis titled **"Effect of different weed management practices on plum (*Prunus salicina*) cv. Red Beaut",** submitted in partial fulfillment of the requirements for the award of the degree of **Master of Science (Horticulture) Fruit Science** in the discipline of **Horticultural Sciences** to Dr. Yashwant Singh Parmar University of Horticulture and Forestry, (Nauni) Solan (H.P.) – 173 230 is a bonafide research work carried out by **Mr. Rakesh Kumar (H-2016-49-M)** son of Shri Guddu Brahmachari under my supervision and that no part of this thesis has been submitted for any other degree or diploma.

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

**Place: Nauni-Solan**
**Dated:**

**(Dr DD Sharma)**
**Major Advisor**

# CERTIFICATE-II

This is to certify that the thesis titled, **"Effect of different weed management practices on plum (*Prunus salicina*) cv. Red Beaut"** submitted by **Mr. Rakesh Kumar (H-2016-49-M)** son of Shri Guddu Brahmachari to the Dr. Yashwant Singh Parmar University of Horticulture and Forestry, (Nauni) Solan (HP) - 173 230 India in partial fulfilment of the requirements for the degree of **Master of Science (Horticulture) Fruit Science** in the discipline of **Horticultural Sciences** has been approved by the Advisory Committee after an oral examination of the student in collaboration with an External Examiner.

10.9.18

**Dr. D.D. Sharma**
**Chairman**
**Advisory Committee**

**Dr. K.K. Pramanick**
**(External Examiner)**

10/9/2018

**Dr. S. K. Patyal**
**Dean's Nominee**

**Advisory Committee**

1. **Dr. D.P. Sharma**
   **Principal Scientist**
   **Department of Fruit Science**

2. **Dr. Uday Sharma**
   **Principal Scientist**
   **Department of Soil Science**
   **& Water Management**

10/9/18

**Professor and Head**
**Department of Fruit Science**

**Dean**
**College of Horticulture**
**Dr Yashwant Singh Parmar University of Horticulture and Forestry**
**(Nauni) Solan (HP) - 173 230 India**

# ACKNOWLEDGEMENTS

*I dedicate my success, failure, happiness, sadness, pleasure, pain and every experience to divine power* ***Almighty God.*** *I belong to Divinity and God is my real teacher, parent, brother, sister and friend. Without God I am nothing. I just initiate the work but supreme power helps me and makes my work successful. I want to say love full thanks to Almighty God for providing me good health, good wealth, good knowledge, help, hope, success, happiness, courage and protection in difficult situations.*

*After God I would like to express my love full gratitude to* ***my whole family*** *whose selfless love, affection, encouragement, sacrifices, sincere prayers, expectations and blessing has always been the most vital source of inspiration and motivation in my life. Every effort is motivated by an ambitious and all ambitious have inspiration behind, I owe this pride place to my beloved parents* ***Smt Chitra Rekha*** *and* ***Sh Guddu Brahmchari*** *for their heartful blessings, selfless love, prudent persuasion and obstinate sacrifice. I feel blessed and lucky to have my elder sisters* ***Neena Thakur*** *who always stand by my side and encourage me at every step of my life.*

*I humbly express my gratitude to the chairman of my advisory committee,* ***Dr DD Sharma****, Principal Scientist, Department of Fruit Science for his expert guidance, critical help, advice, valuable suggestions, constant encouragement and whole hearted support. I also thank him for his considerable help in shaping of this manuscript.*

*I emphatically express my loyal and venerable thanks and heartfelt gratitude to the worthy members of my advisory committee,* ***Dr DP Sharma*** *(Principal Scientist, Department of Fruit Science) and* ***Dr Uday Sharma*** *(Principal Scientist, Department of Soil Science & water management) for their expert guidance, valuable suggestions and kind cooperation.*

*With immense pleasure, I thank* ***Dr JC Chandel****, Professor and Head, Department of Fruit Science for providing me all the help and facilities to carry out the present research.*

*I also wish to express my thanks to* ***Dr RS Dogra, Dr NC Sharma, Dr CL Sharma and Dr Vishal Rana*** *for their sincere, selfless and invaluable help as and when required. I cordially acknowledge the assistance extended by faculty members, office and field staffs of Department of Fruit Science and HRTS and KVK Kandaghat for timely and sincere help during the course of experimentation.*

*I shall be thankful to my friends Gitesh Kumar, Humendra, Abhay Chauhan, Sajan Sharma, Vinay Kardam, Rajesh and my all classmates for their love, affection, company, kind cooperation and valuable help.*

*I own entire responsibility for the errors and omissions, if any.*

**Place: Nauni, Solan**
**Date:** **(Rakesh Kumar)**

# CONTENTS


| CHAPTER | TITLE | PAGE(S) |
|---|---|---|
| 1. | INTRODUCTION | 1-2 |
| 2. | REVIEW OF LITERATURE | 3-11 |
| 3. | MATERIALS AND METHODS | 12-20 |
| 4. | RESULTS AND DISCUSSION | 21-41 |
| 5. | SUMMARY AND CONCLUSION | 42-45 |
| | LITERATURE CITED | 46-51 |
| | ABSTRACT | 52 |
| | APPENDICES | i-viii |
| | BRIEF BIO-DATA | |

# LIST OF TABLES


| Table | Title | Page |
|---|---|---|
| 3.1 | Details of the treatments in the experiment | 12 |
| 3.2 | Details of the herbicide formulation used in the experiment | 13 |
| 3.3 | Details of the methods used in soil analysis | 20 |
| 4.1 | Predominant weed species in experimental nectarine orchard | 22 |
| 4.2 | Effect of different weed management practices on weed population count at different intervals after beginning* of experiment (in 30cm × 30 cm quadrant) | 23 |
| 4.3 | Effect of different weed management practices on weed fresh weight (g) at different intervals after beginning* of experiment (in 30cm × 30 cm quadrant) | 24 |
| 4.4 | Effect of different weed management practices on weed dry weight (g) at different intervals after beginning of experiment (in 30cm × 30 cm quadrant) | 25 |
| 4.5 | Effect of different weed management practices on weed control efficiency (%) at different intervals after beginning of experiment (in 30cm × 30 cm quadrant) | 26 |
| 4.6 | Effect of different weed management practices on nutrient content of weeds in the basins of plum cv. Red Beaut | 27 |
| 4.7 | Effect of different weed management practices on increment in tree height, spread and volume of plum cv. Red Beaut | 28 |
| 4.8 | Effect of different weed management practices on trunk girth (%) and annual shoot extention (m) of plum cv. Red Beaut | 30 |
| 4.9 | Effect of different weed management practices on leaf area and chlorophyll content of plum cv. Red Beaut | 31 |
| 4.10 | Effect of different weed management practices on Leaf nutrient content (N%, P% and K%) of plum cv. Red Beaut | 32 |
| 4.11 | Effect of different weed management practices on yield of plum cv. Red Beaut | 33 |
| 4.12 | Effect of different weed management practices on fruit length, diameter, weight and volume of plum cv. Red Beaut | 35 |
| 4.13 | Effect of different weed management practices on fruit pulp/stone ratio and firmness of plum cv. Red Beaut | 36 |
| 4.14 | Effect of different weed management practices on fruit TSS, titratable acidity, total sugar, reducing sugars and non-reducing sugars of plum cv. Red Beaut | 37 |

| | | |
|---|---|---|
| 4.15 | Effect of different weed management practices on soil pH, soil EC (dS/m) of the basin of plum cv. Red Beaut | 39 |
| 4.16 | Effect of different weed management practices on soil N (kg/ha), soil P (kg/ha) and soil K (kg/ha)of the basin of plum cv. Red Beaut | 40 |
| 4.17 | Benefit : Cost ratio | 41 |

# LIST OF PLATES


| PLATE | TITLE | PAGE(S) BETWEEN |
|---|---|---|
| 1 | Comparison between the weed population in the basins of treatments $T_8$, $T_3$ and $T_6$ with Control | 23-24 |
| 2 | Comparison between the fruits of treatments $T_8$, $T_7$ and $T_6$ with Control | 35-36 |


# LIST OF FIGURES


| FIGURE | TITLE | PAGE(S) |
|---|---|---|
| 1. | Graphical representation of effect of different weed management practices on fresh weight of weeds. | 25-26 |
| 2. | Graphical representation of effect of different weed management practices on dry weight of weeds. | 25-26 |

## ABBREVIATIONS USED

| Abbreviation | | Description |
|---|---|---|
| @ | : | At the rate of |
| ºBrix | : | Degree Brix |
| ºC | : | Degree Centigrade |
| % | : | Per cent |
| a.i. | : | Active ingredient |
| Anon. | : | Anonymous |
| ANOVA | : | Analysis of Variance |
| A.O.A.C | : | Association of Official Analytical Chemists |
| B : C | : | Benifit : Cost |
| CD | : | Critical difference |
| cc | : | Centimetre cube |
| cm | : | Centimetre |
| cv. | : | Cultivar |
| DF | : | Degree of freedom |
| dS $m^{-1}$ | : | Deci Siemens per meter |
| EC | : | Electrical Conductivity |
| etc. | : | Et cetera |
| *et al.* | : | Co-worker |
| g | : | Gram |
| HP | : | Himachal Pradesh |
| ha | : | Hectare (10,000 $m^2$ ) |
| HRTS | : | Horticulture Research and Training Station |
| i.e. | : | That is |
| IUPAC | : | International Union of Pure and Applied Chemistry |
| J&K | : | Jammu and Kashmir |
| K | : | Potassium |
| kg | : | Kilogram |
| kg $ha^{-1}$ | : | Kilogram per hectare |
| KVK | : | Krishi Vigyan Kendra |
| L | : | Litre |
| m | : | Meter |
| mg | : | Milligram |
| ml | : | Milliliters |
| mm | : | Millimeter |
| MSS | : | Mean Sum of Square |
| MT | : | Metric Tonne |

| | | |
|---|---|---|
| N | : | Nitrogen |
| NAA | : | Naphthalene Acetic Acid |
| NS | : | Non-significant |
| P | : | Phosphorus |
| pH | : | *Puissance de Hydrogen* |
| ppm | : | Parts per million |
| RBD | : | Randomized Block Design |
| SS | : | Sum of Square |
| TSS | : | Total Soluble Solids |
| UP | : | Uttar Pradesh |
| USA | : | United States of America |
| var. | : | Variety |
| *viz.* | : | *Videlicet* |

# *Chapter-1*

# INTRODUCTION

Plum is an important stone fruit crop of temperate and sub-tropical region of the world which belongs to the family Rosaceae, genus *Prunus* and have many species like *P. domestica*, *P. salicina* and *P.americana* etc. Most of the commercially grown plums fall into one of the two groups, European or Japanese types. European plums are generally better adapted to cooler regions than Japanese types. Most of the Japanese plums are consumed as fresh fruit.

Among deciduous fruits, the cultivation of plum is widely distributed in the world. This is because of wider adaptability among different species and cultivars of plum which are adaptable to varied agro-climatic and soil conditions. The major producer of plum in world are China, Romania, Serbia, USA, Turkey, Chile, Iran, India, Spain and Italy (Anon. 2016a). Plum is consumed as dessert, processed and dried products. Plum fruits are important source of minerals, vitamins, sugars and organic acids, in addition to proteins, fats and carbohydrates.

The cultivation of plum under Indian conditions is gaining considerable popularity and is occupying an important position as a commercial crop because of its great acceptance to the consumer either as a fresh fruit or its various products. Area under cultivation in India is about 22,000 ha with a production of 76,000 MT and productivity of 3 MT/ha (Anon. 2017). It is mainly cultivated in HP, J&K and Uttrakhand and to a smaller scale in sub-tropical plains of Punjab, Haryana and UP. Further, there is enormous scope for cultivation of plum in vast hilly tracts of North-Eastern states namely, Arunachal Pradesh, Nagaland, Manipur, Meghalaya, Mizoram, Tripura and hills of Nilgiri in the south (Sharma *et al*. 2013).

Himachal Pradesh is one of the major producer of plum in India. Area under plum cultivation in Himachal Pradesh is 8,601 ha with a production of 20,523 MT and productivity of 2.3 MT/ha (Anon. 2016b). Several cultivars of European and Japanese plum are under cultivation in Himachal Pradesh. ‘Santa Rosa’ for a long time has been the major plum cultivar in HP but with the passage of time it has significantly declined in production and productivity. To sustain the cultivation of plums some new introductions were made among which Red Beaut performed very well and was recommended for commercial cultivation.

Red Beaut is one of the early maturing cultivar providing good quality fruit with mild flavour. 'Red Beaut' plums have smooth bright red skin that turns reddish purple when fully ripe and flesh is yellowish fairly firm to slightly soft and very juicy.

In India, the average yield is low due to poor orchard management practices which include weed control and orchard management. Weeds compete with fruit trees for nutrients, space, moisture and light which affect the growth, vigour and fruit yield. Weeds have become a serious problem in orchard management which adds to the cost of cultivation. A wide range of weeds infest plum orchards and cause enormous loss to the productivity if not managed timely. Problem of weeds in plum orchards have become more alarming due to liberal fertilizer application which eventually is consumed by the weeds to put up a luxuriant growth at the expense of growth factors essential for yield and fruit quality.

Weed management in orchard is an important practice which is accomplished by mechanical means (tillage, mowing etc.), mulching, use of herbicides, growing cover crops or combination of two or more methods. The conventional method of hand weeding is costly and time consuming. Cover crops compete for moisture with main fruit crop and affect crop production. Herbicides are more effective and economical method of weed management. Number of pre and post-emergence herbicides are effectively used in different fruit crops at different doses. Use of herbicides for weed management is promising only if used judiciously. Improper use of herbicides can lead to many problems like herbicide resistance and ground water contamination etc. For effective results, herbicides in combinations or integration with organic and other weed management practices are the best option.

Keeping above in view, the present study on "**Effect of different weed management practices on plum (*Prunus salicina*) cv. Red Beaut**" was conducted with the following objectives:

i) To evaluate the effect of herbicides on growth, yield and fruit quality in plum cv. Red Beaut
ii) To assess the effect of weed management practices on soil and leaf nutrient content in plum
iii) To evaluate the efficiency of pre-emergence and post-emergence herbicides for control of weeds

# *Chapter-2*

# REVIEW OF LITERATURE

The work on weed management by mulching, hand weeding and herbicides had been done by many workers. The appropriate literature regarding the "**Effect of different weed management practices on plum (*Prunus salicina*) cv. Red Beaut**" is reviewed as follows:

## 2.1 EFFECT OF DIFFERENT WEED MANAGEMENT PRACTICES ON WEEDS (POPULATION, DENSITY, BIOMASS AND NUTRIENT UPTAKE ETC.)

Americanos (1982) had concluded that the mixture of the contact herbicides like diquat+paraquat effectively managed weeds in orchards of almonds, apples, apricots, cherries, peaches, pears and plums without affecting yield, fruit size, or fruit weight when compared with the control. Niggli (1985) observed highest weed control efficiency with the treatment of organic mulch followed by glyphosate in peach field. Kaundal *et al*. (1995) in a study on peach found that black polythene mulch leads to lower dry matter content and lower nutrient depletion by weeds. Among the various organic mulches, straw mulch gave the best weed control. Khokhar and Sharma (2000) conducted an experiment on almond and found that grass mulch followed by an application of post-emergence herbicide was most effective in reducing weed population. Hipps *et al*. (2004) in a study in apple compared different weed management practices i.e. contact, residual herbicides and straw mulches in a newly planted apple orchard over 8-year period. They found that contact herbicides gave the poorest weed control, followed by residual herbicides while very little weed intrusion occurred in the straw mulch treatments. Bal and Kumar (2005) in a study on guava concluded that herbicides and manual weeding reduced the weed number significantly over control. Mennan *et al.* (2006) in a study on hazelnut observed that weed density and biomass were significantly reduced by the combination of weed control methods i.e. mechanical methods along with herbicide application. Glyphosate or paraquat combined with mechanical methods reduced weed density and dry weight effectively than the pendimethalin and fluazifob-p-butyl mixture. Shylla *et al.* (2006) in an experiment on plum found black polythene mulch to be the most effective in suppressing most of weeds. Chatha and Chanana (2007) in a study on peach observed that all the herbicide treatments significantly reduced the weed population, dry weight of weed and nutrient depletion by weeds as compared to control. Kaur and Kaundal

(2009) conducted an experiment in plum cv. Satluj Purple and found that weed density and weed dry weight was significantly lower in all treatments as compared to control.

Kaith and Bhardwaj (2011) in a study on apple observed that after 30 days of application of herbicides the weed population under treatment differed significantly and was less in comparison to control. Kitis *et al.* (2011) in an experiment on citrus observed that living mulch of common vetch (*Vicia sativa*) reduced the biomass and dry weight of weeds. Living mulch application also reduced weed density and cover proportion to an average of 42.8% and 45.9% respectively, as compared to control. Thakur *et al.* (2012) conducted an experiment on peachto study effect of mulches and herbicide on weed population. They observed 100 per cent control of weeds with the treatment application of black polythene mulch (100µm). They also observed higher weed control efficiency at 6 weeks after application of straw mulch and herbicide treatment of diuron followed by glyphosate in comparison to control.

Kirandeep and Kaundal (2013) in a study on plum cv. Satluj Purple had concluded that the dry matter accumulation by weeds was significantly reduced under the herbicide treated plots. Meena (2013) in an experiment on peach observed that mulch and herbicides exerted a significant effect on weed population. In another study on grape, Lee *et al.* (2013) observed good weed control effect after 10 day of different weed management treatments. They found weed control of 100% in fabric covering, 95.3% in grass planting (*Festuca myuros* L.), 81.9% in mechanical weeding, 98.1% in glufosinate ammonium (3 appplications) and 90.4% inparaquat dichloride (3 applications). Lisek (2014) had revealed that, weed management based onuse of herbicides and alternative methods, suppresses the weed competition in fruit trees. Herbicides were the most effective way of controlling weeds within the fruit crops. Meena *et al.* (2015b) in a study on peach found that among different weed management practices, maximum weed control efficiency was recorded under treatment pendimethalin followed by glyphosate.

