Effect of Weedicide in Mungbean under Guava Based Agri-Horticultural System in Vindhyan Region

काशी हिन्दू विश्वविद्यालय

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THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

Master of Science (Agriculture)
in
Agroforestry

Submitted by

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CERTIFICATE

To,

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Through: The Head,Department of Agronomy**,** Institute of Agricultural Sciences**,** Banaras Hindu University, Varanasi (UP)-221005

Dear Sir,

I have great pleasure in forwarding the thesis entitled **"Effect of weedicide in mungbean under guava based agri-horticultural system in Vindhyan region.''** submitted by *Mr. Sanjay Kumar,* **I.D. No. AGF-12183**, Enrolment No: 350628 in partial fulfilment of the requirements for the degree of **Master of Science (Agriculture)** in **Agroforestry**.

I certified that the work has been carried out under my guidance and the data forming on the basis of this thesis, to the best of our knowledge are original and genuine and no part of the work has been submitted for any other degree or dissertation.

Thanking you,

Your's faithfully,

(J. P. Singh)
Supervisor

FORWARDED
HEAD

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Contents

ABBREVIATIONS AND SYMBOLS USED

et al.	:	and others
@	:	at the rate of
Cm	:	Centimeter
SW		Standard week
cv.	:	Cultivar
DAS	:	Days After Sowing
d.f.	:	degree of freedom
^{o}C	:	degree Celsius
Fig.	:	Figure
G	:	Gram
Ha	:	Hectare
Kg	:	Kilogram
M	:	Meter
Mg	:	Milligram
Mha	:	million hectares
mm	:	Millimeter
N	:	Nitrogen
P	:	Phosphorus
K	:	Potassium
Viz	:	Namely
SEm±	:	Standard error Mean
i.e	:	that is
dS/m	:	Deci Siemens/ meter
NS	:	Non Significant
Max.	:	Maximum
Min.	:	Minimum
DAS	:	Days After Sowing
a.i.	:	Active Ingrdient
DBS	:	Days Before Sowing
S.L.		Soluble Liquid

LIST OF TABLES

LIST OF FIGURES

Chapter I

INTRODUCTION

In developing countries like India, the land resources are shrinking due to continuous increase in population and it is very difficult to maintain present arable land (142.0 m/ha) and also the food security to the population. An integrated approach of land management to sustain the food security is urgently required. Requirement of people by increasing the land productivity is one of the most variable option. As under the food, fodder and fuel production in developing countries including India will have to be increased by 60% in the next 25 years to meet the needs of growing population. Thus, efforts are made to increase productivity of agricultural land by advocating agroforestry as one of the most practical way for meeting the needs of food, fodder and fuel. Agroforestry systems are often claimed to be superior to agricultural systems because of their ability to contribute to sustained production of crops. These systems also play a promising role for environmental protection. It is an established fact that there is reduction in crop yield when crops are grown with tree plantations particularly at later stage of tree growth, but overall productivity remain higher than the either of individual one.

The country has the advantage of growing different horticultural crops in various agro-climatic zones. There is ample scope to exploit the interspaces of the fruit plantation during the initial 6-7 years by growing arable crops (Gill and Bisaria, 1995). Gill and Gangwar (1992) also stated that interspaces of custard apple and aonla orchards can be exploited by intercropping grain and fodder crops during initial years of establishment of fruit trees.

Pulses are the major sources of dietary protein in the vegetarian diet in our country. Besides being a rich source of protein. Pulses have invariably been a weak area in the food grain production of the country. The situation is particularly frequent when viewed in light of the role; the pulses play important role in human nutrition alike. For centuries pulses have been functioning as the "fertilizer factories" on the farmer field. In India pulses occupy 7.07 lakh hectare area and contribute 7.67MT production during 2012-13.The total area under mungbean (2013-14) 1.73 lakh hectare and total production 1.81 lakh MT and yield was 1.04 MT/ha.

In agroforestry system, the selection of suitable crops and cropping system may be one of the strategies to mitigate the problems related to drought. The duration of traditional crops grown in rainfed areas are often longer than the effective season length. The crop usually experience moisture stress, mostly during grain filling period. Introduction of relatively short duration cultivars/crops are found favorable with the environments in rainfed areas. Short duration crops may be intercropped to make the best use of resources in an agroforestry system in which perennial fruit trees and crops as annual grown together. Besides the efficient resource use, the techniques used for crop production in agroforestry, trees also share benefits. For instance, interculture, weed control, tillage, mulching etc.

Mungbean [*Vigna radiata* (L.) is a self-pollinated leguminous crop. Which is grown during kharif season in arid and semi-arid regions of India. It is tolerant to drought and can be grown successfully on well drained loamy to sandy loam soils in areas of erratic rainfall. Mungbean is primarily a rainy season crop but with the development of early maturing varieties, it has also proved an ideal crop of spring and summer seasons. If irrigation water is available. Mungbean is an excellent source of protein (24.5%) with high quality lysine (460 mg g^{-1} N) and tryptophan (60 mg g^{-1}) It also has remarkable quantity of ascorbic acid and contains riboflavin (0.21 mg 100 g^{-1}) and minerals (3.84 g 100 g^{-1}) when sprouted.

Due to lack of improved cultural practices, cultivation on marginal and sub marginal lands of poor fertility, inadequate fertilization, monsoon dependent cultivation, severe weed infestation, high sensitivity to pests and diseases and non-availability of suitable varieties are the major factors responsible for low yield of *kharif* pulses including greengram. Heavy weed growth is a recognized major bottleneck in realizing the full yield potential of greengram. Being a rainy season crop, it is invaded by a large number of fast growing weeds. The critical period of weed competition in pulses is during the first 30 days after sowing. Weeds grow quickly during this time taking the advantage of its slow initial growth.

Guava (*Psidium guajava* L.) is one the important fruits crops which distributed throughout the tropics and is preeminently a desert fruit. It is normally eaten fresh which contain vitamin C (35-42 mg/100 g) which is slightly higher than in grape fruit. Beside vitamin C it has high nutrient value of thiamine, potassium and dietary fibre is also significant. The wood of this tree is a good source of firewood; the light yellow sapwood and brownish heartwood are soft, light in weight and weak. Green fruits, seeds and leaves have effective vermicidal and insecticidal properties. Leaves, shoots, bark and roots have been reported to have medicinal properties. The unripe fruit is astringent, and the root is a drastic purgative. It can be planted as a shade tree and also suitable for growing with short duration arable crops. Like mungbean chickpea maize, etc.

The crop is infested with weeds which smother this crop at every stage of its growth by offering competition for moisture, nutrients, light and space. They absorb significant amount of the native and applied nutrients. The problem is increased manifold under moisture stress conditions where, most of the available soil moisture in root zone is exhausted by dense foliage cover of fast growing weeds.

Uncontrolled weed growth in greengram has been reported up to 95 per cent in wet season and 77 per cent in dry season (Ramanamurthy and Rao, 1996). Therefore, research needs to be conducted to ascertain the critical period of crop-weed competition and evolve appropriate weed management programme for exploiting the yield potential rainfed *kharif* season which is 90 day in this region in agri-horticultural system of guava and green gram.

Therefore, research needs to be conducted to ascertain the critical period of crop-weed competition and evolve appropriate weed management programme for exploiting the yield potential rainfed kharif season which is 90 day in this region under agri-horticultural system of guava and mungbean.

Traditionally, weed control is done by physical methods. Often 2-3 hand weeding are required to keep the crop free from weeds. But manual weeding is costly because it is not only time consuming but labour intensive also. However, its additional advantage of providing greater aeration and soil moisture conservation cannot be ignored. But, with the increasing crisis of labour, exploring the possibility of herbicidal weed control in greengram deserves attention. Identification of a selective and cost effective herbicide can be a good alternative to provide weed free environment during early growth period in such an important crop.

Application of selective herbicides may control certain species or group of weeds but may not be effective on other weed species. In such situation, while one group of weeds is effectively eliminated, the other group takes over and offers severe competition to the crop. High dose of herbicides may leave residue in the soil to injure the next crops to follow and also create the pollution problem (Pahwa and Prakash, 1996). The extent of damage by herbicide residue will however, depend on nature of herbicides, doses applied and sensitivity of succeeding crop. Continuous use of the herbicides may also lead to resistance in weeds. Weed management involving use of selective herbicides to keep the crop weed free during early growth period and one hand weeding at later stages can be a good answer to such problem.

Keeping these views, the present investigation entitled **"Effect of weedicide in mungbean under Guava based agri-horticultural system in Vindhyan region"** was undertaken with the following objectives:

1. To study the effect of different herbicides on growth and yield of Mungbean under guava based agri-horticultural system.
2. To find out an effective and economically viable method of weed control in mungbean and guava.
3. To study weed flora and their growth density and weed control efficiency in different weed control treatment under mungbean + guava inter-cropping system.

Chapter II

REVIEW OF LITERATURE

Mungbean is very rich in protein and it complements the staple rice in Asian diets (AVRDC, 1998). Mungbean occupies dominant position among *Kharif* pulses due to its high nutritional value and its digestibility. However, the production of the crop suffers badly under traditional agriculture. The reasons for low yields are many, but one of the most serious, but less noticeable causes is the presence of weeds. The magnitude of yield losses in Mungbean caused by weeds depends mainly upon the weed species and their densities. There is no specific way to control weeds of all types because of different kinds of social, economical and environmental factors influence the choice of control method to be used Weeds are serious negative factor for crop production, which result in great losses in crop yield, despite the use of costly inputs. Uncontrolled weeds may reduce Mungbean yield as much as 50-90% compared with weed free conditions (Poehlman, 1991).

A review of literature embracing the relevant references related to different aspects of present investigation has been presented in this chapter. This information is mostly from Indian situation in which the experiment was conducted. However, some foreign literatures have also been cited in order to get useful information regarding the present investigation under the appropriate heads.

2.1 Weed

Kumar *et al.* (2000) Weed population under hand weeding treatment was significantly lower than weedy check and fluchloralin whereas fluchloralin was significantly similar to weedy check.

Satyanaran *et al.* (2001) reported that the predominant weed are *Acalypha* spp., *Euphorbia* spp., *Phyllanthus niruri*, *Camulina benghalensis* [*Commelina benghalensis*], *Cynodon dactylon* and tea weed [*Polypodium lachnopus*].

Cheema *et al.* (2001) noticed a habitation of 44, 28 and 44% in total weed dry weight by three sorgaab (sorghum water extract) sprays, one hand-weeding and pendimethalin treatment, respectively.

Kumar and Kundra (2001) reported that pendimethalin, trifluralin and metalochlor were ineffective herbicide to controlled perennial weeds in mungbean, though all herbicides gave very effective control of all annual weeds.

Randhawa *et al.* (2002) found that Pre-emergence application of had pendimethalin significantly lower weed population at harvest than fluchloralin and both resulted in significant reduction of weed population than weedy check and one hand weeding 30 DAS.

Mostafa *et al.* (2000) investigated a field experiment and reported that the major weed species associated with mungbean were *Echinochloa colonum* in grassy and *Portulaca oleracea* in non- grassy weeds.

Dungarwal *et al.* (2003) reported that Mungbean field infested with *Cynodon dactylon* (L.) Pess, *Digitaria sanguinalis* (L) Scop, *Echinochloa Colona* Link., *Seteria glauca* (L.) bear., *Dactyloctenium aegyptium*, *Amaranthus viridis*, *Phyllanthus niruri* and *Trianthema monogyna.*

Tiwari *et al.* (2004) reported that major weed flora infesting the mung bean experimental field comprised of *Parthenium hysterophorus*, *Trianthema monogyna* (*T. portulacastrum*), *Echinochloa Colona* and *Dactyloctenium aegyptium*. Whereas,in Egypt, *Echinochloa colonum*, and *Portulaca oleracea*are the dominant weeds in mung bean.

Kumar *et al.* (2005) investigated a field experiment during the *kharif* seasons of 2002 and 2003, in Palampur, Himachal Pradesh. The dominant weeds in the experimental field were *Echinochloa colonum, Cyperus iria, Digitaria sanguinalis, Panicum dichotomiflorum, Commelina benghalensis, Polygonum alatum* and *Ageratum conyzoides* in green gram field.

Raman *et al.* (2005) reported that the predominant weeds in Mungbean field were *Trianthema portulacastrum, Amaranthus vridis, Phyllanthus niruri, Cynodon dactylon, Echinochloa colonum* and *Eleusine indica.*

Malik *et al.* (2005) conducted a field experiment on mungbean. In Hisar, Haryana, India reported that the *Trianthema portulacastrum* (70%) and *Echinochloa colonum* was the dominant weeds in the experiment field.

Yadav *et al.* (2005) conducted a field trial in Uttar Pradesh at Allahabad district the predominant weeds were *Cynodon dactylon, Cyperus rotundus*, and *Echinochloa colonum* in mungbean field.

Raman (2006) reported that among the weed control treatments, hand weeding on 20 and 40 DAS recorded the lowest population and dry weight of weeds and highest value of weed control efficiency. Increased weed control efficiency and decreased weed population and weed dry matter were noticed with higher dose of herbicides.

. Chattha *et al.* (2007) reported *Trianthema monogyna, Cyperus rotundus, Sorghum halepense*, *Digera arvensis, Echinochloa colona* and *Cynodon dactylon* were the main weed species in mungbean field.

Kundu *et al.* (2009) reported maximum reduction of weed population, weed dry weight, highest weed control efficiency, in the treatment receiving quizalopfop-p-ethyl 50 g a.i. ha^{-1} at 21 day after emergence (DAE) + hand weeding (HW) at 28 DAE.

Nandan *et al.* (2011) An experiment was conducted during *rabi* seasons at Pulses Research Sub-Station Samba, SKUAST-Jammu to study the efficacy of pre and post emergence herbicides in controlling weed flora of urd bean (*Vigna mungo* L.) under rainfed subtropical conditions of Jammu. The weed free treatment produced the highest seed yield and was at par with imazethapyr 250 ml/ha (post-emergence) after 15-20 days sowing. However, among the other treatments, pendimethalin (pre-emergence) 1.0 kg/ha *fb* 1 HW at 30 DAS was found superior in controlling the weed flora and increasing the seed yield. Unweeded check produced the lowest seed yield.

Punia *et al.* (2013) reported that weed flora in greengram was more diverse as compared to black gram. Twenty-two weed species (5 grassy, 3 sedges and 14 broad-leaved) belonging to12 families were found dominant in greengram, where as in black gram only 11 weeds of 7 families were found to be very aggressive. Broad-leaved weed *Digera arvensis* (L.) of family *Amarthanceae* was the most dominant and aggressive weed respectively. *Dactyloctenium aegyptium* (L.) was the most dominant grassy weed. Important broad-leaved weeds found in greengram were: *Trianthema portulacastrum, Mollugo distachya*, *Cleome viscosa, Cucumis callosus*, *Corchorus tridens, Corchorus aestuans* and *Tribulus terristeris*, whereas in blackgram *Commelina benghalensis, Physalis minima, Solanum nigrum* and *Chorchorus olitorious*.

Bhutada *et al.* (2013) A field experiment was conducted during winter season (2010-11) at farm of Agronomy Department, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, to study the effect of herbicides and cultural weed management on weed control in Gram (*Cicer arietinum).* Pendimethaline 1 kg ha-1+1H at 40 DAS recorded least weed count, weed dry weight and highest yield in chemical treatment. But cultural weed control treatment 2H at 15 and 40 DAS + HW at 30DAS recorded highest grain yield and B:C ratio.

Mirjha *et al.* (3013) conduct a field experiment to evaluate the effect of different weed control measures on weedicides in mungbean. The predominanted weed species were *Cynodon dactylon, Cyperus rotandus* and *Trianthema monogyna* all the weed control measures significantly reduced the weed density and dry weight. Two handing weeding at 20 and 40 days after sowing were found significantly better in reducing weed density and biomass of grasses, sedges and broad leaf over herbicidal treatments at 25 and 50 DAS. Amongst different herbicides total weed density and biomass effectively reduced by post emergence application of fenoxaprop-p-ethyl at 50 g/ha+chlorimuron-ethyl at 40 g/ha. Grain yield significantly increased by all weed control treatment over weedy check. Tow hand weeding was found most effective in reducing weed biomass with weed control efficiency 0f 92.05% and produced highest grain yield (989.5 kg/ha), though the highest benefit cost ratio was recorded in fenoxaprop+chlorimuron chlorimuron followed by imazethapyr at 60 g/ha (PoE). Uncontrolled weed growth reduced grain yield by 56.12 compared to 2- handing weeding.

Jha *et al.* (2013) conducted a field experiment at Jabalpur to evaluate the different sowing methods and weed control practices for higher grain yield of soybean. The dominated weed species among monocot weeds were *Cyperus iria, Ehinochloa colona* and *Cynodon dactylon*, however among dictot weed species *Eclipta alba*, *Commelina diffusa*, *Alternenthera sessilis* and *Phylanthus niruri* were observed during the growing season. The results revealed that the weed density of monocot (25.1/m^2) and dicot (18.7/m^2) weed was lowest in broad bed furrow (BBF) sowing method and application of pendimethalin (0.75 kg/ha) *fb* imazethapyr (0.75 g/ha. Maximum weed control efficiency (80.0%) was observed with the application of pendimethalin (0.75 kg/ha) *fb* imazethapyr (0.75 kg/ha). BBF sowing method also recorded highest yield attributes and grain and straw yield (1.47 and 1.51 t/ha). The BBF sowing method of soybean gave maximum net monetary returns and B:C ratio (`16,584/ha and 1.87, respectively).