## 2.2 EFFECT OF DIFFERENT WEED MANAGEMENT PRACTICES ON TREE GROWTH PARAMETRS

### a. Tree growth parameters

Srivastava *et al.* (1973) in an experiment on apple observed an increase in plant growth with the application of grass mulch. Cockcroft and Tisdall (1974) had found that

increased tree circumference of peach was associated with the use of straw mulch that improved structure, soil moisture and soil rooting depth for trees growing in Goulburn Valley.

Nath and Sharma (1992) also recorded similar result, in lemon trees. Lu and Zeng (1998) in an experiment on apple also found that mulching increased shoot growth by 59 per cent. Darbellay (1997) had studied the effect of different soil management practices on young apple planting and found that organic mulches had positive effect on tree growth and fruit yields as compared to polythene mulch. Kumar *et al*. (1999) conducted an experiment on Starking Delicious apple to study the effect of different weed management practices. They recorded the greatest trunk girth, shoot length and fruit yield with herbicide plus mulching with hay followed by herbicide alone while lowest under clean cultivation.

Khokhar and Sharma (2000) in a study on almond found grass mulch to be most effective for raising trunk girth, annual shoot growth, tree height and tree spread. Belding *et al.* (2004) in a study on young peach trees observed weed interference was more where no pre-emergence herbicides were applied. In a study on plum, Singh *et al.* (2004) observed that growth of trees increased significantly under mulch treatments in sandy loam soil as compared to unmulched treatment. Belding *et al.* (2004) in a study on peach found that trunk cross sectional area was increased under different weed management treatments as compared to control.

Rankova (2006) conducted an experiment to study the effects of some soil herbicides on the vegetative habits in mahaleb cherry. He found that maximum grafting zone width was in the plants treated with pendimethalin, napropamid and metolachlore. Szewczuk and Gudarowska (2006) in an experiment on nectarine studied the effect of different mulching and herbicide treatments. They found that trunk cross sectional area was more in the case of the trees mulched with pine bark mulch. Hipps *et al*. (2004) conducted a study for different ground weed management systems viz. contact and residual herbicides, polypropylene woven and straw mulches. They revealed that trees growing in the straw mulch had the greatest shoot growth in apple. In an another study on effect of orchard floor management practices in apple, Pandey *et al.* (2005) observed that dry grass mulch was effective in producing the maximum annual extension growth.

Sharma and Kathiravan (2009) reported that different orchard floor management treatments significantly influenced the annual shoot growth in plum under rain-fed conditions of Himachal Pradesh. Chandel *et al.* (2010) conducted a study on kiwifruit to assess the response of different orchard floor management systems. The growth of vine in terms of annual shoot growth and trunk girth were highest under dry grass mulch and post-emergence herbicides treatment.

Kaith and Bhardwaj (2011) carried out an investigation for chemical control of weeds in apple and reported maximum trunk girth with glyphosate at 0.5 per cent followed by paraquat (0.5 %). Hussain *et al.* (2017) in an experiment on apple recorded highest growth characteristics like annual shoot extension growth and plant spread in treatment paddy straw mulch followed by glyphosate.

**b. Leaf parameters**

Srivastava *et al.* (1973) in an experiment on apple observed increase in leaf area and leaf number under grass mulch. Jawanda *et al*. (1974) in a study on sweet orange under Punjab conditions recorded higher level of phosphorus content in the leaves of plants under treatment of monuron @ 2.50 kg/acre as compared to control. They also observed decreasing trend of potassium in diuron and taficide treatments. Lu and Zeng (1998) conducted an experiment on apple orchard to study the effect of mulching on plant growth and found that mulching increased the leaf area by 30 per cent.

Shylla *et al.* (1999) observed highest percentage of leaf N under herbicide treatment. Further, they also observed highest leaf P, K, Ca and Mg contents under mulching with hay. Meena (2013) observed that there was no significant effect of herbicide and mulch treatments on leaf phosphorus content of peach. He recorded maximum leaf nitrogen in grass mulch followed by glyphosate.

Zhivondov and Rankova (2007) conducted a study on newly planted peach and nectarine orchards to study the effect of application of herbicide. They applied pendimethalin (Stomp 33 EC @ 4.0 l/ha) during spring followed by two sprays of contact herbicide diquat (Reglone forte – 3.0-3.5 l/ha) and compares with control. Significant effects on the contents of leaf pigments were not established after the application of pendimethalin. However, there was a tendency of increased content of leaf pigments in the plants treated with pendimethalin.

Nacheva *et al*. (2012) conducted a study to investigate the effect of application of the soil herbicides pendimethalin and napropamide on the vegetative growth and the pigment content in the leaves of *Prunus domestica* 'Wangenheims' plants under in vitro conditions. The herbicide solution was applied under sterile conditions as a film on the nutrient medium surface. They observed that the content of chlorophyll in the plants treated with pendimethalin was almost twice lower compared to the control. In the variants treated with napropamide (N400, N600) there were no significant differences in the chlorophyll content in comparison to the control plants. Nagy *et al.* (2013) in an experiment on peach evaluate four in-row ground management systems and observed that leaf nitrogen (N) and potassium (K) concentrations increased with mulch.

Hussian *et al.* (2017) in a study on apple revealed that the maximum leaf area was recorded with paddy straw mulch followed by glyphosate, which was statistically at par with treatment paddy straw mulch and cowpea.

## 2.3 EFFECT OF DIFFERENT WEED MANAGEMENT PRACTICES ON YIELD

Duncan and Stapleton (1994) in an experiment on young prunus trees reported that black ploythene mulch was associated with higher fruit yields. McCue *et al.* (1996) compared different weed management methods in 10-year-old trees of 'McIntosh' apple. They observed that yield was increased by the herbicide treatment of paraquat+oryzalin and also in the rotary tilled treatment.

Lal *et al*. (2003) conducted an experiment on apple to investigate effect of organic and black polythene mulch on moisture conservation, tree vigour and yield and recorded highest yield under black polythene mulch. Sharma and Kathiravan (2009) conducted a trial with different mulches and reported increased yield in plum under mulching over unmulched control. Shylla and Chauhan (2003) in study on Santa Rosa variety of plum found that trees under intercropping had 15.95 per cent less yield as compared to herbicide treatment, which recorded the highest yield of 40.75 kg tree$^{-1}$. Belding *et al.* (2004) in a study on peach found that all treatments with herbicide had higher yields than those without herbicides. Pandey *et al.* (2005) observed that yield was highest from the tree receiving dry grass mulch, while minimum fruit yield was under clean cultivation. Sharma and Kathiravan (2009) conducted a trial on plum to study the effect of different mulches and reported increased yield in plum by mulched over unmulched control. Bal and Singh (2011) in a study on ber observed effect of

mulch on plant yield and reported that maximum fruit weight and yield were recorded under black polythene mulch.

Meena *et al.* (2015a) in a study on peach found that fruit yield was maximum under treatment grass mulch followed by two application of glyphosate. Lisek and Buler (2018) in a study on different orchard floor management practices found highest total fruit yield in plots treated with herbicides (two applications with glufosinate ammonium) as compared to trees under mulching.

## 2.4 EFFECT OF DIFFERENT WEED MANAGEMENT PRACTICES ON FRUIT PARAMETERS

Kumar *et al*. (1999) observed maximum fruit length, fruit breadth and fruit weight under herbicide plus hay mulching treatment followed by mulching with hay, while lowest under clean cultivation. However, higher total soluble solids were found under clean cultivation.

Shylla and Chauhan (2004) conducted an experiment on plum trees cv. Santa Rosa and observed that black polythene mulch treatment recorded the highest content of total sugars and reducing sugars. Pandey *et al*. (2005) in apple recorded maximum fruit size, weight, volume and juice content under dry grass mulching.

Szewczuk and Gudarowska (2004) studied the effect of different methods of weed management on yield and quality of Jonagold apple. They observed that trees mulched with pine bark had largest size apples. Apples from trees mulched with pine bark were firmer at harvest than apples from trees treated with herbicide. Fruit weight loss during storage was higher with herbicide than trees mulched with pine bark. Chantha and Chantha (2007) in a study on peach to find the effect of different weed management practices found that highest fruit weight was under treatment oxyflurofen @ 1.0 l (a.i.) $ha^{-1}$ followed by oxadiazon @ 1.0 l (a.i.) $ha^{-1}$ and oxyflurofen @ 0.75 l (a.i.) $ha^{-1}$. Joolka *et al.* (2008) in a study on apple found maximum total sugars value under black polythene mulch followed by dry grass mulch and lowest in control.

Bal and Singh (2011) recorded maximum fruit size, weight and yield from the plants under black polythene mulch while, maximum TSS was recorded from plants mulched with black polythene+gramoxone @ 1 l/ha in ber. Gavat *et al*. (2013) conducted a study in

peach with respect to clean cultivation between tree rows versus the mowed sod strips and revealed an increase in fruit weight by 15%, fruit number per tree by 30% and fruit yield by 55% with clean cultivation.

Kirandeep and Kaundal (2013) conducted an experiment on plum to found the effect of various herbicidal treatments on fruit quality and yield. They concluded that different pre and post emergence herbicide treatments and mulching significantly improved the fruit weight and pulp weight. He also found that the fruit yield was significantly improved with various weed management treatments. Meena (2013) in study on peach observed that total sugar and reducing sugars was maximum under treatment of grass mulch followed by glyphosate and minimum under control. JiBhat *et al*. (2015) in a study on apricot found that the application of grass mulch improved physico-chemical parameters of apricot fruits (i.e. fruit size, fruit weight, TSS, total sugars and reducing sugars) of apricot fruits as compared to all other treatments.

Hussain *et al.* (2017) conducted a study on apple to found effect of different orchard floor management practices. They concluded that maximum fruit length, fruit diameter and fruit weight were observed with paddy straw mulch followed by glyphosate. Sharma *et al.* (2017) in a study on nectarine found that among different orchard floor management practices, mulches performs better than the chemical treatments for different fruit characters like fruit size, weight, TSS, sugars and yield. Similar results were obtained by Sharma *et al.* (2017) in pomegranate where fruit yield and shoot extension growth was found to be better under grass mulch when compared to other orchard floor management practices.

## 2.5 EFFECT OF DIFFERENT WEED MANAGEMENT PRACTICES ON SOIL PARAMETERS

Rao and Pathak (1996) worked on aonla cv. Francis under Faizabad conditions of Utter Pradesh and found that highest available nitrogen content (200.45 kg/ha) was observed in the soil under treatment paddy straw mulch and minimum value of 185.40 kg/ha nitrogen was available in control. They also reported highest available potassium (247.20 kg/ha) content in soil under paddy straw mulch treatment.

Mulching in general, reduces soil loss and minimizes water evaporation. Mulching facilitated retention of soil moisture and helped in control of temperature fluctuations, improves physical, chemical and biological properties of soil (Kumar *et al.* 1990). Shylla *et*

*al*. (1999) in plum cv. Santa Rosa reported that electrical conductivity of the soil was significantly higher under hay mulching treatment.

Shui *et al*. (2008) in an experiment on citrus orchards compared six types of weed management measures in citrus orchards of the hilly red soil region of China. These six treatments included tillage without herbicide (clean tillage), no tillage without herbicide (sod culture) and no tillage with herbicides paraquat, glyphosate, glyphosate-glyphosat-paraquat and paraquat-paraquat-glyphosate. They concluded that sod culture, paraquat, glyphosate, glyphosate-glyphosate-paraquat, and paraquat-paraquat-qlyphosate treatments could improve the soil fertility with annual accumulation of N, P, K, and OM by 7.1%, 6.9%, 5.3%, 6.2%, and 6.6%, respectively, whereas the clean tillage treatment without herbicide reduced soil fertility by 4.4% after three-years experiment. Sinkeviciene *et al.* (2009) had concluded that mulches increased the availability of phosphorus and potassium in the soil which results in higher crop yield.

Meena (2013) studied on peach cv. July Elberta orchard that soil pH was maximum under the treatment of pendimethalin @ 2.0 Kg/ha and minimum under the treatment of pendimethalin 2.0 kg/ha followed by grass mulch. He also observed that electrical conductivity ranged from 0.25 to 0.33 $dSm^{-1}$ and organic carbon was maximum under grass mulch followed by glyphosate treatment. Sharma and Sharma (2018) in a study on nectarine found that soil hydrothermal regimes were maintained effectively under black polythene mulch which had resulted for maximum fruit size, weight and “A” graded fruits under this treatment.

## 2.6 EFFECT OF DIFFERENT WEED MANAGEMENT PRACTICES ON BENEFIT: COST RATIO

Kaur and Kaundal (2013) had concluded that net benefit of the herbicide treatment (glyphosate @ 1.6 l/ha) is the best possible option for effective and economic weed control in high density planted plum. Meena *et al.* (2016) studied the effect of different weed management practices on peach trees. He found that grass mulch followed by two sprays of glyphosate 0.8 kg/ha treatment was most economical for farmers with benefit: cost ratio of 4.31: 1. Gupta *et al*. (2016) in peach found that maximum benefit: cost ratio (1.89: 1) in black polythene mulch treatment. They also observed benefit: cost ratio of 1.70: 1 in pre-emergence herbicide treatments of pendimethalin. They also found that the total cost of cultivation per hectare was highest (Rs.207480.00) in treatments black polythene mulch and white polythene

mulch, respectively whereas, it was found to be lowest of Rs185240.00 in the treatment control.

Iqbal *et al*. (2017) studied economics of different mulching materials on aonla under rainfed conditions of Jammu. The study revealed that the total cost of cultivation was higher (Rs.2566.60) in black polythene mulch and white polythene mulches whereas it was minimum (Rs.2478.30) in control. However, net returns were maximum (Rs. 2672.84/treatment) under black polythene mulch and minimum in control (Rs. 1559.30/treatment). However, benefit: cost (B: C ratio) was also found to be maximum in black polythene mulch (2.04: 1) and minimum in both white polythene mulch and control (1.69: 1). Verma *et al*. (2017) in a study on custard apple found that among different weed management practices, application of pendimethalin had maximum B: C ratio. Hussain *et al.* (2018) in an experiment on effect of fifteen different orchard management practices in apple observed maximum benefit: cost ratio in the treatment of paddy straw mulch followed by glyphosate.

# *Chapter-3*

# MATERIALS AND METHODS

The present study on **"Effect of different weed management practices on plum (*Prunus salicina*) cv. Red Beaut"** was carried out in the experimental orchard "Jadari Farm" of Horticulture Research Station / Krishi Vigyan Kendra Kandaghat, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh. Following is the detail of materials used and methodologies employed for the present studies:

## 3.1 EXPERIMENTAL DETAILS

| | | |
|---|---|---|
| Number of treatments | : | 10 |
| Number of replication | : | 3 |
| Spacing | : | 6 m x 6 m |
| Experimental Design | : | Randomized block design (RBD) |

Trees of plum cv. "Red Beaut" planted in 2009 were used for the experiment. Experimental trees had been raised on seedling rootstocks of wild apricot. During the entire course of investigation, all trees were kept under uniform cultural practices and nutritional doses. For the present study, 30 trees of uniform vigour were selected. Orchard area excluding basin area was allowed to populate with native weedy species and these weeds were removed only at the end of growing season. All the trees were subjected to different treatments i.e. hand weeding, grass mulching and different herbicide doses as follows:

## 3.2 TECHNICAL PROGRAMME OF RESEARCH WORK

**Table 3.1 Details of the treatments in the experiment**

| Treatment Code | Detail of Treatment |
|---|---|
| $T_1$ | Pendamil @ 5.3 ml/L of water |
| $T_2$ | Gramoxone @ 4 ml/L of water |
| $T_3$ | Gramoxone @ 5 ml/L of water |
| $T_4$ | Gramoxone @ 6 ml/L of water |
| $T_5$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water |
| $T_6$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water |
| $T_7$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water |
| $T_8$ | Grass mulching |
| $T_9$ | Hand weeding at 30 days interval |
| $T_{10}$ | Control (Unweeded) |

## 3.3 DETAILS OF HERBICIDE FORMULATION

**Table 3.2 Details of the herbicide formulation used in the experiment**

| Common name | Trade name | a.i. | IUPAC Name | Density | Manufacturer |
|---|---|---|---|---|---|
| Pendimethalin | **Pendamil** | Pendimethalin 30 % EC | 3,4-Dimethyl-2,6-dinitro-*N*-pentan-3-yl-aniline | 1.17 g/cm$^3$ | Insecticides (India) Limited |
| Paraquat | **Gramoxone** | Paraquat dichloaride 24 % SL | 1,1'-Dimethyl-4,4'-bipyridinium dichloride | 1.25 g/cm$^3$ | Syngenta |

## 3.4 DETAIL OF HERBICIDE'S ACTIVE INGREDIENT:

**Pendimethalin** is an herbicide of the dinitroaniline class used to control annual grasses and certain broadleaf weeds. It inhibits root and shoot growth. It controls weed population by preventing their emergence. Its primary mode of action is to prevent plant cell division and elongation in susceptible species. In the classification of herbicides according to their mode of action, Herbicide Resistance Action Committee (HRAC) listed pendimethalin in group K1 (Anon., 2018a).

**Paraquat dichloride** is an organic compound with the chemical formula $[(C_6H_7N)_2]Cl_2$. It is an oxidant that interferes with electron transfer, a process that is common to all life. As an herbicide, paraquat dichloride acts by inhibiting photosynthesis. In light-exposed plants, it accepts electrons from photosystem I and transfers them to molecular oxygen. In this manner, destructive reactive oxygen species are produced. In forming these reactive oxygen species, the oxidized form of paraquat is regenerated, and is again available to shunt electrons from photosystem I to restart the cycle (Anon., 2018b).

## 3.5 METHOD AND TIME OF APPLICATIONS

Pendamil was applied as pre-emergence in treatment $T_1$, $T_5$, $T_6$ and $T_7$ during late February. This day was considered as '0 day' of the experiment. Gramoxone in treatment $T_2$, $T_3$, $T_4$, $T_5$, $T_6$ and $T_7$ was applied at 30$^{th}$ day of experiment.

Grass mulch of thickness 10 cm was applied in basins of treatment $T_8$ at '0 day'. First hand weeding was done at 30$^{th}$ day of experiment and other at 30 days interval. In treatment $T_{10}$ (Control), no weed management practice was followed.

## 3.6 OBSERVATIONS RECORDED

### 3.6.1 Study on weeds

#### 3.6.1.1 Survey of weed flora

The predominant weed flora of experimental orchard was identified and broadly grouped into monocot and dicot weeds.

#### 3.6.1.2 Weed population count

Total numbers of weeds were counted from a fixed quadrant of 30cm × 30cm at $30^{th}$, $60^{th}$, $90^{th}$ and $120^{th}$ day of experiment to get the weed population count.

#### 3.6.1.3 Fresh and dry weight of weeds

Weed sampling was done from an area of 30cm × 30cm at different days of sampling within the basin of tree. At each day of sampling, the samples were collected from area excluding the previously sampled area. Weeds were uprooted at different day's intervals and cleaned properly to remove adhered soil. Weight of fresh samples was recorded to get weed fresh weight. For measurement of dry weight these weeds were dried in hot air oven at 65±2°C for 48 hours.

#### 3.6.1.4 Weed control efficiency

Weed control efficiency (WCE) was expressed in per cent and calculated by following formula suggested by Kondap and Upadhayay (1985).

$$\text{WCE}(\%) = \frac{(\text{DWC} - \text{DWT})}{\text{DWC}} \times 100$$

Where,

DWC = dry weed weight ($g/m^2$) in control treatment ($T_{10}$)

DWT = dry weed weight ($g/m^2$) in treatment under consideration.

#### 3.6.1.5 Nutrient content in weeds

##### 3.6.1.5.1 Collection and processing of weed samples

Weed samples were collected from basin of each tree at $120^{th}$ days of experiment. Weeds were uprooted and then cleaned, dried, grinded and then storage.

#### 3.6.1.5.2 Digestion of weed samples

The digestion of the weed samples for phosphorus and potassium was done in di-acid mixture (nitric acid: perchloric acid 4:1). For nitrogen estimation, concentrated sulphuric acid and digestion mixture were used as suggested by Jackson (1967).

#### 3.6.1.5.3 Weed nutrient estimation

N, P and K in weed samples were estimated according to the procedures laid by Jackson (1973). Total nitrogen was estimated by micro-kjeldahl's method. Phosphorus was determined by spectrophotometric vanadium phosphomolybdate method. Potassium was estimated under flame photometer.

### 3.6.2 Tree parameters

#### 3.6.2.1 Tree height

The tree height was measured with the help of graduated flag staff from the soil surface to the top of a tree.

#### 3.6.2.2 Tree spread

The tree spread was measured in meter (m) in two directions (East-West and North-South) once at the beginning of the experiment. Mean of these two was considered as tree spread.

#### 3.6.2.3 Tree volume

Total above ground volume of each experimental tree was calculated from height and spread measurements according to the formulae given by Westwood (1978) and expressed in per cent increase.

i) For a tree that was taller than its width

$$\text{Volume} = 4/3\ \pi\ ab^2 \quad \text{if } a>b$$

ii) For a tree that was wider than height

$$\text{Volume} = 4/3\ \pi\ a^2b \quad \text{if } a<b$$

Where, $\pi = 3.14$

a = ½ of the height of the tree

b = ½ of the average spread of the tree (East-West and North-South spread average)

#### 3.6.2.4 Trunk girth

The tree trunk was marked with paint at 15 cm above the graft union at the beginning of experiment. The trunk girth was measured at this point with a measuring tape initially at

the beginning of experiment and finally at the end of growing season. The difference between two was increment in trunk girth. Increment in trunk girth was expressed in per cent.

#### 3.6.2.5 Annual shoot growth

Ten shoots were randomly selected from all over the periphery of each tree. The length of these shoots was measured with measuring tape at the end of growing season for calculating average annual shoot growth during the course of investigation and was expressed in metre (m).

#### 3.6.2.6 Leaf area

Ten leaves from each experimental tree were randomly collected and leaf area was recorded with CI-202 Portable Laser Leaf Area Meter and the values were expressed as average leaf area in square centimetre ($cm^2$).

#### 3.6.2.7 Total Chlorophyll content

Ten representative fully grown leaves from the current season's growth of each tree were detached in the morning hours, during end of June and placed immediately in ice box with ice packs and brought to the laboratory. The samples were then kept in the refrigerator at 0°C to avoid degradation of chlorophyll pigments.

**A. Extraction**

Leaves from each sample were washed and chopped into small pieces under subdued light and 100 mg of chopped material was placed in vial containing 7 ml of dimethyl sulphoxide (DMSO). The contents of the vials were incubated at 65$^{o}$C for 30 minutes and then extract was transferred to graduated test tube and final volume was made to 10 ml with dimethyl sulphoxide (Hiscox and Israelstam, 1979).

**B. Estimation**

Optical density (OD) of the above extract was recorded on Spectronic-20 D at 645 and 663 nm wave lengths against DMSO blank and total chlorophyll content was calculated by using the following formula:

$$\text{Total chlorophyll (mg/g)} = \frac{20.2\ \text{A645} + 8.02\ \text{A663} \times \text{V}}{\text{A} \times 1000 \times \text{W}}$$

Where,

V = Volume of extract used

A = Length of light path in cell (1cm)

W = Weight of the sample (g)

A645 = Absorbance at 645 nm wavelength

A663 = Absorbance at 663 nm wavelength

The results were expressed as chlorophyll content in mg/g of fresh weight.

#### 3.6.2.8 Leaf Nutrient Analysis (N, P and K)

**A. Collection and processing of leaf samples**

Leaf samples were collected from the middle of the current season's growth around the periphery of the tree during the last week of June. Samples were cleaned, dried, grinded and stored.

**B. Digestion of leaf samples**

The digestion of the leaf samples for phosphorus and potassium was done in di-acid mixture (nitric acid: perchloric acid 4:1). For nitrogen estimation, concentrated sulphuric acid and digestion mixture were used.

**C. Nutrient estimation**

N, P and K in leaf samples were estimated according to the procedures laid by Jackson (1973). Total nitrogen was estimated by micro-kjeldahl's method. Phosphorus was determined by Spectrophotometric vanadium phosphomolybdate method. Potassium was estimated under flame photometer.

### 3.6.3 Fruit yield

The fruit retained at the time of harvesting were taken as yield of fruits under different treatments by weighing the total fruits on top pan balance. The total yield was expressed in kilograms per plant (kg/plant).

### 3.6.4 Physico-chemical analysis of fruit

#### 3.6.4.1 Physical parameters

##### 3.6.4.1.1 Fruit length and breadth

The size of ten randomly selected fruits from each experimental tree was recorded in terms of length and breadth with the help of digital Vernier calliper. Fruit length was measured between proximal end and distal end of fruit. Fruit breadth was worked out by averaging the two values of diameters at right angle. The average values of fruit length and breadth were expressed in millimetre (mm).

#### 3.6.4.1.2 Fruit weight

Ten fruits which were taken for fruit size measurement were weighed on electronic top pan balance and the average fruit weight was expressed in gram per fruit (g/fruit).

#### 3.6.4.1.3 Fruit volume

Volume of fruits was measured by water displacement method. Ten selected fruits taken for measuring size and weight were immersed in a measuring cylinder filled with water up to a certain graduation. The difference between initial and final readings gave the measure of volume of fruit samples, which were averaged and expressed in cubic centimetre per fruit.

#### 3.6.4.1.4 Fruit firmness

The fruit firmness was determined by digital pressure tester (FHP-802) which recorded the pressure necessary for the plunger to penetrate the peeled flesh of nectarine fruits. Five fruits were tested for each tree and result was expressed in kg per $cm^2$.

#### 3.6.4.1.5 Pulp: stone ratio

Stone of the selected fruits was separated from pulp and weighing of both pulp and stone was done separately. The average ratio of weight of pulp and stone was recorded.

### 3.6.4.2 Chemical parameters

#### 3.6.4.2.1 Total soluble solids (TSS)

Total soluble solids content was determined by Erma hand refractometer (0-32ºBrix) by putting few drops of fruit juice on its prism. The refractometer was calibrated with distilled water before use.

#### 3.6.4.2.2 Titratable acidity

Twenty-five gram of fruit pulp was taken, properly crushed in pestle and mortar. This finely grinded pulp was transferred to flask and volume was made to 250 ml with distilled water. The mixture was then filtered through Whatman No.1 filter paper and 50 ml of this filtrate was separated for titratable acidity estimation. Ten millilitre of the extract was titrated against 0.1 N NaOH solution using phenolphthalein as an indicator and the appearance of light pink colour indicated the end point. The total titratable acidity was calculated in terms of malic acid and one ml of 0.1 N NaOH is equivalent to 0.0067 g of anhydrous malic acid. The results were then expressed in terms of percentage.

$$\text{Titratable acidity } (\% = \frac{\text{Titre value } \times \text{ Nor. of alkali } \times \text{ Volume made } \times \text{ Eq. Wt. dominant acid}}{\text{Wt. of sample for estimation} \times \text{ Volume of aliquot } \times \text{ 1000}} \times 100$$

**3.6.4.2.3 Total sugars**

To the remaining 200 ml filtered stock solution from titratable acidity estimation, 10 ml of saturated lead acetate was added. The contents were shaken and filtered into flask containing 10 ml potassium oxalate and filtered again and the volume was made 250 ml with distilled water. Out of this, 100 ml deleaded and clarified solution was hydrolysed by adding 3 ml of concentrated hydrochloric acid and leaving it overnight. The excess of hydrochloric acid was neutralized by 10 percent sodium hydroxide solution in the presence of phenolphthalein indicator and final volume was made to 250 ml with distilled water. The total sugars were estimated by titrating to the boiling Fehling solution mixture (5 ml each Fehling's A and B solutions) against the hydrolysed pulp solution using methylene blue as an indicator. The titration was carried out till the colour of solution became brick red and the blue tinge of methalin blue get disappeared from the bubble of boiling solution. The results were expressed as percent of fresh weight of the fruit pulp (A.O.A.C., 1980).

$$\text{Total sugar } (\%) = \frac{* \text{ Factor } \times \text{ Dilution}}{\text{Titre value } \times \text{Weight of sample}} \times 100$$

*Factor = 0.05

**3.6.4.2.4 Reducing sugars**

The boiling mixture of 5 ml each of Fehling's A and Fehling's B solutions were titrated against the remaining unhydrolysed but deleaded and clarified pulp solution to determine the reducing sugars using methylene blue as indicator, till the appearance of brick red colour (A.O.A.C., 1980). The values were expressed as percent reducing sugar on fresh pulp weight basis.

**3.6.4.2.5 Non-reducing sugars**

The amount of non-reducing sugars was calculated by subtracting the reducing sugars from the total sugars and multiplying the difference by standard factor 0.95. The results were expressed as per cent non-reducing sugars.

### 3.6.5 Soil analysis

Soil samples were collected from 0 to 15 cm depth from the surface. Representative samples collected from 3 to 4 sites of each experimental plot (tree basin) with the help of

*Kudhali* during second week of December. The samples were dried in shade, sieved in 2 mm metallic sieve, lightly grounded and stored in cloth bags. The soil samples were used for different chemical analysis of the soil.

**Table 3.3 Details of the methods used in soil analysis**

| | |
|---|---|
| **Soil pH** | 1:2 Soil water suspension method (Jackson, 1967) with digital pH meter. |
| **Electrical conductivity ($dSm^{-1}$)** | 1:2 Soil water suspension method (Jackson, 1967) with digital conductivity meter |
| **Organic Carbon (%)** | Walkley and Black's rapid titration method (1934) |
| **Available N** | Alkaline potassium per manganate method (Subbiah and Asija, 1956) |
| **Available P** | Extraction with 0.05 M $NaHCO_3$ (pH 8.5) and development of colour by stannous chloride reduce ammonium molybdate method (Olsen *et al*., 1954) |
| **Available K** | Extraction with neutral normal ammonium acetate and determination by flame photometer (Merwin and Peech, 1951) |

### 3.6.6 Benifit: Cost ratio

The benefit: cost ratio was calculated by division of net return with total cost of cultivation. The Net return was calculated by subtracting total cost of cultivation from gross income. Total cost of cultivation was calculated by adding the cost of different inputs, labour etc. The gross income was calculated from the income obtained by selling the produce. The benefit: cost ratio was worked out for each treatments on per hectare basis.

### 3.6.7 Statistical Analysis

The data generated from these investigations were appropriately computed, tabulated and analysed by using MS-Exel and OPSTAT. The mean values of data were subjected to analysis of variance as procedures outlined by Gomez and Gomez (1984) for Randomized Block Design. Critical difference was calculated at 5 per cent level of significance.

# *Chapter-4*

# RESULTS AND DISCUSSION

The present investigation entitled **"Effect of different weed management practices on plum (*Prunus salicina*) cv. Red Beaut"** was carried out in the experimental orchard of HRTS and KVK, Kandaghat at Jadari farm, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh.

The results obtained during the present study are presented, discussed under following heading:

**4.1 Study on weeds**

**4.2 Plant growth parameters**

**4.3 Fruit yield**

**4.4 Physico-chemicals analysis of fruit**

**4.4.1 Physical parameters**

**4.4.2 Chemical parameters**

**4.5 Soil analysis**

**4.6 Benefit: cost ratio**

## 4.1 STUDY ON WEEDS

### 4.1.1 Weed survey

A survey of weeds in the experimental orchard was carried out to identify the predominant weed flora growing in the orchard. There were different kinds of weeds in the in the basins and surrounding areas. The weeds identified were broadly grouped into monocot and dicot classes and are shown in Table 4.1.

The major species of weeds predominant in orchard observed during the course of study were *Agropyron repens* L., *Amaranthus viridis* L., *Bidens pilosa* L., *Cannabis sativa* L., *Chenopodium album* L., *Cynodon dactylon* L., *Cyperus rotundus* L., *Echinochloa oryzicola* L. and *Oxalis latifolia* Kunth.

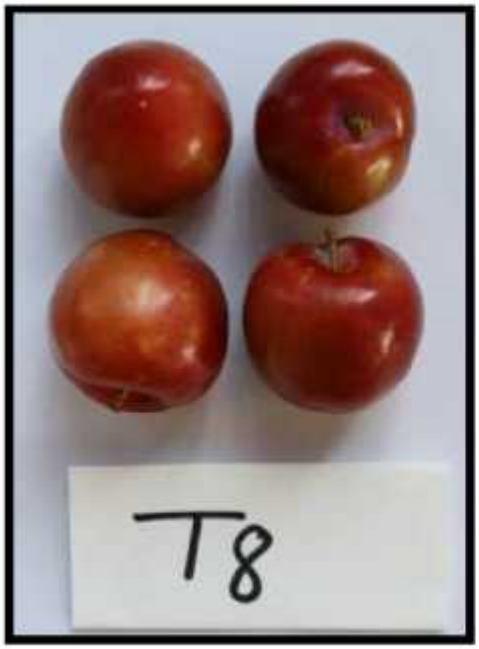
**Table 4.1. Predominant weed species in experimental nectarine orchard**

| Botanical name | Family | English name | Common name |
|---|---|---|---|
| **1. Monocot weeds** | | | |
| *Agropyron repens* L. | Poaceae | Quack grass | - |
| *Avena fatua* L. | Poaceae | Wild oat | Jai |
| *Cynodon dactylon* L. | Poaceae | Bermuda grass | Doob |
| *Cyperus rotundus* L. | Cyperaceae | Nut sedge | Dila |
| *Digitaria sanguinalis* L. | Poaceae | Crab grass | Takrighas |
| *Echinochloa oryzicola* L. | Poaceae | Common barnyard grass | - |
| *Setaria glauca* (L.) Beauv. | Poaceae | Yellow fox tail | Banara |
| **2. Dicot weeds** | | | |
| *Amaranthus viridis* L. | Amaranthaceae | Pig weed | Chaoli |
| *Bidens pilosa* L. | Asteraceae | Beggers stick | - |
| *Cannabis sativa* L. | Moraceae | Hemp | Bhang |
| *Chenopodium album* L. | Chenopodiaceae | Dowlamp bat | Bathu |
| *Euphorbia hirta* L. | Euphorbiaceae | Pod spurge | Bariduhi |
| *Fumaria parviflora* Lam. | Papaveraceae | Fineleaf fumitory | Pitpapra |
| *Galinsoga parviflora* Cav. | Borgariaceae | Gallant soldier | Piphe |
| *Lathyrus aphaca* L. | Fabaceae | Yellow pea | - |
| *Oxalis latifolia* Kunth | Oxalidaceae | Garden pink-sorrel | Tipatiya |
| *Oxalis corniculata* L. | Oxalidaceae | Procumbent yellow-sorrel | Khatti meethi |
| *Sonchus arvensis* L. | Asteraceae | Field milk thistle | Daudhi |

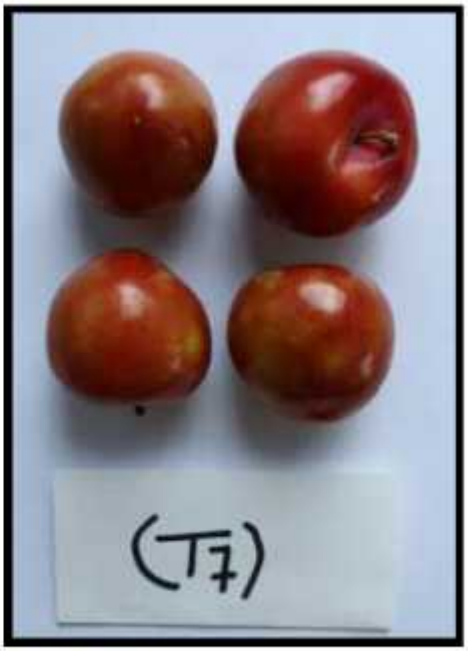
### 4.1.2 Weed population count

The data pertaining to weed population of basin area reveal that different weed management practices had significantly affected the weed population. Maximum weed population at 30$^{th}$ (19.33), 60$^{th}$ (28.33), 90$^{th}$ (31.33) and 120$^{th}$ (39.00) day of experiment was recorded under $T_{10}$ (Control). However, minimum weed population at 30$^{th}$ day (3.33) was under $T_8$ (Grass mulching). At 60$^{th}$, 90$^{th}$ and 120$^{th}$ days, weed population was minimum in $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water) with weed population of 2.00, 4.00 and 7.67, respectively.