In a study on chickpea at Parbhani, two hand weedings resulted in the highest plant height, plant spread, branches, root nodules and dry matter followed by one hoeing + 2 hand weedings, pendimethalin 0.75 kg/ha as pre-emergence, and quizalofop-p-ethyl 40 g/ha as post-emergence. Among the herbicidal treatments, the pre-emergence application of pendimethalin 0.75 kg/ha was effective in recording higher growth parameters followed by quizalofop-p-ethyl 40 g/ha as post-emergence. The highest grain and straw yields were recorded with one hoeing + two hand weedings, followed by 2 hand weedings (Pedde *et al.,* 2013).

2.2 Nodulation

Murti *et al.* (2004) observed that Fluchloralin at 0.75 kg ha^{-1} recorded significantly higher number of nodules per plant; however the effect of Fluchloralin at 1.0 and 1.25 kg ha^{-1} as well as pendimethalin at 0.75 and 1.0 kg ha^{-1} produced nodule number at par with untreated check.

Raman and Krishnamoorthy (2005) reported that twice hand weeding treatment recorded the highest nodule number and weight (31.0 and 4.98 g plant^{-1}) followed by pendimethalin at 1.0 kg ha^{-1} with one hand weeding treatment.

Patel *et al.* (2007) revealed that interculture + hand weeding carried out at 20 and 40 days after sowing recorded the highest number of nodules, dry weight of nodules, and seed yield.

Mishra *et al.* (2013) conducted field experiment at Varanasi, Uttar Pradesh during the rainy (kharif) season of 2009, to study the effect of different weed-control measures on mungbean Vigna radiata (L.). Weed-control treatments significantly increased the grain yield of mungbean over weedy check. Weedy condition for the entire crop season reduced the grain yield compared to hand-weeding (HW) twice at 20 and 40 days after sowing. Hand-weeding at 20 and 40 days after sowing (DAS) also recorded maximum number of branches/plant, weed-control efficiency, shoot dry weight/plant, nodules number and dry weight/plant followed by post emergence application of fenoxaprop-p-ethyl 50 g/ha + chlorimuron-ethyl 4 g/ha. Highest benefit: cost ratio was obtained with the fenoxaprop-p-ethyl 50 g/ha + chlorimuron-ethyl 4 g/ha.

2.3 Growth and growth attributes

Cheema *et al.* (2000) investigated pre-emergence sprays of s. metolachlor 1.15 kg/ha+ sorghum water extract concentrate (sorgaab) 10 L/ha (78%) and pendimethalin 165 g/ha +sorgaab (conc.) @ 10 L/ha found that maximum plant height. Similarly, Khaliq *et al.* (2002) also reported highest plant height under 2-hand hoeing (15 and 30 DAS) and was statistically at par to pre-emergence application of pendimethalin 165 g/ha +sorgaab10 L/ha, s. metolachlor 1.15 kg/ha+sorgaab10 L/ha (PE), s. metolachlor 2.3 kg/ha, and pendimethalin 330 g/ha.

Khaliq *et al.* (2002) reported, two hands hoeing (15+30 DAS) resulted in maximum plant height. All other treatments except sorgaab (sorghum water extract) conc. @ 10 L ha^{-1} (15+30 DAS) gave statistically similar plant height that was higher than control.

Malik *et al.* (2005) reported pendimethalin 1.5 kg ha^{-1} with one hand hoeing proved superior in producing dry matter accumulation by crop at 60 DAS compared to two mechanical hoeing and two hand weeding.

Faida *et al.* (2009) tested weed control treatments *viz.* fluazifop-p-ethyl 2.0 l/fed (PoE), fluazifop-p-ethyl (1, 1.5, and 2 L) along with urea (1, 2, 3%), twice hand weeding and weedy control. All the weed control treatments showed significantly higher plant height over weedy control. Similarly, El-Bially (2001) also reported that weeded treatments recorded taller plant height over unweeded control.

2.4 Yield and Yield attributes

Kumar *et al.* (2000) reported that application of fluchloralin brought about significantly higher grain yield followed by hand weeding. Hand weeding at 25 DAS resulted in significantly higher grain yield over weedy check. The increase in grain yield of greengram was 88.3 and 70.2 % due to application of fluchloralin and 20.4 and 30.8 % due to hand weeding as compared to weedy check in first and second year, respectively.

Rao *et al.* (2001) studied weed management practices, *viz.*3-hoeing (3, 4 and 5 WAS), 1-hand weeding (3 WAS) + 1-hoeing (5 WAS), pendimethalin 1.0 kg/ha (PE)+ 2-hoeing (3 and 5 WAS) and data showed that 1-hand weeding (3 WAS) + 1-hoeing (5 WAS) recorded higher grain yield (1020 kg/ha) which was closely followed by 3-hoeing (3, 4 and 5 WAS) (998 kg/ha) and pendimethalin 1.0 kg/ha + 2-hoeing (3 and 5 WAS) (969 kg/ha).

Kumar and Kundra (2001) observation that herbicide treated plots recorded significantly higher seed yield than unweeded control as well as hand weeded plots, except trifluralin 0.75 kg ha^{-1} in summer Mungbean.

Bhandri *et al.* (2004) while studying in urdbean reported the test weight was not significantly affected due to herbicidal treatments.

Buttar *et al.* (2004) stated that pendimethalin at 1.5 kg ha^{-1} + hand-weeding at 30 DAS resulted in maximum Mungbean grain yield as compared to pendimethalin at 1.5 kg ha^{-1} or hand-weeding at 30 DAS alone.

Chand *et al.* (2004) reported that in urdbean weed free treatment produced the higher grain yield and was on par with two hand weeding at 20 and 40 DAS, weed population and weed dry weight were found to be negatively correlated with yield.

Kumar *et al.* (2004) observed that Pendimethalin at 1.5 kg ha^{-1} + hand weeding 30 DAS bring at par with weed-free produced significantly higher grain yield as compared to pendimethalin at 1.5 kg ha^{-1} or hand weeding 30 DAS alone. They also observed that among the yield attributes, pods per plant and 1000 grain weight were increased significantly due to weed control, but number of seeds per pod was not affected.

Tomar *et al.* (2004) tested 7-weed management practices *viz.*weedy, 2-hand weeding (20 and 35 DAS), pre-emergence application of pendimethalin 0.5 kg/ha, 1.0 kg/ha, 1.0kg/ha + 1-hand weeding (HW) (30 DAS),pre-plant application of fluchloralin 0.5 kg/ha,1.0 kg/ha + 1-HW (30 DAS) and found that application of pendimethalin 1.0 kg/ha + 1-HW (30 DAS) gave the highest yield.

Mitra and Bhattacharya (2005) reported that application of butachlor along with one hand-weeding (35 days after sowing) resulted in maximum mungbean biomass, yield attributes, seed yield.

Malik *et al.* (2005) recorded maximum seed yield of mungbean (1947 and 1870 kg ha^{-1}) was attained under weed free treatment, which was statistically at par with pendimethalin fb one hand hoeing (1779 and 1727 kg ha^{-1}) and two hand weeding during respective years.

Kushwah *et al.* (2005) reported that 2-hand-weedings recorded higher values for growth, yield attributes, harvest index and yield of soybean followed by application of imazethapyr 10% 75 g/ha (PoE) from Sehore, Madhya Pradesh. But, Deore *et al.* (2008) envisaged that highest seed yield (27.75 quintal/ha) with application of higher rate of imazethapyr i.e. 200 g/ha, as compared to imazethapyr (50, 75, 100 g/ha), chlorimuron-ethyl (9.37 g/ha), fenoxaprop-ethyl (67.5 g/ha), pendimethalin (750 g/ha) and fluchloralin (1.0kg/ha).

Kothawade *et al.* (2007) studied the effect of imazamox (Raptor™) 30 or 40 g/ha, imazethapyr (Pursuit™)75 or 100 g/ha, imazamox + imazethapyr(Odyssey™)

0.8 or 1.0 litre/ha, alachlor 2.5 kg/ha and fluchloralin (1.0 kg/ha) on soybean and found that all herbicides significantly increased the soybean seed yield , out of tested treatments imazamox + imazethapyr (Odyssey™) 0.8 and 1.0 litre/ha recorded highest seed yield (30.11 and 30.26 q/ha).

Raman (2006) observed that twice hand weeding recorded the highest no. of pods plant^{-1} ultimately resulting in the highest seed yield (858 kg ha^{-1}). These results are in line with find of Gupta *et al.* (1990). The lowest seed yield (400 kg ha^{-1}) was obtained with weedy check which might be due to higher weed interference.

Asaduzzaman *et al.* (2008) observed that weed free between 15-25 days after sowing and 25-35 days after sowing gave significant higher mungbean yield than unweeded control. In mungbean concluded that two hand weddings (20 and 40 DAS) was found best in terms of yield attributes and yield, (Singh *et al.*, 2008).

Dipali *et al.* (2009) revealed that in mungbean weed free from 7 or 14 DAS resulted in significantly higher yield. On the contrary weed free after 28 DAS onwards did not increase the yield significantly over unweeded control.