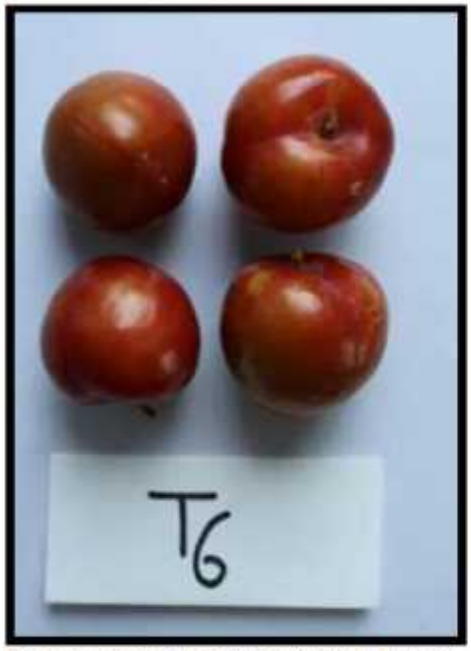
In the present study, weed population was found minimum in treatment grass mulching ($T_8$) at 30$^{th}$ day of experiment. This may be because of the slow decomposition of grass mulch which resulted in covering the basin area properly during early days of its application. At 60$^{th}$, 90$^{th}$ and 120$^{th}$ day, weed population was minimum in $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water) may be because of the effect



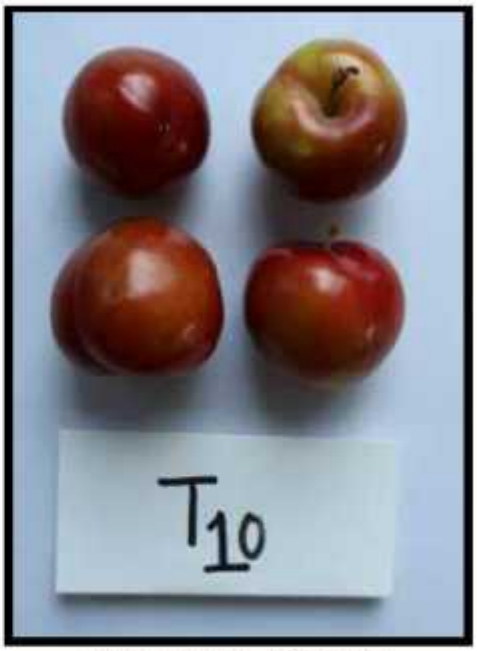

Treatment $T_8$ (Grass mulching)




Treatment $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water)




Treatment $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water)




Treatment $T_{10}$ (Control)

**Plate 2: Comparison between the fruits of treatments $T_8$, $T_7$ and $T_6$ with Control**

of both pre and post-emergence herbicides. The present study was in agreement with the findings of several workers (Kaith and Bhardwaj, 2011 and Chatha and Chanana, 2007) who had reported low weed population under different herbicide treatments.

**Table 4.2 Effect of different weed management practices on weed population count at different intervals after beginning* of experiment (in 30cm × 30 cm quadrant)**

| Treatments | | 30th day | 60th day | 90th day | 120th day |
|---|---|---|---|---|---|
| $T_1$ | **Pendamil @ 5.3 ml/L of water** | 10.00 | 13.00 | 18.00 | 24.00 |
| $T_2$ | **Gramoxone @ 4 ml/L of water** | 17.67** | 6.67 | 9.67 | 14.00 |
| $T_3$ | **Gramoxone @ 5 ml/L of water** | 17.33** | 5.33 | 9.33 | 13.67 |
| $T_4$ | **Gramoxone @ 6 ml/L of water** | 19.00** | 4.33 | 9.00 | 13.00 |
| $T_5$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water** | 9.33 | 2.67 | 5.00 | 8.33 |
| $T_6$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water** | 9.67 | 2.33 | 4.33 | 8.00 |
| $T_7$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water** | 9.33 | 2.00 | 4.00 | 7.67 |
| $T_8$ | **Grass mulching** | 3.33 | 4.00 | 11.67 | 16.00 |
| $T_9$ | **Hand weeding at 30 days interval** | 18.67** | 7.67 | 7.33 | 9.67 |
| $T_{10}$ | **Control (Unweeded)** | 19.33 | 28.33 | 31.33 | 39.00 |
| $CD_{0.05}$ | | 2.10 | 2.24 | 2.00 | 1.78 |

* Time of application of pre-emergence herbicide
** Observations recorded before application of treatment.

### 4.1.3 Fresh weight of weeds

Data in Table 4.3 show that mean fresh weight of weeds at 30th day of experiment was maximum (22.50 g) under treatment $T_9$ (Hand weeding at 30 days interval) which was at par with treatment $T_{10}$, $T_2$ and $T_4$. However, it was minimum (3.87 g) in $T_8$ (Grass mulching). At 60th day of experiment, minimum fresh weight (2.43 g) of weeds was recorded in $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water) which was statistically at par with $T_4$, $T_5$ and $T_6$. However, it was found maximum (37.47 g) in $T_{10}$ (Control). At 90th day of experiment, minimum fresh weight (12.82 g) of weeds was recorded in $T_9$ (Hand weeding at 30 days interval) which was statistically at with $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water. However, it was found maximum (67.89 g) in $T_{10}$ (Control). At 120th day of experiment minimum fresh weight (14.60 g) of

weeds was recorded in $T_9$ (Hand weeding at 30 days interval). However, it was found maximum (104.39 g) in $T_{10}$ (Control).

**Table 4.3 Effect of different weed management practices on weed fresh weight (g) at different intervals after beginning* of experiment (in 30cm × 30 cm quadrant)**

| Treatments | | 30th day | 60th day | 90th day | 120th day |
|---|---|---|---|---|---|
| $T_1$ | **Pendamil @ 5.3 ml/L of water** | 11.97 | 21.60 | 43.65 | 72.35 |
| $T_2$ | **Gramoxone @ 4 ml/L of water** | 20.83** | 8.07 | 26.97 | 48.41 |
| $T_3$ | **Gramoxone @ 5 ml/L of water** | 19.77** | 6.33 | 25.50 | 47.57 |
| $T_4$ | **Gramoxone @ 6 ml/L of water** | 22.43** | 5.20 | 24.29 | 46.41 |
| $T_5$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water** | 11.73 | 3.37 | 18.15 | 36.02 |
| $T_6$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water** | 10.73 | 2.87 | 17.09 | 34.81 |
| $T_7$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water** | 10.60 | 2.43 | 16.41 | 34.05 |
| $T_8$ | **Grass mulching** | 3.87 | 6.13 | 22.42 | 58.45 |
| $T_9$ | **Hand weeding at 30 days interval** | 22.50** | 13.53 | 12.82 | 14.60 |
| $T_{10}$ | **Control (Unweeded)** | 22.43 | 37.47 | 67.89 | 104.39 |
| $CD_{0.05}$ | | 2.52 | 2.87 | 4.17 | 8.78 |

* Time of application of pre-emergence herbicide
** Observations recorded before application of treatment.

### 4.1.4 Dry weight of weeds

It is evident from data presented in Table 4.4 that dry weight of weeds at 30th day of experiment was maximum under treatment $T_{10}$ (6.48 g) which was at par with treatments $T_4$, $T_9$, $T_2$ and $T_3$. At 60th, 90th and 120th day of experiment, weed dry weight was also maximum under treatment $T_{10}$ with weight of 14.99 g, 28.95 g and 48.64 g respectively. Minimum dry weight of weeds at 30th, 60th, 90th and 120th day of experiment was recorded under $T_8$ (0.29 g), $T_7$ (0.81 g), $T_7$ (2.67 g) and $T_9$ (4.74 g) treatments respectively.

Both herbicides and mulch had a significant effect on fresh and dry weight of weeds. Maximum fresh and dry weight of weeds in all the sampling dates was found under untreated control. These results are in agreement with the findings of Kaur and Kaundal (2009) who also reported maximum weed dry weight under unweeded control. Grass mulching ($T_8$) had minimum weed population at 30th day of experiment. Treatment $T_7$ (pendamil @ 5.3 ml/L of

water followed by Gramoxone @ 6 ml/L of water) had minimum fresh weight in 60th (2.43 g) and in 90th day (16.41 g) of experiment in comparison to other treatments on the same day. At 120th day of experiment weed fresh and dry weight was minimum in $T_9$ (Hand weeding at 30 days interval). These results are in line with the finding of Chatha and Chanana (2007) who reported that herbicide treatments significantly reduced the dry weight of weeds and nutrient depletion by weeds as compared to control.

**Table 4.4 Effect of different weed management practices on weed dry weight (g) at different intervals after beginning* of experiment (in 30cm × 30 cm quadrant)**

| Treatments | | 30th day | 60th day | 90th day | 120th day |
|---|---|---|---|---|---|
| $T_1$ | **Pendamil @ 5.3 ml/L of water** | 3.00 | 9.00 | 17.71 | 31.61 |
| $T_2$ | **Gramoxone @ 4 ml/L of water** | 5.84** | 2.69 | 8.07 | 15.95 |
| $T_3$ | **Gramoxone @ 5 ml/L of water** | 5.45** | 2.11 | 7.46 | 15.51 |
| $T_4$ | **Gramoxone @ 6 ml/L of water** | 6.36** | 1.73 | 6.95 | 14.90 |
| $T_5$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water** | 2.73 | 1.12 | 3.40 | 9.43 |
| $T_6$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water** | 2.87 | 0.96 | 2.95 | 8.79 |
| $T_7$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water** | 2.73 | 0.81 | 2.67 | 8.40 |
| $T_8$ | **Grass mulching** | 0.29 | 2.04 | 4.21 | 17.74 |
| $T_9$ | **Hand weeding at 30 days interval** | 6.23** | 4.37 | 2.84 | 4.74 |
| $T_{10}$ | **Control (Unweeded)** | 6.48 | 14.99 | 28.95 | 48.64 |
| $CD_{0.05}$ | | 1.05 | 1.07 | 1.87 | 4.66 |

* Time of application of pre-emergence herbicide
**Observations recorded before application of treatment.

### 4.1.5 Weed control efficiency

Data in the Table 4.5 reveals that maximum weed control efficiency at 30th day of experiment was under $T_8$ (95.47 %) and minimum under $T_{10}$ (0.00 %). At 60th and 90th day of experiment, maximum weed control efficiency was under $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water) with 95.42 % and 90.76 % respectively and

minimum under control $T_{10}$ on both day of sampling. At 120th day of experiment, maximum weed control efficiency of 90.24 % was recorded under treatment $T_9$ (Hand weeding at 30 days interval).

Mulch and herbicide had a significant effect on weed control efficiency on all sampling dates after application. Maximum weed control efficiency varied as per the day of observation. While treatment $T_{10}$ (Control) had lowest weed control efficiency on all the durations, as compared to all the other treatments. These results are in agreement with the finding of Thakur *et al.* (2012) who had reported higher weed control efficiency under straw mulch and herbicide treatment in comparison to control. Weed control efficiency after every successive sampling dates in treatment $T_1$ (Pendamil @ 5.3 ml/L of water), $T_2$ (Gramoxone @ 4 ml/L of water), $T_3$ (Gramoxone @ 5 ml/L of water) and $T_4$ (Gramoxone @ 6 ml/L of water) had been found to be decreasing may be because of the reason that herbicides degradation after application increases with passage of time which made more weeds to come.

**Table 4.5 Effect of different weed management practices on weed control efficiency (%) at different intervals after beginning* of experiment (in 30cm × 30 cm quadrant)**

| Treatments | | 30th day | 60th day | 90th day | 120th day |
|---|---|---|---|---|---|
| $T_1$ | **Pendamil @ 5.3 ml/L of water** | 53.80 | 39.92 | 38.53 | 35.22 |
| $T_2$ | **Gramoxone @ 4 ml/L of water** | - | 82.18 | 72.06 | 67.21 |
| $T_3$ | **Gramoxone @ 5 ml/L of water** | - | 85.90 | 73.89 | 68.10 |
| $T_4$ | **Gramoxone @ 6 ml/L of water** | - | 89.06 | 75.84 | 69.26 |
| $T_5$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water** | 57.75 | 92.31 | 87.99 | 80.59 |
| $T_6$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water** | 55.70 | 94.65 | 89.82 | 81.90 |
| $T_7$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water** | 57.61 | 95.42 | 90.76 | 82.72 |
| $T_8$ | **Grass mulching** | 95.47 | 87.17 | 85.47 | 63.54 |
| $T_9$ | **Hand weeding at 30 days interval** | - | 69.55 | 90.14 | 90.24 |
| $T_{10}$ | **Control (Unweeded)** | 0.00 | 0.00 | 0.00 | 0.00 |
| $CD_{0.05}$ | | 16.36 | 5.90 | 4.68 | 8.85 |

* Time of application of pre-emergence herbicide

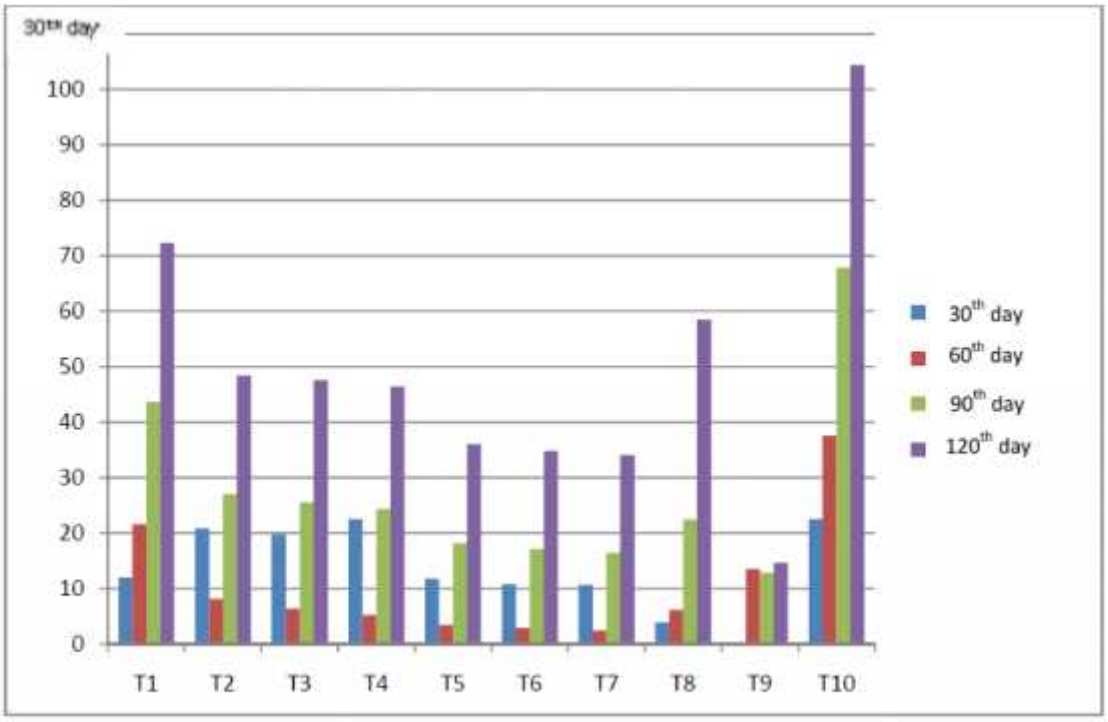



**Figure 1:Graphical representation of effect of different weed management practices on fresh weight of weeds**

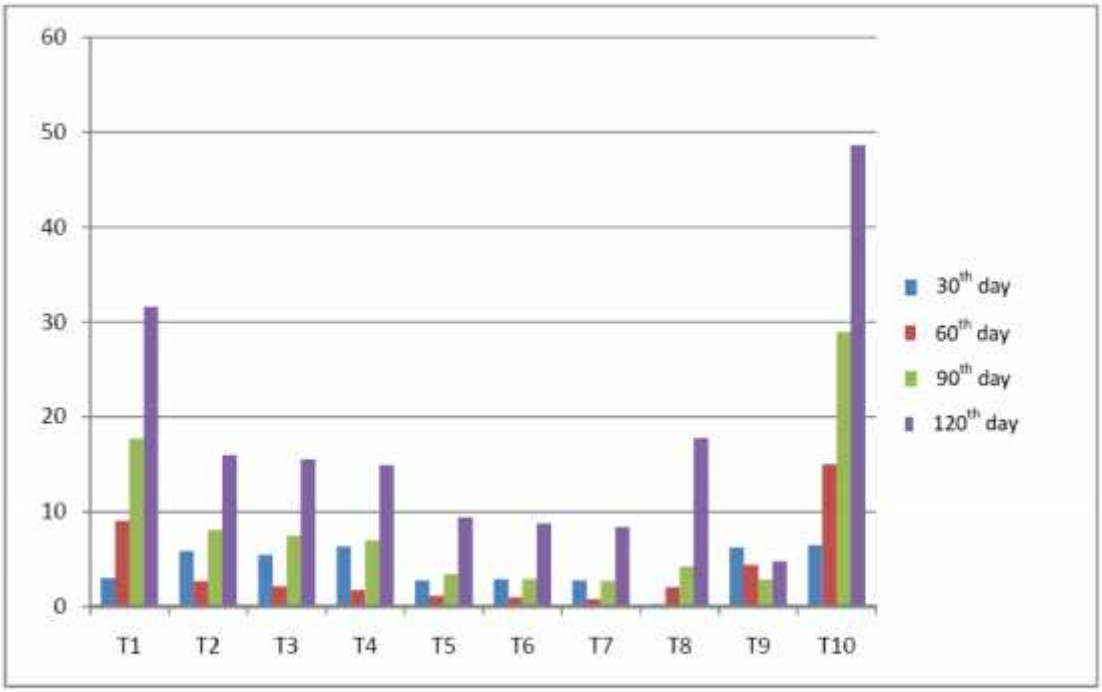



**Figure 2: Graphical representation of effect of different weed management practices on dry weight of weeds**

### 4.1.6 Nutrient content of weeds

Nitrogen percentage in weeds varies significantly. Maximum nitrogen percentage of 3.45 % was found in weeds of treatment $T_8$ (Grass mulching) which was at par with treatment $T_{10}$ (Control). Minimum nitrogen percentage in weeds was found in treatment $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water) with 3.10 %.