Gupta *et al.* (2013) conducted an experiments during *kharif* 2007 and 2009 to study the effect of different pre and post-emergence herbicides along with two hand weeding's at 20 and 40 days after sowing and weedy check on urdbean (*Vigna mungo* (L.) Hepper). Highest seed yield was observed with two HWs at 20 and 40 DAS and the values were found statistically at par with POE application of imazethapyr 25 g/ha at 20 DAS. The highest weed control efficiency and lowest weed biomass was recorded with two HWs at 20 and 40 DAS followed by application of imazethapyr 25 g/ha (post-emergence) at 20 DAS. Application of Fenoxaprop-p-ethyl, quizalofop-p-ethyl, chlorimuron-p-ethyl as post-emergence and their combinations also reduced weed biomass and improved seed yield and yield attributing parameters as compared to weedy check

Yadav *et al.* (2009) tested different weed control measures on soybean *viz.*,weed-free, unweeded, 2-hand weddings (15 and 30 DAS), hand weeding (15 DAS) followed by hoeing (30 DAS), 2-hoeings (15 and 30 DAS), imazethapyr 0.075 kg/ha (15 DAS), imazethapyr 0.075 kg/ha(15 DAS) + 1-hoeing (30 DAS), chlorimuron-ethyl 0.009 kg/ha (15 DAS), 0.009 kg chlorimuron-ethyl (15 DAS) + 1-hoeing (30 DAS), quizalofop-ethyl0.05 kg/ha (15 DAS) and quizalofop-ethyl0.05 kg/ha (15 DAS) + 1-hoeing (30 DAS).Result indicated that highest seed yield obtained by application of imazethapyr0.075 kg/ha+1-hoeing (30 DAS) whereas, all the weed control treatments recorded significantly higher seed yields compared to the weedy control.

Lhungdim *et al.* (2013) conducted a field study during *rabi*, 2010-11 and 2011-12 at Agricultural Research farm, BHU, Varanasi (U.P.) where five herbicides either as sole, integrated with mechanical weeding (MW) or sequentially applied were evaluated for efficacies of the herbicides on yield and production economics on lentil **(***Lens culinaris* Medikus**)** significantly highest yield (1365 kg ha-1), highest pods plant-1 (66.07), seeds pod-1 (1.94) and nodules plant-1 (8.20) were recorded under Pendimethalin+MW which was comparable and significantly not different from Pendimethalin+Imazethapyr @ 37.5 g a.i. ha-1.

Ibrahim Usman. (2013) carried out a field experiments in 2010 and 2011 cropping seasons at the Institute for Agricultural Research, Ahmadu Bello University, Zaria- Nigeria the effect of pre emergence herbicides on growth and yield parameters of cowpea. The different herbicides used are, S-metolachlor 960 EC @ the rate of 3.5 litre ha-*1*, pendimethalin 33% (w/v) EC @ the rate of 3.5 liter ha-*1* and Butachlor E.C at the rate of 3.5Lha-*1*. There was significant yield increase due to Application of pendimethalin at 3.5 L ha-*1* + Hand weeding of cowpea at 6WAS. There was a significantly superior performance in terms of plant height, number of leaves per plant, number of branches per plant, number of pods per plant and grain yield ha*1*. However Leaf area per plant and 100 – grain weight were not significantly influenced by the treatments. Of all the weed control methods, chemical weed control using pendimethalin at 3.5 L ha-*1* + Hand weeding at 6WAS, significantly gave better results than the other treatments on both growth and yield parameters.

Aktar *et al.* (2013) observed the efficacy of tow herbicides on the yield of lentil (BARI masur-5). Paraxon, Whipsuper, Ronstar and Topstar were the herbicidal treatments applied after sowing of seeds and two leaf stage of weeds according to their mode of action Dry weight of weed samples were recorded at 25 DAS and 40

DAS. The dry weight of weeds was found to be maximum in unweeded control. The highest yield of lentil 1086.6 kg ha^{-1} was observed when Whipsuper was applied while the control treatment showed the lowest yield (626.7 kg ha^{-1}). A. correlation existed between the weed dry matter weights and yield of lentil

Madalagiriyappa *et al.* (2013) conducted a field experiment during *rabi* 2008-09 and 2009-10 at ZARS,Babbur Farm,Hiriyur,Karnataka, to find out suitable post-emergence herbicides for the management of weed in chickpea. Results indicated that weed control treatment significantly reduced dry weight of weed in chickpea. Hand weeding twice at 25-30 and 50-55 DAS was found to be superior (83.43% WCE) compared to other herbicides. Among post emergence application of Imazethapyr 40 g/ha at 30-35 DAS (1239 ka/ha) and quizalofop-ethyl promising for getting higher nodule number, chlorophyll contents, weed control efficiency yield and yield components of checkpea.

Effect of agri-horticultural system on arable crops

Agroforestry is the system where both woody and non woody components occur together, a variety of positive and negative interactions occur (García-Barrios and Ong, 2004). The interactions in agroforestry system can be complementary (positive), supplementary (neutral), or competitive (negative) (van Noordwijk and Hairiah, 2000). The key to success in agroforestry is the minimization of negative interactions and maximization of positive interactions to get the best results (Thevathasan and Gordon, 2004).

Pests have been cited as one of the factors diminishing the benefits from tropical agroforestry (Mchowa and Ngugi, 1994 and Rao *et al.,* 2000). Weeds are one of the most serious limiting factors to tropical agriculture and their control has proved to be beyond the capacities of many smallholder farmers (Akobundu, 1991,; Akobundu, 1993; and Gallagher *et al.,* 1999). In the tropics, weeds estimated to account for 13 per cent of losses (Oerke *et al.,* 1994) at the same time, weed control takes over 50 per cent of the total labor needed to produce a crop (Sileshi *et al.,* 2008). Unless the biological constraints imposed by pests are removed, the potential benefits of agroforestry in terms of increased capture and efficient use of resources cannot be translated into economic benefits (Ong and Rao, 2001).

Agri-horticultural system is a part of agro-forestry system in which the agricultural crops are grown with the mainly fruits crops. The agricultural crops should be short duration and have ability to tolerate shading effect of component trees species .Fruit-tree based agro-forestry involves intentional, simultaneous association of annual or perennial crops with perennial fruit producing trees on the same farm unit. Because of the relatively short juvenile(pre-production) phase of fruit trees, high market value of their products, and the contribution of fruits to household dietary needs, fruit-tree-based agro-forestry enjoys high popularity among resource limited producers worldwide (Bellow, 2004). On the basis of complementary to each other. They must be dissimilar in growth habit and maturity period for efficient use of resources.

Fadl and Sheikh (2001) studied the effect of an *A. Senegal* agro-forestry system on the growth and yield of groundnuts, sesame and roselle with *A Senegal* gave LER more than one indicating the superiority of growing the field crops in intercropping than the monocropping system. The intercropping of sesame gave the second net revenue, while the sole groundnut gave the lowest net revenue. Form economical point of view, it is recommended that roselle and sesame can be intercropped with *A. Senegal.*

Lal *et al.* (2004) conducted that litchi plantation- based agri-horticultural system can be raised on degraded gravelly riverbed land in Doon Valley of Uttar Pradesh with cowpea, okra, sesame, black gram and pigeon pea, as intercrops during the *kharif* season and toria during the *rabi* season.

Hong *et al.* (2003) screened a number of weeds, shrubs, and trees for their allopathic effects to use them as mulch in the agricultural land. They found that trees like *Morus alba*, *Melia azedarach*, and *Leucaena glauca* were very promising. Later, Hong *et al.* (2004) reported that *Morus alba* and *L. glauca* applied in the paddy fields at a rate of 2 ton/ha significantly reduced weed density and enhanced rice productivity owing to their allelopathic effects. Likewise, mulching of *Melia azedarach* applied in the paddy fields at the rate of 1 ton/ha reduced weeds by 90% and can thus be used for weed management. Rizvi *et al.* (1980) observed that ethanolic extracts of *Annona squamosa* seeds inhibit germination of *Amaranthus spinosus* by 13 percent, similarly living root exudates and alcohol extract of dried roots of *Psidium guajava* inhibit germination of *Lactuca sativa* and *Setaria verticillata* (Brown *et al.,* 1983).

Economics

Bayanand Gogoi (1998) determine an effective and economical method of weed control. Comparative economics showed that 1-hand hoeing (20 DAS) gave higher economic returns (Rs 6565 and 2888 in 1995 and 1996, respectively). Whereas, Kumar and Kairon (1988) reported that application fluchloralin 1 kg/ha provided the highest returns (Rs 1946/ha over the unweeded control) followed by 2-hoeing (Rs 1504), fluchloralin 1.5 kg (Rs 1255) and pendimethalin 1.5 kg (Rs 1178). Wheel hoeing (10 and 30 DAS) was less profitable (Rs 248/ha) than unweeded control. Though, Naeem *et al.* (2001) obtained higher net benefits and marginal rate of return of mungbean with the application of pendimethalin 1.5 kg/ha over weedy check.

Kohli *et al.* (2006) concluded that pendimethalin at 1.0 kg ha^{-1} + hand weeding at 35 DAS gave the highest grain yield (15.1 q ha^{-1}), net return (Rs 24 095) and profit over weedy control (Rs 10 595 ha^{-1}).

Sheoran *et al.* (2006) reported that net returns (Rs 6274 ha^{-1}) and B:C ratio (1.65) were highest with pre-plant application of trifluralin (0.50 kg ha^{-1}) + one hand weeding at 30 DAS among all the treatments.

Chattha *et al.* (2007) reported that chemical-weeding at 2-3 leaf stage of weeds + hand weeding at 50 DAS resulted in higher net benefit (Rs 62400 ha^{-1}). Mechanical weeding at 20 DAS had less net benefits (Rs 59505 ha^{-1}). But in case of marginal analysis mechanical weeding at 20 DAS was found better than all the treatments with maximum marginal rate of return.

Deore *et al.* (2007) tested nine weed control treatments (Imazethapyr 50, 75, 100 and 200 g/ha, chlorimuron ethyl 9.37 g/ha, fenoxaprop ethyl 67.5 g /ha, pendimethalin 750 g/ha, fluchloralin 1 kg/ha and control (weedy check) and found that benefit: cost ratio (B:C ratio) was maximum in imazethapyr 100 g/ha (1.98) followed by fenoxaprop ethyl 67.5 g/ha (1.97), chlorimuron ethyl 9.37 g/ha (1.84) and imazethapyr 200 g/ha (1.79). Hence, imazethapyr 100 g/ha was the most economical viable treatment.

Rathi *et al.* (2008) revealed that maximum net return was obtained under two hand weeding (Rs 18,135 and Rs 17,302 ha^{-1}), followed by pre-emergence application of pendimethalin at 0.5 kg ha^{-1} supplemented with one hand weeding at 30 DAS (Rs 17,925 and Rs 16,501 ha^{-1}) under the row spacing of 40 cm and controlled weeds.

Yadav *et al.* (2009) tested weed control treatments [hand weeding (15 and 30 DAS), hand weeding (15 DAS)+ hoeing (30 DAS), hoeing (15 and 30 DAS), imazethapyr 0.075 kg/ha (PoE) with or without hoeing at 30 DAS, chlorimuron ethyl 0.009 kg (PoE) with or without hoeing at 30 DAS, and quizalofop ethyl0.05 kg/ha (PoE) with or without hoeing at 30 DAS] in soybean and found that the highest gross income (Rs 41822/ha), net monetary return (Rs 21971.50/ha) and benefit: cost ratio (2.11) were recorded under weed-free control, followed by hand weeding (15 and 30 DAS) (Rs 39198 and 20547/ha, respectively).

Sharma *et al.* (2009) Field trials were conducted for 5 consecutive winter seasons during 2002-03 to 2006-07 to study the effect of weed management practices on seed yield of irrigated chickpea (*Cicer arietinum* L.). Results revealed two hand weedings at 20 and 40 DAS recorded lowest dry weight of both monocot and incorporation of fluchloralin at 0.75 kg/ha + 1 hand weeding at 30 DAS was most effective in reducing the dry and dicot weeds and higher weed control efficiency (61.5%). Among the herbicides, pre-planting weight of both monocot and dicot weeds at harvesting, ascertained highest seed yield (1530 kg/ha) over other treatments with net returns of Rs 16904/ha and maximum weed control efficiency (54.5 %). Seed yield recorded with this treatment was at par to pre-emergence pendimethalin at 0.75 kg/ha + 1 hand weeding 30 DAS treatment.

Hidayat *et al.* (2013) conducted an experiment in 2008 at the University of Agriculture, Peshawar in RCB design. The treatments included in the experiment were Roundup 480 SL @ 0.47, Sencor 70WP @ 0.75 kg a.i. ha-1, plastic mulches (both black and white), organic mulches (wheat straw @ 5 t ha-1 and saw dust @ 6 t ha-1), a hand weeding and a no weeding treatment. The yield was the highest in hand weeding and glyphosate treatments (13750 and 13580 kg ha-1, respectively). The herbicide treated plots were better in economic return as compared to the mulches and hand weeding practices however among the herbicides the most remunerative treatments were metribuzin and glyphosate

Rao *et al.* (2010) conducted a field experiment during winter seasons of 2007-08 and 2008-09 to study the bio-efficacy of sand mix application of pre emergence herbicides, pendimethalin 1000 g ha-1, pretilachlor 500 g ha-1, oxyfluorfen 120 g ha-1, imazethapyr 63 g ha-1 alone and in sequence with post emergence application of imazethapyr 50 g ha-1 on weed control in black gram grown as relay crop. Results indicated that sequential treatments were found to be superior to individual applications. Among the sequential treatments, pre emergence sand mix application of pendimethalin 1000 g ha-1 followed by imazethapyr 50 g ha-1 at 20 days after sowing (DAS) significantly reduced weed growth and recorded the highest seed yield (1113 kg ha-1), net monetary returns (Rs.2255 ha-1) and B:C ratio (1.33) and was at par with other sequential treatment, oxyfluorfen 120 g ha-1 followed by imazethapyr 50 g ha-1 and also with hand weeding at 15 and 30 DAS. Uncontrolled weed growth caused 61 percent reduction in seed yield of blackgram.

Raj *et al.* (2012) recorded that Higher seed (1297 kg/ha) and haulm (3720 kg/ha) yields with higher weed control efficiency (77.77%) were obtained with two hand weeding along with hoeing at 20 and 40 DAS.

Yadav *et al.* (2013) conducted a field experiment to explore the feasibility of growing lentil with integration of weed management practices using herbicide, increased plant population and manual weeding at Meerut during 2008-09 and 2009-10. The experiment was laid out in randomized block design with four replications and ten treatments. The highest grain yield of 1662 kg/ha was recorded by pendimethalin 0.75 kg/ha plus one hand weeding, which was statistically at par with weed free as well as pendimethalin 1.0 kg/ha. Increased seed rate of 25% significantly decreased the weed dry weight (32.0%) and increased seed yield (22.8%) in comparison to their respective treatments. On an average of 37.7% yield reduction was recorded due to weed infestation. The highest gross returns of 23,268, net returns of 15,918 and B:C was recorded by pendimethalin 0.75 kg/ha PE + one hand weeding.

Kalhapure *et al.* (2013) conducted an experiment to study the integrated weed management in groundnut (*Arachis hypogaea* L.) for consecutive two *Kharif* seasons in 2010 and 2011 at Rahuri with combination of 12 weed management treatments in three replications. Weed free check (two hand weeding at 20 and 40 DAS and manually uprooting of weeds at 60 DAS) was found more effective to control weeds in groundnut and recorded lowest weed density, wed dry matter and weed index and highest weed control efficiency. It was also recorded significantly highest growth and yield attributes in groundnut over all the other treatments *viz*. plant height, dry matter weight of plant, number of pods/plant and pod yield/hectare. Though highest gross monetary returns (1,09,845/ha) was recorded in treatment weed free check, maximum net monetary returns (61,460/ha) and B:C ratio (2.42) were recorded in the treatment application of pendimethalin 1.5 kg/ha as pre-emergence + imazethapyr 0.150 kg/ha as post-emergence + one hand weeding at 40 DAS which was found most economically feasible weed management practice for groundnut..

The effect of chemical weed management practices in lentil was studied during 2010-11 and 2011-12 at Agra (Utter Pradesh) by Duppar *et al.* (2013). The treatments included: control, pendimethalin 0.50 kg/ha, pendimethalin 0.75 kg/ ha, pendimethalin 1.0 kg/ha, pendimethalin 1.25 kg/ha, pendimethalin 1.50 kg/ha and hand weeding. All herbicidal treatments including hand weeding significantly controlled the weeds. Among all the treatments hand weeding gave the highest weed control (84.8%) and produced lower weed biomass (54.0 g/m2). It gave maximum net income (30,850) with CBR of 1:4.4. Pendimethalin 1.5 kg/ha controlled the weeds effectively but germination of seeds were affected. Highest grain yield (1.50 t/ha) was recorded from hand weeding plot with 48.6 and 52.0% increase in yield during 2011 and 2012, respectively.

Chapter III

MATERIAL AND METHODS

The present investigation entitled **"Effect of weedicide in mungbean under guava based agri-horticultural system in Vindhyan region"** was conducted during rainy (*kharif*) season of 2013 at Agricultural Research Farm of Rajiv Gandhi South Campus, Barkachha (BHU), Mirzapur, Uttar Pradesh. The edaphic and climatic condition under which the experimental crop was raised and materials and techniques employed in conducting the experiment are being described in this chapter.