Phosphorus percentage of 0.32 % in weeds was recorded in treatment $T_8$ (Grass mulching) which was maximum and minimum in treatment $T_9$ (Hand weeding at 30 days interval). Weed potassium percentage varied from 1.55 % to 1.70 %. Potassium percentage in weeds was recorded maximum in treatment $T_8$ (Grass mulching) and minimum in treatment $T_9$ (Hand weeding at 30 days interval).

**Table 4.6 Effect of different weed management practices on nutrient content of weeds in the basins of plum cv. Red Beaut**

| Treatments | | Weed N (%) | Weed P (%) | Weed K (%) |
|---|---|---|---|---|
| $T_1$ | **Pendamil @ 5.3 ml/L of water** | 3.24 | 0.25 | 1.57 |
| $T_2$ | **Gramoxone @ 4 ml/L of water** | 3.30 | 0.27 | 1.63 |
| $T_3$ | **Gramoxone @ 5 ml/L of water** | 3.29 | 0.27 | 1.61 |
| $T_4$ | **Gramoxone @ 6 ml/L of water** | 3.30 | 0.26 | 1.60 |
| $T_5$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water** | 3.11 | 0.25 | 1.56 |
| $T_6$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water** | 3.10 | 0.25 | 1.56 |
| $T_7$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water** | 3.11 | 0.24 | 1.55 |
| $T_8$ | **Grass mulching** | 3.45 | 0.32 | 1.70 |
| $T_9$ | **Hand weeding at 30 days interval** | 3.23 | 0.22 | 1.55 |
| $T_{10}$ | **Control (Unweeded)** | 3.43 | 0.31 | 1.68 |
| **$CD_{0.05}$** | | 0.14 | NS | NS |

Nitrogen percentage in weeds was higher in treatment grass mulching ($T_8$) may be because of the fact that nutrients were abundantly available in the soil due to maintained hydrothermal regimes under mulching and the weeds which were able to survive under grass

mulch were able to take nutrients better. Weeds from herbicide treated plots had lower nitrogen percentage may be because of the physiological imbalance caused by chemicals to the weeds.

## 4.2 PLANT GROWTH PARAMETERS

### 4.2.1 Tree height increment

The data presented in Table 4.7 shows that different weed management treatments exerted a significant effect on tree height. The maximum tree height increment (46.96%) was recorded in treatment $T_8$ (Grass mulching), which was statistically at par with $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water) and $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water). The minimum increase in tree height (39.82 %) was recorded in $T_{10}$ (control) which was statistically at par with $T_1$ (pendamil @ 5.3 ml/L of water) and $T_2$ (Gramoxone @ 4 ml/L of water).

**Table 4.7 Effect of different weed management practices on increment in tree height, spread and volume of plum cv. Red Beaut**

| Treatments | | Tree Height Increment (%) | Tree Spread Increment (%) | Tree Volume Increment (%) |
|---|---|---|---|---|
| $T_1$ | **Pendamil @ 5.3 ml/L of water** | 41.03 | 54.44 | 166.27 |
| $T_2$ | **Gramoxone @ 4 ml/L of water** | 41.49 | 55.30 | 190.39 |
| $T_3$ | **Gramoxone @ 5 ml/L of water** | 42.25 | 55.80 | 205.73 |
| $T_4$ | **Gramoxone @ 6 ml/L of water** | 43.01 | 56.01 | 215.38 |
| $T_5$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water** | 44.68 | 56.81 | 243.52 |
| $T_6$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water** | 45.90 | 56.88 | 255.74 |
| $T_7$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water** | 46.35 | 57.31 | 265.22 |
| $T_8$ | **Grass mulching** | 46.96 | 57.16 | 267.80 |
| $T_9$ | **Hand weeding at 30 days interval** | 43.77 | 56.59 | 234.33 |
| $T_{10}$ | **Control (Unweeded)** | 39.82 | 52.79 | 144.88 |
| $CD_{0.05}$ | | 2.04 | NS | NS |

### 4.2.2 Tree spread increment

Different treatments had non-significant effect on tree spread (Table 4.7). Maximum tree spread increment of 57.31 % was recorded under treatment $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water). However, minimum tree spread increment of 52.79 % was recorded in $T_{10}$ (Control).

### 4.2.3 Tree volume increment

Table 4.6 shows that different weed management treatments had non-significant effect on tree volume increment. The maximum tree volume increment of 267.80 % was recorded in the $T_8$ (Grass mulching). However, minimum tree volume increment of 144.88 % was recorded in the treatment $T_{10}$ (Control).

### 4.2.4 Trunk girth

The data presented in Table 4.8 shows that different weed management treatment have significant effect on trunk girth. The trunk girth increment of 12.03 % was highest in the treatment T8 (Grass mulching), which was statistically at par with $T_5$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water), $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water) and $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water). However, minimum trunk girth increment of 9.80 % was recorded in $T_{10}$ (Control).

### 4.2.5 Annual shoot extension

The data presented in Table 4.8 reveals that maximum shoot growth of 1.08 m was recorded in trees under $T_8$ (Grass mulch), which was statistically at par with $T_9$ (Hand weeding at 30 days interval), $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water), $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water)and $T_5$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water). The minimum annual shoot growth (0.75 m) was recorded in $T_{10}$ (Control) which was statistically at par with $T_1$ (Pendamil @ 5.3 ml/L of water), $T_2$ (Gramoxone @ 4 ml/L of water) and $T_3$ (Gramoxone @ 5 ml/L of water).

All the herbicide and mulch treatments had significant effect on tree height increment, whereas for tree spread and volume increment they had non-significant effects. Grass mulch treatment resulted maximum tree height increment, tree volume increment,

trunk girth increment and annual shoot extension, whereas tree spread was maximum in $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water). The results are in accordance with the finding of Negi (2015) who had reported that plant growth parameters of trees under treatment grass mulch had significantly better results than other treatments. Cockcroft and Tisdall (1974) had also found that increased tree circumference of peach was associated with the use of straw mulch.

**Table 4.8 Effect of different weed management practices on trunk girth (%) and annual shoot extension (m) of plum cv. Red Beaut**

| Treatments | | Trunk girth Increment (%) | Annual shoot extension growth (m) |
|---|---|---|---|
| **$T_1$** | **Pendamil @ 5.3 ml/L of water** | 10.63 | 0.80 |
| **$T_2$** | **Gramoxone @ 4 ml/L of water** | 10.90 | 0.83 |
| **$T_3$** | **Gramoxone @ 5 ml/L of water** | 10.97 | 0.86 |
| **$T_4$** | **Gramoxone @ 6 ml/L of water** | 11.27 | 0.90 |
| **$T_5$** | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water** | 11.57 | 0.98 |
| **$T_6$** | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water** | 11.60 | 1.03 |
| **$T_7$** | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water** | 11.67 | 1.05 |
| **$T_8$** | **Grass mulching** | 12.03 | 1.08 |
| **$T_9$** | **Hand weeding at 30 days interval** | 11.27 | 0.96 |
| **$T_{10}$** | **Control (Unweeded)** | 9.80 | 0.75 |
| **$CD_{0.05}$** | | 0.10 | 0.13 |

### 4.2.6 Leaf area

It is evident from the data presented in Table 4.9 that different weed management treatments exerted a significant effect on leaf area. The maximum leaf area (46.41cm$^2$) was recorded in trees under $T_8$ (Grass mulching), which was statistically at par with $T_6$ and $T_7$, while minimum leaf area (44.19 cm$^2$) was recorded in $T_{10}$ (control).

**Table 4.9 Effect of different weed management practices on leaf area and chlorophyll content of plum cv. Red Beaut**

| Treatments | | Leaf Area ($cm^2$) | Leaf Chlorophyll (mg/g) |
|---|---|---|---|
| $T_1$ | Pendamil @ 5.3 ml/L of water | 45.02 | 2.45 |
| $T_2$ | Gramoxone @ 4 ml/L of water | 45.15 | 2.47 |
| $T_3$ | Gramoxone @ 5 ml/L of water | 45.28 | 2.50 |
| $T_4$ | Gramoxone @ 6 ml/L of water | 45.32 | 2.51 |
| $T_5$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water | 45.50 | 2.54 |
| $T_6$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water | 46.32 | 2.61 |
| $T_7$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water | 46.37 | 2.58 |
| $T_8$ | Grass mulching | 46.41 | 2.72 |
| $T_9$ | Hand weeding at 30 days interval | 45.43 | 2.52 |
| $T_{10}$ | Control (Unweeded) | 44.19 | 2.28 |
| $CD_{0.05}$ | | 0.81 | 0.16 |

### 4.2.7 Leaf chlorophyll content

The data presented in Table 4.9 reveals that different weed management treatments had a significant influence on leaf chlorophyll content. The maximum leaf chlorophyll content (2.72 mg/g) was found in T8 (Grass mulch), which was statistically at par with $T_6$ and $T_7$. The minimum leaf chlorophyll content (2.28 mg/g) was recorded under $T_{10}$ (Control).

Leaf area was recorded highest under grass mulching ($T_8$) and minimum under control. Leaf chlorophyll content was also found maximum under grass mulching ($T_8$) treatment. Higher leaf area under grass mulch may be because of the less competition which made plant to take better growth and also there may be better hydrothermal regimes under grass mulch. These results are in agreement with the finding of Hussain *et al.* (2018), who had reported that leaf area was maximum under treatment paddy straw mulch followed by glyphosate.

### 4.2.8 Leaf nutrient content

The data representing to leaf nutrients given in Table 4.10, shows that leaf nitrogen and potassium content were significantly affected by various weed management treatments whereas leaf phosphorus content was statistically non-significant.

**Table 4.10 Effect of different weed management practices on Leaf nutrient content (N%, P% and K%) of plum cv. Red Beaut**

| Treatments | | Leaf N (%) | Leaf P (%) | Leaf K (%) |
|---|---|---|---|---|
| $T_1$ | Pendamil @ 5.3 ml/L of water | 2.36 | 0.16 | 1.82 |
| $T_2$ | Gramoxone @ 4 ml/L of water | 2.37 | 0.16 | 1.84 |
| $T_3$ | Gramoxone @ 5 ml/L of water | 2.39 | 0.16 | 1.85 |
| $T_4$ | Gramoxone @ 6 ml/L of water | 2.39 | 0.16 | 1.86 |
| $T_5$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water | 2.41 | 0.17 | 1.91 |
| $T_6$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water | 2.47 | 0.17 | 1.91 |
| $T_7$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water | 2.48 | 0.18 | 1.93 |
| $T_8$ | Grass mulching | 2.62 | 0.19 | 1.95 |
| $T_9$ | Hand weeding at 30 days interval | 2.40 | 0.17 | 1.90 |
| $T_{10}$ | Control (Unweeded) | 2.28 | 0.14 | 1.74 |
| $CD_{0.05}$ | | 0.15 | NS | 0.04 |

The maximum leaf N content (2.62%) was found in T8 (Grass mulch), which was statistically at par with $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water) and $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water). The minimum leaf N content (2.28%) was recorded under $T_{10}$ (Control) which was statistically at par with $T_1$ (Pendamil @ 5.3 ml/L of water), $T_2$ (Gramoxone @ 4 ml/L of water), $T_3$ (Gramoxone @ 5 ml/L of water), $T_4$ (Gramoxone @ 6 ml/L of water) and $T_5$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water). The maximum leaf K content (1.95%) was found in T8 (Grass mulch), which was statistically at par with $T_6$ and $T_7$. The minimum leaf K content (1.74%) was recorded under $T_{10}$ (Control). The maximum leaf P content (0.19%) was found in T8 (Grass mulch) and minimum (0.14%) in $T_{10}$ (control).

Leaf nitrogen and potassium were significantly affected by different weed management practices. Higher leaf nitrogen, phosphorus and potassium was recorded in trees under grass mulching may be because of the better hydrothermal regimes maintained under the grass mulching which made the nutrients available in soil solution and plant could take them properly and become sufficient in nutrient content. In addition, the weed completion

was also reduced by mulching in earlier days and in later days grass mulching also released nutrients on decomposition which fulfil the requirement of nutrients. These results are in accordance with the findings of Meena et al. (2015b) who reported significantly higher leaf nitrogen content with grass mulching followed by glyphosate. Similar results were also reported by Shylla *et al.* (1999) in plum who reported that leaf nutrients were significantly influenced by different orchard floor management practices. Sas-Paszt *et al*. (2014) also reported that grass mulch significantly increased leaf N content.

## 4.3 YIELD PER PLANT

Maximum yield was recorded under treatment $T_8$ (Grass mulching) with 17.49 kg/tree which is statistically at par with $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water) and $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water). Minimum yield was recorded under $T_{10}$ (Control) having yield of 14.09 kg/tree.

**Table 4.11 Effect of different weed management practices on yield of plum cv. Red Beaut**

| Treatments | | Yield (kg/tree) |
|---|---|---|
| **$T_1$** | **Pendamil @ 5.3 ml/L of water** | 14.96 |
| **$T_2$** | **Gramoxone @ 4 ml/L of water** | 14.98 |
| **$T_3$** | **Gramoxone @ 5 ml/L of water** | 15.12 |
| **$T_4$** | **Gramoxone @ 6 ml/L of water** | 15.25 |
| **$T_5$** | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water** | 16.45 |
| **$T_6$** | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water** | 17.38 |
| **$T_7$** | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water** | 17.41 |
| **$T_8$** | **Grass mulching** | 17.49 |
| **$T_9$** | **Hand weeding at 30 days interval** | 16.30 |
| **$T_{10}$** | **Control (Unweeded)** | 14.09 |
| **$CD_{0.05}$** | | 0.51 |

Different weed management practices had significant effect on fruit yield. Highest yield was recorded under grass mulching treatment. These results are in agreement with the findings of Pandey *et al.* (2005) who observed that yield was highest from the tree receiving

dry grass mulch, while minimum yield was under clean cultivation. Other workers (Duncan and Stapleton, 1994; Lal *et al*., 2003; Sharma and Kathiravan, 2009 and Bal and Singh, 2011) also had reported higher yield under mulch treatments in comparison to control.

## 4.4 PHYSICO-CHEMICAL PARAMETERS OF FRUIT

### 4.4.1 Physical parametes

#### 4.4.1.1 Fruit Length

The data pertaining to the effect of different weed management practices on fruit length is presented in Table 4.12. Fruit length was maximum in $T_8$ (44.71 mm), which is statistically at par with $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water), $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water) and $T_5$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water). Minimum fruit length was recorded under treatment $T_{10}$ (Control).

#### 4.4.1.2 Fruit diameter

It is clear from the data presented in Table 4.12 that maximum fruit diameter was under the treatment $T_8$ (Grass mulching) which is statistically at par with treatment $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water) and $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water). Minimum fruit diameter was found under treatment $T_{10}$ (Control).

#### 4.4.1.3 Fruit weight

Persual of data presented in Table 4.12 shows that maximum fruit weight was under $T_8$ (Grass mulching) which is statistically at par with $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water), $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water) and $T_5$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water). Minimum fruit weight was under treatment $T_{10}$ (Control).

#### 4.4.1.4 Fruit volume

It is evident from Table 4.12 that maximum fruit volume was under $T_8$ (Grass mulching) which is statistically at par with $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water), $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone

@ 5 ml/L of water) and $T_5$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water). Minimum fruit volume was under $T_{10}$ (Control).

Fruit parameters i.e. length, diameter, weight and volume were recorded higher under treatment grass mulching ($T_8$) and minimum under control ($T_{10}$). These results are similar to Kirandeep and Kaundal (2013) who had concluded that different pre and post-emergence herbicide treatments and mulching significantly improved the fruit weight and pulp weight. These results are also in agreement with many other earlier workers (Kumar *et al*., 1999; Pandey *et al*., 2005; Hussain *et al*., 2017) who had reported higher physical parameters of fruits on trees under different mulch treatments.