3.1 EXPERIMENTAL SITE

The experiment was carried out at the Agricultural Research Farmof Rajiv Gandhi South Campus, Barkachha (BHU), Mirzapur which is situated in *Vindhyan* region of district Mirzapur (25º 18'N latitude, 88º 18'E longitude and altitude of 128.93 meters above mean sea level) occupying over an area of more than 1000 ha where variety of crops like agricultural, horticultural, medicinal and aromatic plants are grown. Barkachha soil (Red lateritic) comes under rain fed and invariably poor fertility status. This region comes under agro-climatic zone III A (semi-arid eastern plain zone).

3.2 CLIMATE AND WEATHER

Mirzapur falls in a belt of semi-arid to sub-humid climate. The normal period for the onset of monsoon in this region is the third week of June and it lasts up to end of September or sometimes extends to the first week of October. Winter showers are often experienced in between the month of December to mid of February. However, March to May is generally dry. On an average, out of the total annual rainfall major fraction (75 per cent) is received from June to September. The winter months are cool whereas summers are hot and dry. The coldest and hottest month is January and may, respectively. The temperature begins to rise from the month of February and reaches its maximum in May.

During the crop season total rainfall received was 746.11 mm. Out of total rainfall more than 88 per cent received between 30 to 35 Standard Meteorological Weeks (SMW). Data showed that there was very less fluctuations in maximum temperature. The mean maximum temperature during the crop growth season is 35.44^{0}C whereas, mean minimum temperature is 25.67^{0}C. The average weekly temperature was lowest (32.92^{0}C) in 35 meteorological week and maximum (35.44^{0}C) in 30 meteorological weeks. The relative humidity varied between 90 per cent and 96.57 per cent, which meteorological data during crop growth period obtained from Krishi Bhawan, Government of Uttar Pradesh, Mirzapur. A standard week-wise data on weather parameters are presented in below table.

Table 3.1: Mean weather data: 10 years mean (2003-2012)

Month	Rainfall (mm)	Temperature (^{0}C)		Relative humidity (%)		Sunshine (hours)	Evaporation (mm)
		Max.	Min.	Max.	Min.		
January	2.6	19.90	8.20	85.21	41	6.04	1.72
February	1.2	26.80	12.30	84.50	43	8.43	2.55
March	0.67	32.3	16.1	73.3	29	8.90	4.13
April	1.40	35.86	20.72	58.4	23.5	9.38	5.7
May	2.75	38.65	25.45	64.3	26.7	9.08	8.3
June	58.10	35.6	27.2	71.8	50	6.88	7.2
July	50.40	32.6	27.3	84.2	70.4	4.70	3.88
August	73.8	31.17	26.65	88.5	76	5.35	3.3
September	75.15	30.8	26.45	89.25	80.6	6.20	2.92
October	0.70	31.66	20.72	84.6	45.6	7.75	2.9
November	0.20	28.97	15.1	90.75	39.75	8.0	2.6
December	0.30	21.77	9.75	94	54.75	6.48	1.42
Annual		30.60	19.73	80.81	47.90	7.20	3.88

Source: Annual Report of The All India Co-ordinated Research Project on Dryland Agriculture, BHU (2012)

Table 3.2: Mean week-wise meteorological data during crop season rainy (*Kharif*), 2013.

Standard week No.	Months	Rainfall (mm)	Temperature (˚C)		Relative humidity (%)
			Max.	Min.	
28	July	60.59	34.19	26.29	90
29	July	45.32	35.25	27.78	91.33
30	July	105.29	35.44	26.90	92.60
31	August	107.64	33.52	26.66	94.83
32	August	32.35	34.11	26.55	95.50
33	August	78.22	33.35	26.23	94.14
34	August	149.93	33.34	26.21	96.57
35	August	186.80	32.92	26.02	92.57
36	September	54.26	34.34	25.67	92.10
37	September	25.29	34.58	25.91	94.52

Source: Observatory, Krishi Bhawan, Mirzapur

3.3 SOIL AND SOIL ANALYSES

Soil samples were taken before actually conducting the experiment from a depth of 0-20 cm, taking all the possible precautions prescribed for soil sampling. The samples were brought to the laboratory, air dried and crushed to pass through 2.0 mm mesh sieve. The processed samples were subjected to appropriate mechanical and chemical analyses. The results thus obtained are presented in Table 3.3.

Table 3.3: Mechanical and physico-chemical analyses of soil of the experimental field

Particulars	Value	Rating	Method	Reference
1.Mechanical analyses				
Sand (%)	50.3		Hydrometer	Bouyoucos (1962)
Silt (%)	37.2			
Clay (%)	12.5			
Textural class	Sandy loam		Textural triangle	Black *et al.* (1965)
2. Physical constants				
Bulk density (Mg m^{-3})	1.45		Core sampler	Black *et al.* (1965)
Particle density ((Mg m^{-3})	2.65		Pycnometer	
3. Chemical analyses				
Organic carbon (%)	0.36	Low	Wet digestion method	Walkley and Black's (1934)
Available N (kg ha^{-1})	168.50	Low	Alkaline potassium permanganate	Subbiah and Asija (1956)
Available P_2O_5 (kg ha^{-1})	16.00	Low	0.5 M$NaHCO_3$ extractable	Olsen *et al.* (1954)
Available K_2O (kg ha^{-1})	113.32	Low	1N Ammonium acetate	Hanway and Heidal (1952)
pH (1:2.5 soil: water suspension)	5.6	Slightly acidic	Glass electrode digital pH meter	Sparks (1996)
Electrical conductivity (1:2.0 soil: water suspension) dSm^{-1} at 25 ºC)	0.28	Normal	Systronics electrical conductivity meter	Sparks (1996)

3.4 CROPPING HISTORY OF THE EXPERIMENTAL FIELD

The crop sequences followed in the experimental field during the past five years have been presented in Table 3.4. During 2009-10 and 2010-11 mungbean-gram and 2011-12 and 2012-13 mungbean-mustard sequence was taken thus, the fertility set up has not been disturbed. Hence, as such the field is ideally suitable for the experiment.

Table 3.4: Cropping history of the experimental field

Year	**Season**	
	Rainy (*Kharif*)	**Winter (*Rabi*)**
2009-10	Mungbean	Gram
2010-11	Mungbean	Gram
2011-12	Mungbean	Mustard
2012-13	Mungbean	Mustard
2013-14	Experimental crop	--

3.5 EXPERIMENTAL DETAILS

The experiment was conducted during *kharif* season of 2013, on mung bean crop grown in alleys of guava trees, in completed Randomized block design replicated thrice. Agri-horticultural system, in which mungbean was sown between Guava alley of total seven treatment weed control treatments. The treatments were replicated forthree times. The details of the treatments and layout plan are given in Table: 3.4 and 3.5 and Fig. 3.2.

Table 3.5: Treatment details

S. No.	Treatments	Symbol used
1	Propaquizafop-10% E.C.-50 ml a.i. / ha	T_1
2	Propaquizafop-10% E.C.-75 ml a.i. / ha	T_2
3	Pendimethalin -30% E.C. Pre 1 l a.i./ha	T_3
4	Pendimethali-30% E.C. Pre 1.5 l a.i./ha	T_4
5	Pendimethalin-30% E.C. Pre 2 l a.i./ha	T_5
6	Weedy check	T_6
7	Weed free	T_7

Table 3.6: The layout plan of experimental field is as follows

Experimental design		Randomized block design
No. of treatment	:	7
No. of replication	:	3
Total number of plots	:	7 x 3 = 21
Block border	:	1.0 m
Gross plot size	:	4.2m x 4.0 m = 16.8 m^2
Net plot size	:	3.0m x 3.0 m = 9.0 m^2
Plot border	:	0.5 m
Row to row distance	:	30 cm
Plant to plant distance	:	10 cm