**Table 4.12 Effect of different weed management practices on fruit length, diameter, weight and volume of plum cv. Red Beaut**

| Treatments | | Fruit Length (mm) | Fruit Diameter (mm) | Fruit Weight (g) | Fruit Volume (cc) |
|---|---|---|---|---|---|
| $T_1$ | **Pendamil @ 5.3 ml/L of water** | 42.74 | 44.75 | 49.81 | 50.76 |
| $T_2$ | **Gramoxone @ 4 ml/L of water** | 42.76 | 44.78 | 49.83 | 50.78 |
| $T_3$ | **Gramoxone @ 5 ml/L of water** | 42.82 | 44.85 | 49.89 | 50.85 |
| $T_4$ | **Gramoxone @ 6 ml/L of water** | 43.03 | 45.09 | 50.03 | 50.98 |
| $T_5$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water** | 44.45 | 46.28 | 51.47 | 52.42 |
| $T_6$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water** | 44.65 | 46.63 | 51.87 | 52.82 |
| $T_7$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water** | 44.68 | 46.68 | 51.91 | 52.86 |
| $T_8$ | **Grass mulching** | 44.71 | 46.69 | 51.94 | 52.89 |
| $T_9$ | **Hand weeding at 30 days interval** | 44.15 | 46.15 | 51.31 | 52.26 |
| $T_{10}$ | **Control (Unweeded)** | 42.31 | 44.31 | 49.22 | 50.17 |
| **$CD_{0.05}$** | | **0.26** | **0.18** | **0.53** | **0.54** |

#### 4.4.1.5 Fruit firmness

Fruit firmness character of fruit was found statistically non-significant for different weed management practices. Maximum fruit firmness was recorded under treatment $T_{10}$

(Control) and minimum under $T_8$ (Grass mulching). These results are in line with the findings of Meena (2013) who had reported in peach that minimum fruit firmness was under control and maximum was under treatment grass mulch followed by post-emergence herbicide.

#### 4.4.1.6 Pulp / stone ratio

Effect of different weed management practices on pulp/stone ratio of fruit was found to be statistically significant. Maximum pulp/stone ratio was recorded under $T_8$ (Grass mulching) which is statistically at par with $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water), $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water) and $T_5$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water). Minimum pulp/stone ratio was recorded under $T_{10}$ (Control), which is statistically at par with $T_1$ (Pendamil @ 5.3 ml/L of water), $T_2$ (Gramoxone @ 4 ml/L of water) and $T_3$ (Gramoxone @ 5 ml/L of water).

Maximum pulp/stone ratio was recorded under grass mulching treatment and minimum under control. These findings are in agreement with Meena (2013) who had recorded highest pulp/stone ratio in treatment of grass mulch followed by glyphosate.

**Table 4.13 Effect of different weed management practices on fruit pulp/stone ratio and firmness of plum cv. Red Beaut**

| Treatments | | Pulp/Stone | Fruit Firmness ($Kg/cm^3$) |
|---|---|---|---|
| $T_1$ | **Pendamil @ 5.3 ml/L of water** | 30.46 | 4.55 |
| $T_2$ | **Gramoxone @ 4 ml/L of water** | 30.67 | 4.43 |
| $T_3$ | **Gramoxone @ 5 ml/L of water** | 30.92 | 4.53 |
| $T_4$ | **Gramoxone @ 6 ml/L of water** | 31.28 | 4.67 |
| $T_5$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water** | 32.41 | 4.53 |
| $T_6$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water** | 32.91 | 4.67 |
| $T_7$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water** | 32.95 | 4.59 |
| $T_8$ | **Grass mulching** | 33.12 | 4.51 |
| $T_9$ | **Hand weeding at 30 days interval** | 32.10 | 4.75 |
| $T_{10}$ | **Control (Unweeded)** | 29.95 | 4.83 |
| **$CD_{0.05}$** | | **0.98** | **NS** |

Treatment $T_8$ (Grass Mulching)

Treatment $T_3$ (Gramoxone @ 5 ml/L of water)

Treatment $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water)

Treatment $T_{10}$ (Control)

**Plate 1: Comparison between the weed population in the basins of treatments $T_8$, $T_3$ and $T_6$ with Control**

### 4.4.2 Chemical parameters

#### 4.4.2.1 TSS

Fruit TSS was found to be non-significant for different weed management practices. The value of TSS ranges from 12.08 ˚Brix to 12.37 ˚Brix. Maximum TSS was found under treatment $T_8$ (Grass mulching) while minimum fruit TSS was recorded under treatment $T_{10}$ (Control).

#### 4.4.2.2 Titratable acidity

From Table 4.14, it is evident that different weed management practices had non-significant effect on titratable acidity of fruit. Titratable acidity ranges from 1.44 % to 1.24 %. Maximum titratable acidity was found in $T_{10}$ (Control) and minimum in $T_8$ (Grass mulching).

**Table 4.14 Effect of different weed management practices on fruit TSS, titratable acidity, total sugar, reducing sugars and non-reducing sugars of plum cv. Red Beaut**

| Treatments | | TSS (˚Brix) | Titratable acidity (%) | Total Sugar (%) | Reducing Sugar (%) | Non-reducing Sugar (%) |
|---|---|---|---|---|---|---|
| $T_1$ | Pendamil @ 5.3 ml/L of water | 12.12 | 1.40 | 6.38 | 5.10 | 1.22 |
| $T_2$ | Gramoxone @ 4 ml/L of water | 12.14 | 1.38 | 6.33 | 5.30 | 0.98 |
| $T_3$ | Gramoxone @ 5 ml/L of water | 12.17 | 1.38 | 6.43 | 5.41 | 0.96 |
| $T_4$ | Gramoxone @ 6 ml/L of water | 12.20 | 1.36 | 6.52 | 5.54 | 0.93 |
| $T_5$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water | 12.31 | 1.30 | 6.60 | 5.60 | 0.95 |
| $T_6$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water | 12.33 | 1.27 | 6.69 | 5.70 | 0.94 |
| $T_7$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water | 12.33 | 1.28 | 6.70 | 5.81 | 0.85 |
| $T_8$ | Grass mulching | 12.37 | 1.24 | 6.82 | 5.91 | 0.87 |
| $T_9$ | Hand weeding at 30 days interval | 12.26 | 1.33 | 6.54 | 5.55 | 0.94 |
| $T_{10}$ | Control (Unweeded) | 12.08 | 1.44 | 6.01 | 4.83 | 1.12 |
| $CD_{0.05}$ | | NS | NS | 0.12 | 0.11 | 0.15 |

#### 4.4.2.3 Total sugars

It is evident from Table 4.14 that different weed management practices had significant effect on total sugars of fruit. Maximum total sugars were found under treatment $T_8$ (7.82 %) which is statistically at par with T7. Minimum total sugars were found in treatment $T_{10}$ (7.01 %).

#### 4.4.2.4 Reducing sugars

It is clear from Table 4.14 that effect of different weed management practices had significant effect on reducing sugars of fruit. Maximum reducing sugars were recorded under $T_8$ (Grass mulching) which is statistically at par with $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water). Minimum reducing sugars were recorded under $T_{10}$ (Control).

#### 4.4.2.5 Non-reducing sugars

Non-reducing sugars of fruit were significantly affected by different weed management practices. Maximum non-reducing sugars were recorded under treatment $T_1$ (1.12 %) and $T_{10}$ (1.12 %) which is statistically at par with $T_{10}$. Minimum non-reducing sugars were recorded under $T_7$ (0.85 %).

Different weed management practiced had significant effect on total sugars of fruit. Maximum total sugars were found under treatment $T_8$ (Grass mulching) while minimum total sugars were found under treatment $T_{10}$ (Control). It is clear from Table 4.14 that effect of different weed management practices had significant effect on reducing sugars of fruit. Maximum reducing sugars were recorded under $T_8$ (Grass mulching) which is statistically at par with $T_7$. Minimum reducing sugars were recorded under $T_{10}$ (Control). These results are in agreement with the findings of many earlier workers (Shylla and Chauhan, 2004; Joolka *et al.* 2008; Meena 2013 and Hussain *et al.*, 2017) who had reported higher levels of sugar in fruits of trees under different mulches.

## 4.5 SOIL PARAMETERS

### 4.5.1 Soil pH and EC

The given data in Table 4.15 revealed that different weed management treatments did not had any significant effect on soil pH. The pH value of soil under different treatments ranged from 6.69 to 6.82.

**Table 4.15 Effect of different weed management practices on soil pH, soil EC (dS/m) of the basin of plum cv. Red Beaut**

| Treatments | | Soil pH | Soil EC (dS/m) | Organic Carbon (%) |
|---|---|---|---|---|
| $T_1$ | Pendamil @ 5.3 ml/L of water | 6.82 | 0.34 | 1.45 |
| $T_2$ | Gramoxone @ 4 ml/L of water | 6.74 | 0.33 | 1.53 |
| $T_3$ | Gramoxone @ 5 ml/L of water | 6.76 | 0.32 | 1.54 |
| $T_4$ | Gramoxone @ 6 ml/L of water | 6.77 | 0.32 | 1.54 |
| $T_5$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water | 6.78 | 0.31 | 1.47 |
| $T_6$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water | 6.79 | 0.30 | 1.48 |
| $T_7$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water | 6.79 | 0.29 | 1.49 |
| $T_8$ | Grass mulching | 6.69 | 0.33 | 1.73 |
| $T_9$ | Hand weeding at 30 days interval | 6.76 | 0.28 | 1.43 |
| $T_{10}$ | Control (Unweeded) | 6.77 | 0.26 | 1.41 |
| $CD_{0.05}$ | | NS | NS | 0.03 |

Lowest soil pH was recorded under treatment grass mulching ($T_8$) and highest under treatment $T_1$ (Pendamil @ 5.3 ml/L of water). The value of soil EC was highest (0.34 dS/m) under $T_1$ (Pendamil @ 5.3 ml/L of water) and lowest (0.26 dS/m) under control ($T_{10}$). Among different treatments, the electrical conductivity was higher under grass mulch. These results follow the trend to the findings of Shylla *et al*. (1999) who had reported that electrical conductivity of the soil was significantly higher under hay mulching treatment.

### 4.5.2 Soil organic carbon

Table 4.15 shows the levels of organic carbon in soil of different weed management treatments were statistically variable. Grass mulching ($T_8$) recorded maximum organic carbon of 1.73 % in soil. Minimum soil organic carbon of 1.41% was recorded under $T_{10}$ (Control).

Soil organic carbon was highest under grass mulching ($T_8$) treatment. This may be due to the addition of organic matter to the soil on decomposition of the mulch materials. Delver (1980) had also found increase in soil carbon with addition of organic material. Negi

(2015) had reported higher level of organic carbon under grass mulch as compared to herbicide treatment and control.

### 4.5.3 Available nutrient content in soil (N, P, K)

Table 4.16 shows the effect of different weed management practices on soil nutrient content. Maximum N, P and K was recorded under treatment $T_8$ (Grass mulching) having amount of 283.29 kg/ha, 27.12 kg/ha and 255.56 kg/ha respectively. Minimum N, P and K was under treatment $T_{10}$ (Control) having amount of 275.76 kg/ha, 25.12 kg/ha and 254.04 kg/ha respectively.

Different weed management practices significantly affect the N, P and K content in the soil. Grass mulching treatment had high level of N, P and K in the soil. This may be due to the addition of nutrients by grass mulching on its decomposition. These results are in agreement with the findings of Rao and Pathak (1996) who had reported highest level of nitrogen and potassium under paddy straw mulch.

**Table 4.16 Effect of different weed management practices on soil N (kg/ha), soil P (kg/ha) and soil K (kg/ha) of the basin of plum cv. Red Beaut**

| Treatments | | Soil N (kg/ha) | Soil P (kg/ha) | Soil K (kg/ha) |
|---|---|---|---|---|
| $T_1$ | **Pendamil @ 5.3 ml/L of water** | 277.14 | 26.2 | 255.11 |
| $T_2$ | **Gramoxone @ 4 ml/L of water** | 277.66 | 26.45 | 255.18 |
| $T_3$ | **Gramoxone @ 5 ml/L of water** | 277.70 | 26.58 | 255.24 |
| $T_4$ | **Gramoxone @ 6 ml/L of water** | 277.76 | 26.67 | 255.26 |
| $T_5$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water** | 278.83 | 26.85 | 255.42 |
| $T_6$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water** | 278.89 | 26.91 | 255.48 |
| $T_7$ | **Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water** | 278.98 | 26.97 | 255.24 |
| $T_8$ | **Grass mulching** | 283.29 | 27.12 | 255.56 |
| $T_9$ | **Hand weeding at 30 days interval** | 278.79 | 26.78 | 255.31 |
| $T_{10}$ | **Control (Unweeded)** | 275.76 | 25.12 | 254.04 |
| $CD_{0.05}$ | | 0.54 | 0.91 | 0.34 |

## 4.6 BENEFIT: COST RATIO

Benefit: cost ratio for cultivation under different treatments is listed in Table 4.17. Maximum cost of cultivation of Rs 72517 was in treatment $T_9$ (Hand weeding at 30 days

interval) when calculated on per hectare basis followed by treatment $T_8$ (Grass mulching) with Rs 64217 and minimum cost of cultivation of Rs 54517 was in treatment $T_{10}$ (Control). Benefit: cost ratio was maximum in treatment $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water) of 3.16: 1 and minimum in treatment $T_{10}$ (Control). Net returns was calculated to be maximum in treatment $T_6$ with Rs 182846 and minimum in treatment $T_{10}$ (Control) with amount Rs 140630.

These results are in agreement with Kaur and Kaundal (2013) who had reported net benefit of herbicide treatment to be most effective and economic for weed control in high density planted plum orchard.

**Table 4.17 Benefit: Cost ratio**

| Treatment | | Yield (Kg/tree) | Gross Income (Rs/ha) | Total cost of cultivation (Rs) | Net returns (Rs) | Benefit: cost ratio | Profit over control |
|---|---|---|---|---|---|---|---|
| $T_1$ | Pendamil @ 5.3 ml/L of water | 14.96 | 207196 | 55867 | 151329 | 2.71 : 1 | 10700 |
| $T_2$ | Gramoxone @ 4 ml/L of water | 14.98 | 207473 | 56117 | 151356 | 2.70 : 1 | 10727 |
| $T_3$ | Gramoxone @ 5 ml/L of water | 15.12 | 209412 | 56517 | 152895 | 2.71 : 1 | 12266 |
| $T_4$ | Gramoxone @ 6 ml/L of water | 15.25 | 211213 | 56917 | 154296 | 2.71 : 1 | 13666 |
| $T_5$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water | 16.45 | 227833 | 57467 | 170366 | 2.96 : 1 | 29736 |
| $T_6$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water | 17.38 | 240713 | 57867 | 182846 | 3.16 : 1 | 42217 |
| $T_7$ | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water | 17.41 | 241129 | 58817 | 182312 | 3.10 : 1 | 41682 |
| $T_8$ | Grass mulching | 17.49 | 242237 | 64217 | 178020 | 2.77 : 1 | 37390 |
| $T_9$ | Hand weeding at 30 days interval | 16.30 | 225755 | 72517 | 153238 | 2.11 : 1 | 12609 |
| $T_{10}$ | Control (Unweeded) | 14.09 | 195147 | 54517 | 140630 | 2.58 : 1 | 0 |

# *Chapter-5*

# SUMMARY AND CONCLUSION

The present investigation entitled **"Effect of different weed management practices on plum (*Prunus salicina*) cv. Red Beaut"** was carried out in the experimental farm at Jadari of HRTS and KVK Kandaghat, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, during the year 2016 - 2017. The results obtained are summarized as under:

## 5.1 WEED PARAMETERS

**5.1.1** On 30$^{th}$ day of experiment, treatment $T_8$ (grass mulching) had minimum weed population (3.33). On 60$^{th}$, 90$^{th}$, and 120$^{th}$ day of experiment weeds were minimum under treatment $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water) which was statistically at par with treatment $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water).

**5.1.2** On 60$^{th}$ day of experiment minimum weed fresh weight of 2.43 g was found under treatment $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water). On 120$^{th}$ day of experiment minimum fresh weight of 8.40 g was found under treatment $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water).

**5.1.3** Weed dry weight was found to be minimum (0.29 g) under treatment $T_8$ (grass mulching) on 30$^{th}$ day of experiment. Maximum dry weight of weeds was recorded under treatment $T_{10}$ (control) on all sampling dates.

**5.1.4** Treatment $T_7$ (pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water) had maximum weed control efficiency of 95.42 % which was statistically at par with treatment $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water) on 60$^{th}$ day of experiment.

**5.1.5** Nutrient percentage in weeds i.e. N %, P % and K % was recorded maximum in Treatment $T_8$ with nitrogen of 3.45 %, phosphorus of 0.32% and potassium of 1.70%. Minimum nitrogen in weeds was recorded in treatment $T_6$ with nitrogen percentage of 3.10 %.

## 5.2 PLANT GROWTH PARAMETERS

**5.2.1** Maximum tree height increment of 46.96 % was recorded under treatment $T_8$ (grass mulching) which was at par with the treatment $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water).

**5.2.2** Maximum tree spread increment of 57.31 % was recorded under treatment $T_7$ (pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water). Minimum spread increment of 52.79 % was recorded under treatment $T_{10}$ (control).

**5.2.3** Maximum tree volume increment (267.80 %) was recorded under treatment grass mulching ($T_8$) and minimum (144.88 %) under control ($T_{10}$).

**5.2.4** Maximum trunk girth increment of 12.03 % was recorded under treatment $T_8$ (grass mulching) which did not differ significantly with the treatment $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water).

**5.2.5** Different weed management practices had significant effect on annual shoot extension growth. Maximum annual shoot extension growth of 1.08 m was recorded under treatment $T_8$ (grass mulching) which was at par with the treatment $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water).

**5.2.6** Leaf area parameter was also significantly affected by different weed management practices. Maximum leaf area was recorded under treatment $T_8$ (grass Mulching) with 46.41 $cm^2$ and minimum leaf area of 44.19 $cm^2$ was recorded under treatment $T_{10}$ (control).

**5.2.7** Leaf chlorophyll content was found to be significantly affected by different weed management practices. Maximum leaf chlorophyll content (2.72 mg/g) was recorded under treatment $T_8$ (grass Mulching) and minimum leaf chlorophyll content (2.28 mg/g) was recorded under treatment $T_{10}$ (control).

**5.2.8** Maximum leaf N (2.62 %) was recorded in treatment $T_8$ (Grass Mulching) and minimum under $T_9$ with 2.28 % (Hand weeding at 30 days interval).

**5.2.9** Leaf K was also found to be significantly affected by different treatments. Maximum leaf K was found in treatment $T_8$ (grass Mulching) with 1.95 % and minimum leaf K under treatment $T_{10}$ (control).

## 5.3 SOIL PARAMETERS

**5.3.1** Soil organic carbon was found to be significantly affected by different weed management practices. Highest organic carbon of 1.73 % in soil was recorded under treatment $T_8$ (grass mulching) and minimum of 1.41 % in treatment $T_{10}$ (control).

**5.3.2** Soil N was significantly affected by different weed management practices. Soil N was found to be maximum under $T_8$ (grass mulching) with quantity of 283.29 kg/ha and minimum in treatment $T_{10}$ (control).

**5.3.3** Different weed management practices had significant effect on soil P content. Maximum soil P of 27.12 kg/ha was recorded under treatment $T_8$ (grass mulching) and minimum under $T_{10}$ (control).

**5.3.4** Soil K was also significantly affected by different weed management practices. Maximum soil K was recorded under treatment $T_8$ (grass mulching) with quantity of 255.56 kg/ha and minimum under $T_{10}$ (control) with a quantity of 254.04 kg/ha.

## 5.4 YIELD

**5.4.1** Maximum yield of 17.49 kg/plant was recorded under treatment $T_8$ (grass mulching) and which did not differ significantly with the treatment $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water). Minimum fruit yield was recorded under $T_{10}$ (control) with a yield of 14.09 kg/plant.

## 5.5 PHYSICO-CHEMICAL PARAMETERS OF FRUIT

**5.5.1** Maximum fruit length of 44.71 mm was recorded maximum under treatment $T_8$ (grass mulching) and minimum under treatment $T_{10}$ (control).

**5.5.2** Fruit diameter was also found to be significantly affected by different weed management practices. Maximum fruit diameter of 46.69 mm was recorded under treatment $T_8$ (grass mulching) and minimum of 44.31 mm in treatment $T_{10}$ (control).

**5.5.3** Fruit weight was significantly affected by different weed management practices. Maximum fruit weight (51.94 g) was recorded under treatment $T_8$ (grass mulching) which was at par with the treatment $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water).

**5.5.4** Different weed management practice had significant effect on fruit volume. Maximum fruit volume of 52.89 cc was recorded under treatment $T_8$ (grass mulching) and minimum of 50.17 in treatment $T_{10}$ (control).

**5.5.6** Fruit pulp/stone ratio was also affected by different weed management practices significantly. Maximum pulp/stone ratio (33.12) was recorded under treatment $T_8$ (grass mulching) and minimum (29.95) in treatment $T_{10}$ (control).

**5.5.7** Highest total sugars (6.82 %) was recorded in treatment $T_8$ (grass mulching) and lowest (6.01 %) in treatment $T_{10}$ (control).

**5.5.8** Reducing sugars were found to be significantly influenced by different treatments. Maximum reducing sugars (5.91 %) was recorded in treatment $T_8$ (grass mulching) and minimum (4.83 %) in treatment $T_{10}$ (control).

**5.5.9** Non-reducing sugars was found to be maximum in treatment $T_1$ (pendamil @ 5.3 ml/L of water) with a quantity of 1.22 % and minimum of 0.85 % in treatment $T_7$ (pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water).

## 5.6 BENEFIT : COST RATIO

**5.6.1** Maximum benefit : cost ratio of 3.16 : 1 was observed under treatment $T_6$ (pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water) and minimum benefit : cost ratio of 2.58 : 1 was recorded under treatment $T_{10}$ (control).

## CONCLUSION

On the basis of results obtained in the present investigation it is concluded that grass mulch was most effective for enhancing different plant growth parameters like tree height, tree volume, trunk girth, annual shoot extension growth, leaf area and leaf chlorophyll content. Fruit characters like fruit length, diameter, weight and volume were also found more under this treatment. This treatment was also found to be most effective for improving soil nutrient contents. On the basis of economic evaluation of different treatments, pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water was found to be the most economical treatment.

# LITERATURE CITED


A.O.A.C. 1980. *Official methods of analysis for Association of Official Analytical Chemist*s.13th edn. Benjamin Franklin Station, Washington, DC. 1018p.

Americanos PG. 1982. *Chemical control of weeds in deciduous fruit trees*. Technical bulletin 44. Agricultural Research Institute, Cyprus. 9p.

Anonymous. 2016a. Production rankings, countries by commodity. http://www.fao.org/faostat/en/#rankings/countries_by_commodity [1:37PM, 18th May 2018]

Anonymous. 2017. 2nd Advance Estimate of Area and Production of Horticulture Crops (2016-2017). http://nhb.gov.in/area-pro/Areapro16-17.pdf [11:21AM, 11th June 2017]

Anonymous.2016b. Horticulture at a glance (State Department of Horticulture). http://www.hpagrisnet.gov.in/hpagris/Horticulture/Default.aspx?SiteID=5&PageID=1219 [10:46AM, 11th June 2017]

Anonymous.2018a. Pendimethalin. https://en.wikipedia.org/wiki/Pendimethalin [10:02AM, 20th May 2018]

Anonymous.2018b. Paraquat. https://en.wikipedia.org/wiki/Paraquat [10:30 AM, 20th May 2018]

Bal JS and Kumar N. 2005. Effect of various herbicides on the control of weeds in guava orchard. *Haryana Journal of Horticultural Sciences* 34:12-13.

Bal JS and Singh S. 2011. Effect of mulch material and herbicides on tree growth, yield and fruit quality of ber. *Indian Journal of Horticulture* 68:189-192.

Belding RD, Gradley AM, Lokaj GRW, Hammerstedt J and Ayeni AO. 2004. Orchard floor management influence on summer annual weeds and young peach tree performance. *Weed Technology* 18:215-222.

Chandel JS, Neena C and Singh R. 2010. Effect of orchard floor management systems on growth, yield, fruit quality and nutrient contents of kiwifruit (*Actinidia deliciosa* Chev.). *Horticultural Journal* 23:1-5.

Chatha RPS and Chanana YR. 2007. Studies on weed management in young peach orchards. *Indian Journal of Horticulture* 64:300-303.

Cockcroft B and Tisdall J M. 1974. Soil management of irrigated young peach trees in the Goulburn Valley. *Australian Journal of Experimental Agriculture and Animal Husbandry* 14:269-272.

Darbellay C. 1997. Young fruit plantings. Soil management. *Arboriculture Fruitiere* 506:26-30.

Delver P. 1980. Uptake of nutrients by trees grown in herbicide strips. In: *Mineral nutrition of trees* (Atkinson D, Jackson JE, Sharples RO and Waller WM, eds). Butter Worths, London and Botson. pp.229-240.

Duncan RA and Stapleton JJ. 1994. Mulching in young *Prunus* trees with black polythene film increases blossoming and yield, reduces need for irrigation, eliminates weeds and controls pathogenic nematodes. *25th National Agricultural Plastic Congress. Proceedings of a Conference*, held at Lexington, 23-27 September. pp.147-150.

Gavat C, Dumitru L M, Moale C and Iancu M. 2013. Influence of management and fertilization systems on tree growing and fruit setting in a peach tree orchard**.** *Acta Horticulturae* 981:385-388.

Gomez KA and Gomez AA. 1984. *Statistical Procedures for Agricultural Research*. John Wiley and Sons Inc., New York. pp.357-427.

Gupta P, Bhat DJ, Wali VK, Bakshi P, Bhat A and Jasrotia A. 2016. Cost and return analysis of different treatments of mulching and herbicide application on Peach (*Prunus persica* (L.) Batsch) cv. Shan-e-Punjab. *Economics Affairs* 61:481-486.

Hipps NA, Davies MJ and Johnson DS. 2004. Effects of different ground vegetation management systems on soil quality, growth and fruit quality of culinary apple trees. *Journal of Horticultural Science and Biotechnology* 79:610-618.

Hiscox JD and Israelstam GF. 1979. A method for the extraction of chlorophyll from leaf tissue without maceration. *Canadian journal of botany* 57:1332-1334.

Hussain S, Sharma MK, Bashir D, Tundup P, Bangroo SA and Kumar A. 2018. Effect of orchard floor management practices on nutrient status in apple cv. Royal Delicious. *International Journal of Current Microbiology and Applied Sciences 7*:2771-2792.

Hussain S, Sharma MK, Tundup P, Ali M, Hussain S and Bashir D. 2017. Effect of orchard floor management practices on growth, yield and quality attributes of apple cv. Royal Delicious. *International Journal of Pure and Applied Bioscience* 5:944-952.

Iqbal M, Bakshi P, Wali VK and Hamid N. 2017. Economics of different mulching materials on aonla (*Emblica officinalis* Gaertn.) under rainfed conditions of Jammu. *International Research Journal of Agricultural Economics and Statistics* 8:418-421.

Jackson ML. 1967. *Soil Chemical Analysis.* Prentice Hall of India Pvt. Ltd., New Delhi, 498p.

Jackson ML. 1973. *Soil Chemical Analysis.* Asian Publishing House Bombay. pp.10-25

Jawanda JS, Vij VK, Munshi SK and Sharma JN. 1974. Effect of different pre- emergence herbicides on pre-harvest fruit drop, fruit quality and mineral composition of the leaves of sweet orange. *Punjab Journal of Horticulture* 17:24-29.

JiBhat D, Sharma CL, Wali VK and Jasrotia A. 2015. Studies on the effect of orchard floor management practices on quality parameters and leaf nutrient status in apricot (*Prunus armeniaca* L.) cv. New Castle. *Progressive Horticulture* 47:70-73.

Joolka NK, Chand R and Sharma S. 2008. Impact of water conservation techniques and herbicidal treatments on yield and quality of Delicious apple under water stress conditions. *Indian Journal of Horticulture* 65:12-15.

Kaith NS and Bhardwaj JC. 2011. Effect of different herbicidal concentrations on weed density, tree growth and fruit yield of “Starking Delicious” apple. *Agriculture Science Digest* 31:126-130.

Kaundal GS, Singh S, Chanana YR, Grewal SS and Singh S. 1995. Effect of glyphosate and plastic mulch on weed control in peach orchard. *Journal Research Punjab Agriculture University* 32:32-38.

Kaur K and Kaundal GS. 2009. Efficacy of herbicides, mulching and sod cover on control of weeds in plum orchards. *Indian Journal of Weed Science* 41:110-112.

Kaur K and Kaundal GS. 2013. Economics and effect of various herbicidal treatments on fruit quality and yield of plum cv. Satluj Purple. *Asian Journal of Horticulture* 8:101-105.

Khokhar UU, and Sharma MK. 2000. Effect of different orchard floor management systems on weed population, yield and quality of Merced almond (*Prunus amygdalus* Batsch). *Haryana Journal of Horticultural Sciences* 29:21-23.

Kirandeep K and Kaundal GS. 2013. Economics and effect of various herbicidal treatments on fruit quality and yield of plum cv. Satluj Purple. *Asian Journal of Horticulture* 8:101-105.

Kitis YE, Koloren O and Uygur FN. 2011. Evaluation of common vetch (*Vicia sativa* L.) as living mulch for ecological weed control in citrus orchards. *African Journal of Agricultural Research* 6:1257-1264.

Kondap S and Upadhyay UC.1985. A practical manual of weed control. *Oxford and IBH Publication Co*. New Delhi. 43p.

Kumar DG, Sachin SS and Kumar R. 1990. Importance of mulch in crop production. *Indian Journal of Soil Conservation* 18:20-26.

Kumar J, Rehalia AS, Rana SS and Verma HS. 1999. Long term effects of orchard soil management practices on growth, yield and fruit quality of apple (*Malus* × *domestica*). *Indian Journal of Agricultural Sciences* 69:355-358.

Lal H, Rao VK and Singh VP. 2003. Effect of various mulches on growth and yield of apple orchard cv. Starking Delicious. *Progressive Horticulture* 35:100-103.

Lee KY, Kim SK, Lee JW, Lee YS, Lee SH, Hong EY and Park YS. 2013. Effects of yield and the grape growth each of weed control methods on at the vineyard in chungbuk province. *The Korean Journal of Pesticide Science* 17:20-26.

Lisek J and Buler Z. 2018. Growth and yield of plum trees in response to in-row orchard floor management. *Turkish Journal of Agriculture and Forestry* 42:97-102.

Lisek J. 2014. Possibilities and limitation of weed management in fruit crops of temperate climate zone. *Journal of Plant Protection Research* 54:318-326.

Lu L and Zeng ZC. 1998. Studies on covering straw mulching of orchard in arid desert area. *Advances in Horticulture* 2:246-249.

Mark AN. 2012. *Effect of Mulches and Herbicides on Growth, Yield, Nut Quality and Weed Control in Pecan Nut (Carya illinoensis Koch.)*. M.Sc. Thesis. Department of Fruit Science, Dr YS Parmar University of Horticulture and Forestry, Solan. 61p.

McCue JJ, Schupp JR and Farm H. 1996. Effects of weed control method on growth, yield and fruit quality of `Mcintosh' apple trees. *Journal of Tree Fruit Production* 1:1-14.

Meena MK. 2013. *Effect of Different Weed Management Practices on Growth, Yield and Fruit Quality of Peach (Prunus persica Batsch) cv. July Elberta*. M.Sc. Thesis. Department of Fruit Science, Dr YS Parmar University of Horticulture and Forestry, Solan. 82p.

Meena MK, Sharma DD and Meena OP. 2015a. Effect of different weed management practices on weed population, yield potential and nutrient status of peach cv. July Elberta. *Research on Crops* 16:519-525.

Meena MK, Sharma DD and Meena R. 2016. Effect of different weed management practices on yield attributing characters and economic feasibility of peach cv. July Elberta. *Indian Journal of Horticulture* 73:430-432.

Meena MK, Sharma DD, Garg S and Sharma G. 2015b. Effect of different weed management practices on fruit quality parameters, soil and leaf nutrient status of peach. *Green Farming* 6:361-364.

Mennan H, Ngouajio M, Isık D and Kaya E. 2006. Effects of alternative management systems on weed populations in hazelnut (*Corylus avellana* L.). *Crop Protection* 25:835-841.

Merwin HD and Peech M. 1951. Exchangeability of soil potassium in the sand, silt, and clay fractions as influenced by the nature of the complementary exchangeable cation. *Soil Science Society of America Journal* 15:125-128.

Nacheva L, Rankova Z and Gercheva P. 2012. Effect of some soil herbicides of the vegetative habits and pigment content of *Prunus domestica* 'Wangenheims' plum rootstock under in vitro conditions. *Bulgarian Journal of Agricultural Science* 18:583-588.

Nagy T P, Biro T, Nyeki J and Szabo Z. 2013. Groundcover as a useful tool for efficient resource management and sustainable production. *Communications in Soil Science and Plant Analysis* 44:688-695.

Nath JC and Sharma R. 1992.Effect of organic mulches on growth on yield of Assam lemon. *The Horticulture Journal* 5:19-23.

Negi PK. 2015. Effect of orchard floor management practices on growth, cropping and quality of nectarine [*Prunus persica* (L.) Batsch var. *nucipersica*] cv. Snow Queen. M.Sc. Thesis. Department of Fruit Science, Dr YS Parmar University of Horticulture and Forestry, Solan.83p.

Niggli D. 1985. Weed control in peach orchards. *Indian Farming* 41:37-39.

Olsen SR. 1954. *Estimation of available phosphorus in soils by extraction with sodium bicarbonate*. United States Department of Agriculture, Washington.

Pandey KK, Dimri DC and Kamboj P. 2005**.** Effect of various mulches on growth, yield and quality attributes of apple. *Indian Journal of Horticulture* 62:145-147.

Rankova Z. 2006. Effect of some soil herbicides on the vegetative habits of mahaleb cherry (*Prunus mahaleb* L.) seedling rootstocks. *Bulgarian Journal of Agricultural Science* 12:429-433.

Rao VK and Pathak RK. 1996. Effect of mulches on soil properties in aonla orchard established on sodic land. *Indian Journal of Horticulture* 53:251-254.

Sas-Paszt L, Pruski K, Żurawicz E, Sumorok B, Derkowska E and Głuszek S. 2014. The effect of organic mulches and mycorrhizal substrate on growth, yield and quality of Gold Milenium apples on M.9 rootstock. *Canadian journal of plant science* 94:281-291.

Sharma DP, Chakma J, Sharma N and Singh N. 2017. Effect of different orchard management practices on the growth and production of rejuvenated pomegranates (*Punica granatum* L.) cv. Kandhari Kabuli. *Journal of applied and Natural Science* 9:577-581.

Sharma DP, Seema K and Sharma N. 2013. Plum. In: *Fruit Production in India* (Dhillon WS ed). Narendra Publishing House, Delhi. pp.537-558

Sharma JC and Kathiravan G. 2009. Effect of mulches on soil hydrothermal regimes and growth of plum in mid hill region of Himachal Pradesh. *Indian Journal of Horticulture* 66:465-471.

Sharma S, Sharma DP and Sharma N. 2017. Effect of orchard floor management practices on Fruit quality in nectarine [*Prunus persica* (L.) Basch var. *nucipersica*] cv. Snow Queen. *Indian Journal of Ecology* 44:673-676.

Sharma S, Sharma DP. 2018. Effect of orchard floor management treatments on soil hydrothermal regimes under rainfed conditions of Himachal Pradesh in nectarine (*Prunus persica* var. *nucipersica*) cv. Snow Queen. *Indian Journal of Agricultural Sciences* 88:1115-1122.

Shui JG, Wang QZ, Liao GQ, Au J and Allard JL. 2008. Ecological and economic benefits of vegetation management measures in citrus orchards on red soils1. *Pedosphere* 18:214-221.