EXPERIMENTAL LAYOUT

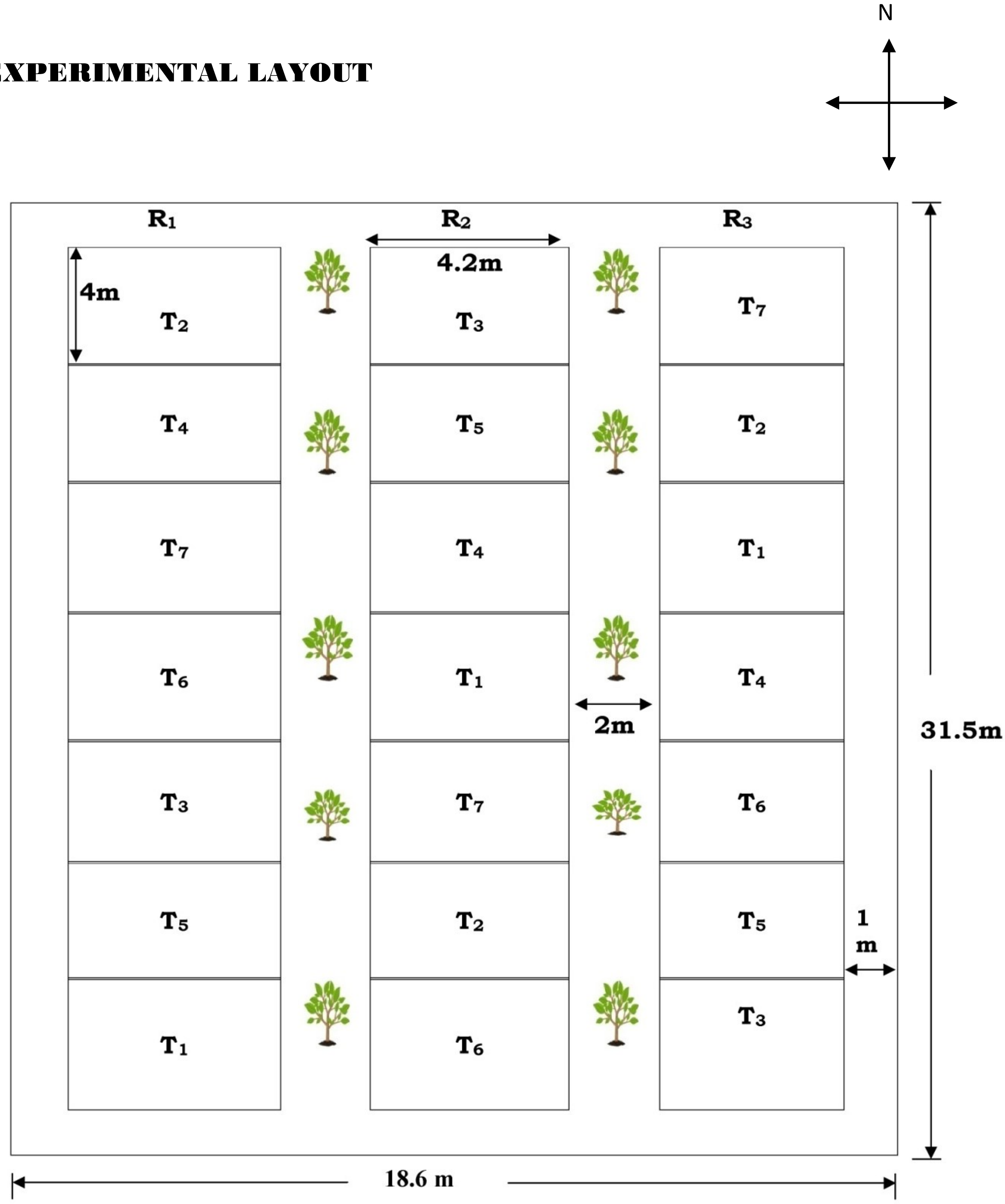


Figure 3.1: Experimental Layout

3.6 EXPERIMENTAL CROPS AND VARIETY

Mungbean (*Vigna radiate* L.) chosen for conducting the experiment under guava based agri-horti system.

Table 3.7: Schedule of field operations

S. No.	Operation	Date
(A).	Pre-sowing operations	
1.	Land preparation • First Ploughing • First ploughing	 23.07.2013 24.07.2013
2.	Layout and experiment	07.08.2013
(B).	Sowing operations	
1.	Fertilizer application and sowing	08.08.2013
(C).	Post-sowing operations	
1.	Thinning	23.08.2013
2.	I. Weeding in selected plot II. Weeding in selected plot	23.08.2013 08.09.2013
3.	Weedicide spraying • Pendimethalin- 30% E.C. Pre • Propaquizafop-10% E.C. post	 08.08.2013 28.08.2013
4.	Harvesting (i) First picking (ii) Second picking	 10.10.2013 15.10.2013
5.	Threshing	25.10.2013

3.6.1 Variety (SAMRAT)

A recommended variety for cultivation in summer and *Kharif*, matures in 60-65 days. Plant height is 40-45 cm. Growth habit is erect. Pod shape is long slender, medium in size. Pod length is 8 cm and number of seed/pod 10-11, 1000 grains weight is 38-40g. The grain is green and medium bold. Yield potential is 10-12 qt. ha^{-1}.

3.6.2 Field operation

The detail of cultural operations done starting from field preparation to harvesting of the crop is given in Table 3.7.

3.7 LAND PREPARATION

Field was ploughed with the help of disc plough and cultivator was done followed by planking. Thereafter, layout was done according to plan and design.

3.7.1 Fertilizer and manure application

Fertilizers were applied at the rate of 30 kg N, 60 kg P and 30 kg K in the form of urea, diammonium phosphate (DAP) and muriate of potash, respectively. Whole amount of fertilizers were placed below the seed in respective rows at the time of sowing.

3.7.2 Seed rate and sowing

The seed were sown manually in the furrow opened by *kudal* at a row distance of 30 cm as per treatment. Relatively higher seed rate (20 kg ha^{-1}) was used for proper maintenance of plant population. A plant spacing of 10 cm within the row was maintained by thinning done about 15 days after sowing.

3.7.3 Thinning and intercultural operation

Extra plants were thinned to maintain the desired plant population at 15 days after sowing. Two weeding was done manually by *khurpi* at 15 and 30 days after sowing to weed free.

3.7.4 Application of Herbicides

The required amount of herbicide were carefully measured and mixed in measured volume of water for each plot separately. After the preparation, herbicides were applied with a hand operated knapsack sprayer fitted flat fan nozzle. Pendimethalin was applied pre-emergence of crop doses of 1 l. a.i./ha, 1.5 l. a.i./ha, 2 l. a.i./ha and Propaquizafop was applied post-emergence of crop doses of 50 ml a.i./ha, 75 ml a.i/ha at 20 DAS.

3.7.5 Herbicide used and Specification

The specification of herbicides used in the experiments are given below

Table 3.8: Common and Chemical name of used herbicides

S.No.	Common name	Trade name	Chemical Name	Type of Formulation With a.i.
1	Pendimethalin	Stomp	N-(1-ethylpropyl)-3,4-dimethyl-,6-dinitrobenzeenamine	30% E.C.
2	Propaquizafop	Society		10% E.C.

3.7.5 Plant protection

To protect the crops, mainly from leaf caterpillar, *Kranti* (Carpet hydrochloride 50% SP) @ 250 ml per hectare was sprayed at 20 days after sowing.

3.7.6 Harvesting

Crops were harvested at complete maturity as judged by visual observations. The border rows were harvested first and kept aside. Thereafter, the net plots were harvested and brought to the threshing floor after proper tagging and sun drying.

3.7.7 Threshing

After properly sun drying of tagged bundle, each bundled was weighted, threshed and cleaned separately and grain yield per plot was recorded. For recording stalk yield, grain yield was deducted from the total bundle weight.

3.8: BIOMETRIC OBSERVATION

Five plants from each plot were randomly selected and tagged for recording the biometric observations at different growth stages. The observations on growth attributes were recorded at an interval of 20 days i.e. 40^{th} after sowing and at maturity.

Yield attributes and yield were studied before and after harvesting as per investigation required.

3.8.1 Growth attributes

3.8.1.1 Plant height (cm)

Height of randomly selected and marked plants from each plot was measured from base of the plants up to growing tip of main stem. The average plant height was calculated by taking the mean of observation of five plants and expressed in cm.

3.8.1.2 Branches plant^{-1}

Three randomly tagged plants are used for counting the number of branches. All the branches emerging from the main shoot were counted at 20, 40 DAS and at harvest stage of crop growth. The average number of branches per plant was worked out.

3.8.1.3 Dry matter accumulationplant^{-1} (g)

For recording dry matter accumulation, 5 plants from each plot were cut from the ground level of border rows. Sampled plants were sun dried first then dried in an oven for 24 hours to get constant dry weight. Thereafter, the average dry weight was recorded in g plant^{-1}.

3.8.1.4 No. of nodules plant^{-1}

Total numbers of active nodules were counted from five plants and average nodules were recorded.

3.9 YIELD ATTRIBUTING CHARACTERS

The following observations on yield attributes and yield studies were recorded during the experimentation:

3.9.1 Number of pod plant^{-1}

Total number of pod on the tagged plants was counted and average number of pod per plant was recorded.

3.9.2 Pod length (cm)

Length of ten randomly selected pods was measured from five tagged plants and average was worked out to get the pod length.

3.9.3 Number of grain pod^{-1}

The ten randomly selected pods from each five tagged plants per plot were taken out and total number of grain was counted. Average number of grain per pod was then calculated and recorded.

3.9.4 1000 seed weight (g)

Randomly selected 1000 grains from the grain yield samples of crop were counted from each plot and their combined weight was recorded to get the test weight of 1000 grains.

3.9.5 Grain and straw yield (kg ha^{-1})

The plants from the net plot area were harvested, bundled and weighed after sun drying. Thereafter, the material was transferred to threshing floor, threshed, cleaned and grain yield (kg plot^{-1}) was recorded. The difference of the bundle weight and the grain yield gave the stalk/straw yield of crop. Yield obtained in kg plot^{-1} were converted to yield in kg ha^{-1} by multiplying with appropriate conversion factor.