Shylla B and Chauhan JS. 2003. Influence of orchard floor management practices on cropping and quality of Santa Rosa plum grown under mid hill conditions. In, *VII International Symposium on Temperate Zone Fruits in the Tropics and Subtropics 662*:213-216.

Shylla B and Chauhan JS. 2004. Influence of orchard floor management practices on cropping and quality of Santa rosa plum grown under mid hill conditions. *Acta Horticulturae* 662:213-216.

Shylla B, Chauhan JS and Sharma U. 2006. Effect of orchard floor management practice on weed control of Santa Rosa plum. *Proceedings of International Conference on World perspective on short Rotation Forestry for Industrial and Rural Development.*7-13 September. Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan, India. pp.414-417.

Shylla B, Chauhan JS, Awasthi RP and Bhandari AR. 1999. Effect of orchard floor management practices on leaf nutrient status of plum. *Indian Journal of Horticulture* 56:34-37.

Singh R, Bhandari AR, Thakur BC. 2004. Effect of mulching on in-situ soil moisture, growth, yield and economics of plum fruit trees under rainfed condition in mid hills of Himalayas. *Journal of the Indian Society of Soil Science* 52:411-414.

Sinkeviciene A, Jodaugiene D, Pupaliene R and Urboniene M. 2009. Influence of organic mulches on soil properties and crop yield. *Agronomy Research* **7**:485–491.

Srivastava RP, Mishra RS, Pandey VS and Pathak RK. 1973. Effect of various mulches on the soil temperature and moisture, weed density, survival and growth of apple grafts. *Progressive Horticulture* 5:27-42.

Subbiah BV and Asija GL. 1956. A rapid method for the estimation of nitrogen in soil. *Current Science* 26:259-260.

Szewczuk A and Gudarowska E. 2006. Effects of mulching in a nectarine orchard in sustainable fruit production. *Journal of fruit and ornamental plant research* 14:217-223.

Szewczuk A and Gudarowska E. 2004. Effect of different types of mulching on yield, size, color and storability of Jonagored apples. *Journal of Fruit and Ornamental Plant Research* 14:135-141.

Thakur A, Singh H, Jawanda SK and Kaur T. 2012. Mulching and herbicide in peach: Weed biomass, fruit yield, size and quality. *Biological Agriculture and Horticulture* 28:280-290.

Verma SK, Prasad SK, Singh SB, Singh YV, Singh RP and Bahadur, S. 2017. Influence of mulching and weed management practices on weeds and nutrient uptake in greengram (*Vigna rediata* L.) under eight year old custard apple plantation. *International Journal of Bio-Resource & Stress Management* 8:191-195.

Walkley A and Black IA. 1934. An examination of the Degtgareff method for determining soil organic matter, and a proposed modification of the chromic acid titration method. *Soil science* 37:29-38.

Westwood MN. 1978. *Temperate Zone Pomology*. WH Freeman and Company. San Francisco, USA. 427p.

Zhivondov A and Rankova Z. 2007.Effect of the chemical weed control on the vegetative habits of newly planted peach and nectarine orchards. *Acta Agriculturae Serbica* 12:11-17.

**Dr YS Parmar University of Horticulture and Forestry**
**Nauni, Solan (HP) 173 230**
**Department of Fruit Science**

| | | |
|---|---|---|
| **Title of Thesis** | : | **Effect of different weed management practices on plum (*Prunus salicina*) cv. Red Beaut** |
| **Name of the Student** | : | Rakesh Kumar |
| **Admission Number** | : | H-2016-49-M |
| **Major Field** | : | Fruit Science |
| **Minor Field(s)** | : | Soil Science |
| **Degree Awarded** | : | M.Sc. Horticulture (Fruit Science) |
| **Year of Award of Degree** | : | 2018 |
| **No. of pages in Thesis** | : | 52+viii |
| **No. of words in Abstract** | : | 293 |
| **Major Advisor** | : | Dr DD Sharma |

## ABSTRACT

The present study entitled, **"Effect of different weed management practices on plum (*Prunus salicina*) cv. Red Beaut"** was carried out in the experimental farm located at Jadari of HRTS and KVK Kandaghat, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, during the year 2016-17. The experiment was laid out in Randomized Block Design (RBD) with ten treatments and three replications. The treatments comprise of $T_1$: Pendamil @ 5.3 ml/L of water, $T_2$: Gramoxone @ 4 ml/L of water, $T_3$: Gramoxone @ 5 ml/L, $T_4$: Gramoxone @ 6 ml/L of water, $T_5$: Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water, $T_6$: Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water, $T_7$: Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water, $T_8$: Grass mulching, $T_9$: Hand weeding at 30 days interval and $T_{10}$: Control (Unweeded). Among different weed management practices grass mulching was found to be most effective for enhancing different plant growth parameters like increment in tree height, tree volume, trunk girth, annual shoot extension growth, leaf area and leaf chlorophyll content. Fruit characters like fruit length, diameter, weight and volume were also found to be better under grass mulching treatment. Grass mulching treatment also had higher soil nutrient contents. From economical point of view treatment $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water) gave the best results. It was further observed that treatment $T_6$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water) had many of the results at par with treatment $T_7$ (Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water) and $T_8$ (Grass mulching).

**Signature of Major Advisor** **Signature of the Student**

**Countersigned**

**Professor and Head**
**Department of Fruit Science**
**Dr YS Parmar University of Horticulture & Forestry**
**Nauni, Solan, (HP) - 173 230**

# APPENDIX-I

## ANALYSIS OF VARIANCE FOR DIFFERENT PARAMETERS

**ANOVA of weed population at 30th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 2.467 | 1.233 |
| **Treatments** | 9 | 863.633 | 95.959 |
| **Error** | 18 | 26.867 | 1.493 |
| **Total** | 29 | - | - |

**ANOVA of weed population count at 60th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 9.867 | 4.933 |
| **Treatments** | 9 | 1716.300 | 190.700 |
| **Error** | 18 | 30.800 | 1.711 |
| **Total** | 29 | - | - |

**ANOVA of weed population at 90th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 4.067 | 2.033 |
| **Treatments** | 9 | 1842.967 | 204.774 |
| **Error** | 18 | 23.933 | 1.330 |
| **Total** | 29 | - | - |

**ANOVA of weed population at 120th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 26.600 | 13.300 |
| **Treatments** | 9 | 2532.300 | 281.367 |
| **Error** | 18 | 19.400 | 1.078 |
| **Total** | 29 | - | - |

**ANOVA of weed fresh weight at 30th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 4.807 | 2.403 |
| **Treatments** | 9 | 1173.082 | 130.342 |
| **Error** | 18 | 38.900 | 2.161 |
| **Total** | 29 | - | - |

**ANOVA of weed fresh weight at 60th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 35.505 | 17.753 |
| **Treatments** | 9 | 3312.094 | 368.010 |
| **Error** | 18 | 50.436 | 2.802 |
| **Total** | 29 | - | - |

**ANOVA of weed fresh weight at 90th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 14.319 | 7.160 |
| **Treatments** | 9 | 7400.530 | 822.281 |
| **Error** | 18 | 106.464 | 5.915 |
| **Total** | 29 | - | - |

**ANOVA of weed fresh weight at 120th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 50.657 | 25.329 |
| **Treatments** | 9 | 16450.179 | 1827.798 |
| **Error** | 18 | 471.738 | 26.208 |
| **Total** | 29 | - | - |

**ANOVA of weed dry weight at 30th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 1.216 | 0.608 |
| **Treatments** | 9 | 123.167 | 13.685 |
| **Error** | 18 | 6.702 | 0.372 |
| **Total** | 29 | - | - |

**ANOVA of weed dry weight at 60th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 0.108 | 0.054 |
| **Treatments** | 9 | 563.726 | 62.636 |
| **Error** | 18 | 6.969 | 0.387 |
| **Total** | 29 | - | - |

**ANOVA of weed dry weight at 90th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 0.940 | 0.470 |
| **Treatments** | 9 | 1943.797 | 215.977 |
| **Error** | 18 | 21.484 | 1.194 |
| **Total** | 29 | - | - |

**ANOVA of weed dry weight 120th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 49.079 | 24.540 |
| **Treatments** | 9 | 4705.614 | 522.846 |
| **Error** | 18 | 133.065 | 7.393 |
| **Total** | 29 | - | - |

**ANOVA of weed control efficiency at 30th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 396.981 | 198.491 |
| **Treatments** | 9 | 29488.311 | 3276.479 |
| **Error** | 18 | 1636.188 | 90.899 |
| **Total** | 29 | - | - |

**ANOVA of weed control efficiency at 60th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 23.638 | 11.819 |
| **Treatments** | 9 | 25059.469 | 2784.385 |
| **Error** | 18 | 213.171 | 11.843 |
| **Total** | 29 | - | - |

**ANOVA of weed control efficiency at 90th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 74.667 | 37.334 |
| **Treatments** | 9 | 23203.835 | 2578.204 |
| **Error** | 18 | 134.093 | 7.450 |
| **Total** | 29 | - | - |

**ANOVA of weed control efficiency at 120th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 149.020 | 74.510 |
| **Treatments** | 9 | 19840.328 | 2204.481 |
| **Error** | 18 | 478.777 | 26.599 |
| **Total** | 29 | - | - |

**ANOVA of weed nitrogen percentage at 60th day**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 0.017 | 0.009 |
| **Treatments** | 9 | 0.423 | 0.047 |
| **Error** | 18 | 0.110 | 0.006 |
| **Total** | 29 | 0.550 | |

**ANOVA of tree height increment (%)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 92.749 | 46.374 |
| **Treatments** | 9 | 158.339 | 17.593 |
| **Error** | 18 | 25.358 | 1.409 |
| **Total** | 29 | - | - |

**ANOVA of trunk girth increment (%)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 13.208 | 6.604 |
| **Treatments** | 9 | 10.896 | 1.211 |
| **Error** | 18 | 3.019 | 0.168 |
| **Total** | 29 | - | - |

**ANOVA of annual shoot extension growth (m)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 1.081 | 0.541 |
| **Treatments** | 9 | 0.345 | 0.038 |
| **Error** | 18 | 0.099 | 0.006 |
| **Total** | 29 | - | - |

**ANOVA of leaf area ($cm^2$)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 2.028 | 1.014 |
| **Treatments** | 9 | 13.236 | 1.471 |
| **Error** | 18 | 4.017 | 0.223 |
| **Total** | 29 | - | - |

**ANOVA of leaf chlorophyll (mg/g of fresh weight)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 0.886 | 0.443 |
| **Treatments** | 9 | 0.353 | 0.039 |
| **Error** | 18 | 0.150 | 0.008 |
| **Total** | 29 | - | - |

**ANOVA of leaf N (%)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 0.886 | 0.443 |
| **Treatments** | 9 | 0.353 | 0.039 |
| **Error** | 18 | 0.150 | 0.008 |
| **Total** | 29 | - | - |

**ANOVA of leaf K (%)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 0.002 | 0.001 |
| **Treatments** | 9 | 0.105 | 0.012 |
| **Error** | 18 | 0.000 | 0.000 |
| **Total** | 29 | - | - |

**ANOVA of soil organic carbon (%)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 0.002 | 0.001 |
| **Treatments** | 9 | 0.220 | 0.024 |
| **Error** | 18 | 0.007 | 0.000 |
| **Total** | 29 | - | - |

**ANOVA of soil N (kg/ha)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 1.852 | 0.926 |
| **Treatments** | 9 | 109.098 | 12.122 |
| **Error** | 18 | 12.604 | 0.700 |
| **Total** | 29 | - | - |

**ANOVA of soil P (kg/ha)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 1.936 | 0.968 |
| **Treatments** | 9 | 8.893 | 0.988 |
| **Error** | 18 | 5.082 | 0.282 |
| **Total** | 29 | - | - |

**ANOVA of soil K (kg/ha)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 0.517 | 0.258 |
| **Treatments** | 9 | 4.881 | 0.542 |
| **Error** | 18 | 0.706 | 0.039 |
| **Total** | 29 | - | - |

**ANOVA of yield (kg/plant)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 0.241 | 0.121 |
| **Treatments** | 9 | 40.429 | 4.492 |
| **Error** | 18 | 1.572 | 0.087 |
| **Total** | 29 | - | - |

**ANOVA of fruit length (mm)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 0.113 | 0.057 |
| **Treatments** | 9 | 25.679 | 2.853 |
| **Error** | 18 | 0.423 | 0.024 |
| **Total** | 29 | - | - |

**ANOVA of fruit diameter (mm)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 0.180 | 0.090 |
| **Treatments** | 9 | 23.881 | 2.653 |
| **Error** | 18 | 0.197 | 0.011 |
| **Total** | 29 | - | - |

**ANOVA of fruit weight (g)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 1.145 | 0.572 |
| **Treatments** | 9 | 30.516 | 3.391 |
| **Error** | 18 | 1.822 | 0.101 |
| **Total** | 29 | - | - |

**ANOVA of fruit volume (cc)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 0.334 | 0.167 |
| **Treatments** | 9 | 30.466 | 3.385 |
| **Error** | 18 | 1.764 | 0.098 |
| **Total** | 29 | - | - |

**ANOVA of pulp/stone ratio**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 0.228 | 0.114 |
| **Treatments** | 9 | 36.443 | 4.049 |
| **Error** | 18 | 5.785 | 0.321 |
| **Total** | 29 | - | - |

**ANOVA of total sugar (%)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 0.016 | 0.008 |
| **Treatments** | 9 | 1.435 | 0.159 |
| **Error** | 18 | 0.072 | 0.004 |
| **Total** | 29 | - | - |

**ANOVA of reducing sugars (%)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 0.069 | 0.034 |
| **Treatments** | 9 | 0.347 | 0.039 |
| **Error** | 18 | 0.128 | 0.007 |
| **Total** | 29 | - | - |

**ANOVA of non-reducing sugars (%)**

| Source of variation | DF | SS | MSS |
|---|---|---|---|
| **Replications** | 2 | 0.069 | 0.034 |
| **Treatments** | 9 | 0.442 | 0.049 |
| **Error** | 18 | 0.130 | 0.007 |
| **Total** | 29 | - | - |

# APPENDIX : II

## COST OF CULTIVATION FOR FRUIT PRODUCTION OF PEACH PER HA BASIS AS AFFECTED BY DIFFERENT TREATMENTS

| A. | Particulars | Rs. |
|---|---|---|
| 1 | Land prepation : Basin preparation : 27 man days @ Rs.300/man days | 8100 |
| 2 | Manure application : FYM 110 q/ha @ Rs. 0.7/kg | 7700 |
| 3 | Fertilizer application : Urea 1250 kg/ha @ Rs. 285/50 kg | 3843 |
| 4 | Fertilizer application : DAP 625 kg/ha @ Rs. 1170/50 kg | 1807 |
| 5 | Fertilizer application : MOP 1750 kg/ha @ Rs. 600/50 kg | 3556 |
| 6 | Labour cost for manure and fertilizer application: 3 man days @ Rs.300/man days | 900 |
| 7 | Irrigation : (5 irrigations) 5 man days @ Rs.300/man days | 1500 |
| 8 | Training and pruning application: 20 man days @ Rs.300/man days | 6000 |
| 9 | Harvesting : 15 days @ Rs.300/man days | 4500 |
| 10 | Grading and packaging material (Wooden box, cushioning materials) | 7000 |
| 11 | Labour cost for grading and packaging : 5 man days @ Rs.300/man days | 1500 |
| 12 | Transport cost (Local market/Mandi) | 1000 |
| | Total fixed cost | **47406** |
| **B.** | **Cost involved in the individual treatments** | |
| T1 | Pendamil @ 5.3 ml/L of water : Price Rs 500/L plus 2 man day for spray | 1350 |
| T2 | Gramoxone @ 4 ml/L of water : Price Rs 560/L plus 2 man day for spray | 1600 |
| T3 | Gramoxone @ 5 ml/L of water | 2000 |
| T4 | Gramoxone @ 6 ml/L of water | 2400 |
| T5 | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 4 ml/L of water | 2950 |
| T6 | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 5 ml/L of water | 3350 |
| T7 | Pendamil @ 5.3 ml/L of water followed by Gramoxone @ 6 ml/L of water | 4300 |
| T8 | Grass mulching 4 unit per plant @ Rs 10 per unit | 11080 |
| T9 | Hand weeding @ 30 days interval (60 man days @ Rs.300/man days) | 18000 |
| T10 | Control (Unweeded) | -------- |
| | | |
| **C.** | **Other costs** | |
| 1. | Risk Factor (5% of working capital)*only fixed cost included | 2370 |
| 2. | Management cost (10% of working capital)*only fixed cost included | 4741 |
| | Total other costs | 7111 |
| | Spacing 6m × 6m (277 plants per hactare) | |
| | Selling price of plum Rs 50/kg | |

# BRIEF BIO-DATA

**Name** : Rakesh Kumar

**Father's Name** : Sh. Guddu Brahmachari

**Mother's Name** : Smt. Chitra Rekha

**Date of Birth** : 8th November, 1993

**Permanent Address** : Vill. Saroti, P.O. Deori, Teh. Anni
Dist. Kullu, Himachal Pradesh

**Educational Qualifications :**

| Certificate/ degree | Class/ grade | University/ Board | Marks (%) | Year |
|---|---|---|---|---|
| 10th | First | HP Board of School Education, Dharamshala | 81.14 | 2010 |
| 10+2 | First | HP Board of School Education, Dharamshala | 81.20 | 2012 |
| B.Sc. (Hons) Horticulture | First | Dr. Yashwant Singh Parmar University of Horticulture & Forestry Nauni, Solan (H.P.) | 73.80 | 2016 |

**Scholarship/ Stipend/ Fellowship, any Other financial assistance received during the study period** : University stipend

**Whether sponsored by some state/Central Govt./Univ./SAARC** : N.A.

**Place: Solan**
**Date :** **(Rakesh Kumar)**