3.9.6 Harvest index (%)

The harvest index was calculated by dividing the economic yield by the biological yield and multiplying by 100.

$$\text{Harvest index (\%)} = \frac{\text{Economic yield (kg ha}^{-1})}{\text{Biological yield (kg ha}^{-1})} \times 100$$

3.10 STUDIES ON WEEDS

3.10.1 Identification of weeds

The weeds infesting the individual plots were recorded. The spectrum of weed was identified for their dominance in relation to other species that were in existence in experiment. The identified weeds were *Cynodon dactylon, Trianthema monogyna* L., *Echinochloacolonum (*L.*) Commelina bengalensis* L., *Phyllanthus niruri* L.*, Physallis minima* L.*, Fimbristylis miliaceae (*L.*) Vahl., Euphrbia hirta* L.*, Ageratum conyzoides* L.*, Digeramuricata (*L.*) Digitaria sanguinalis (*L.*) Cyperus rotundus* L.*, Dactyloctinium aegyptium* L. etc.

3.10.2 Weed population (m^2)

An area of 1 m^2 was marked at random in each treatment with the help of quadrant. Weeds enclosed in a quadrant were recorded from each plot at base of the ground counted and grouped species wise (grasses, sedges, broad leaved weeds and as total weeds)

3.10.3 Dry mater accumulation by weeds (g m^{-2})

After counting weed population, these weeds were allowed for sun drying of two days, samples were put in the oven at 70 $\pm$ 1^0 C for 48 to 72 hrs for complete drying so as to obtained constant weight. The dry weight of weed sample obtained at a different stage (20 DAS, 40 DAS and at harvest) was expressed in g m^{-2}.

3.10.4 Weed control efficiency (WCE) %

The WCE was calculated on the basis of reduction in dry weight of weeds in treated plots in comparison to weedy check plots and expressed as percentage. It was calculated using the formula suggested by Mani *et al.* (1973) as given below.

$$WCE\ (\%) = \frac{DMC - DMT}{DMC} \times 100$$

DMC = Dry matter yield of weeds in weedy check plot

DMT = dry matter yield of weeds in treated plot

3.10.5 Weed Index (WI) %

Weed index is per cent reduction in grain yield due to weeds as compared total yield of weed free treatments. The weed index was calculated by using the formulas fallow

$$WI(\%) = \frac{X - Y}{X} \times 100$$

Where X = Grain yield from weed free plot

Y = Grain yield from treated plot.

3.11 GROWTH PARAMETERS OF GUAVA

The following growth parameters of guava, situated at border of the plot, were recorded.

3.11.1 Height

The height of guava was measured from base of the plants up to growing tip of main stem. The plant height was measured and expressed in meters.

Height (m)		
At sowing	**40 DAS**	**At harvest**
4.10	4.75	5.00

3.11.2 Canopy

The canopy area of guava was recorded with the help of meter tape and it was recorded from the highest canopy diameter in meters.

Canopy diameter(m)		
At sowing	**40 DAS**	**At harvest**
4.35	**4.53**	**4.65**

3.11.3 Stem girth

The stem girth of guava was recorded from base of the plants in centimeters.

Stem girth (cm)		
At sowing	**40 DAS**	**At harvest**
37.80	**38.20**	**38.43**

3.11.4 Shading

The shading area of the guava was recorded with the help of meter tape and measured as width and length in meters.

Shading area (m)					
At sowing		**40 DAS**		**At harvest**	
Length	**Width**	**Length**	**Width**	**Length**	**Width**
3.70	3.32	3.75	3.40	3.82	3.41

3.12 ECONOMICS

The cost of cultivation was worked out by taking into consideration all the expenses incurred. Gross income was worked out by multiplying grain and straw yield of the crop with their prevailing market prices. Calculations were made as per normal rates prevalent at the Research Farm, R.G.S.C. (B.H.U.), Barkachha, Mirzapur. The cost of fertilizers, manure, plant protection chemicals and seed etc. were taken as per prevailing market prices. Net return (` ha^{-1}) and benefit: Cost ratios (BC ratio) were calculated with the help of the following formula:

Net return (` ha$^{-1)}$ = Gross return (` ha^{-1}) – Cost of cultivation (` ha^{-1})

$$\text{Benefit: cost ratio} = \frac{\text{Net return (` ha}^{-1})}{\text{Cost of cultivation (` ha}^{-1})}$$

3.13 STATISTICAL ANALYSIS

For determining the significance between the treatment means and to draw valid conclusion, statistical analysis was made. Data obtained from various observations were subjected to statistical analysis by adopting appropriate method of "Analysis of Variance". The significance of the treatment effect was judged with the help of 'F' test (Variance ratio). The difference of the treatments mean was tested using critical difference (C. D.) at 5% level of probability (Gomez and Gomez, 1976).

If the variance ratio (F test) was found significant at 5% level of significance, the standard error of mean (S.Em.±) and critical differences (CD) were calculated for further comparison.

$$\text{S.Em.}\pm = \sqrt{\frac{V_E(a)}{r\ x\ C}}$$

C.D. at 5% = S.Em.±× $\sqrt{2}$ ×t value at value at 5% of error (a) d.f.

Fig 3.1: Mean weather data: 10 years mean (2003-2012)

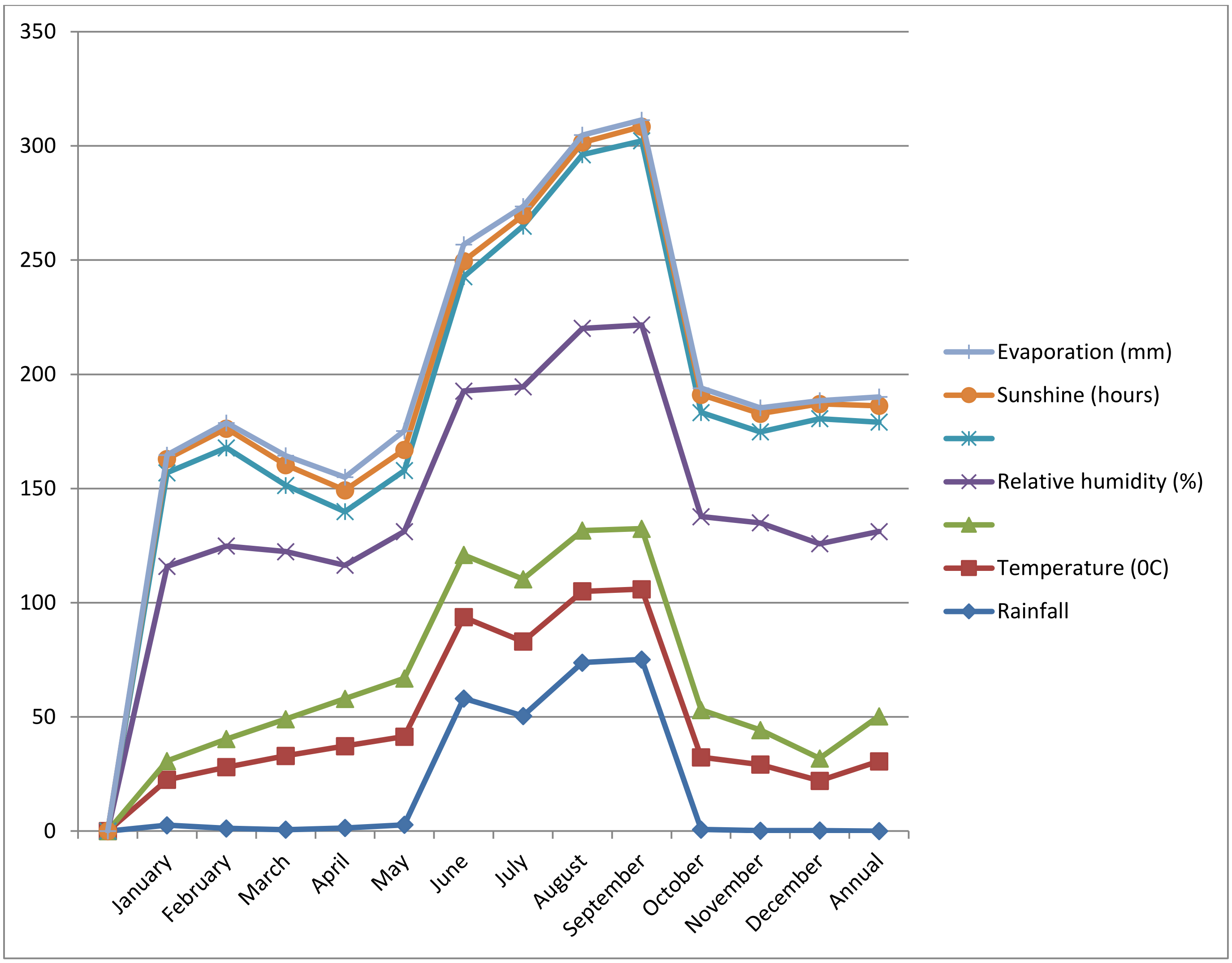
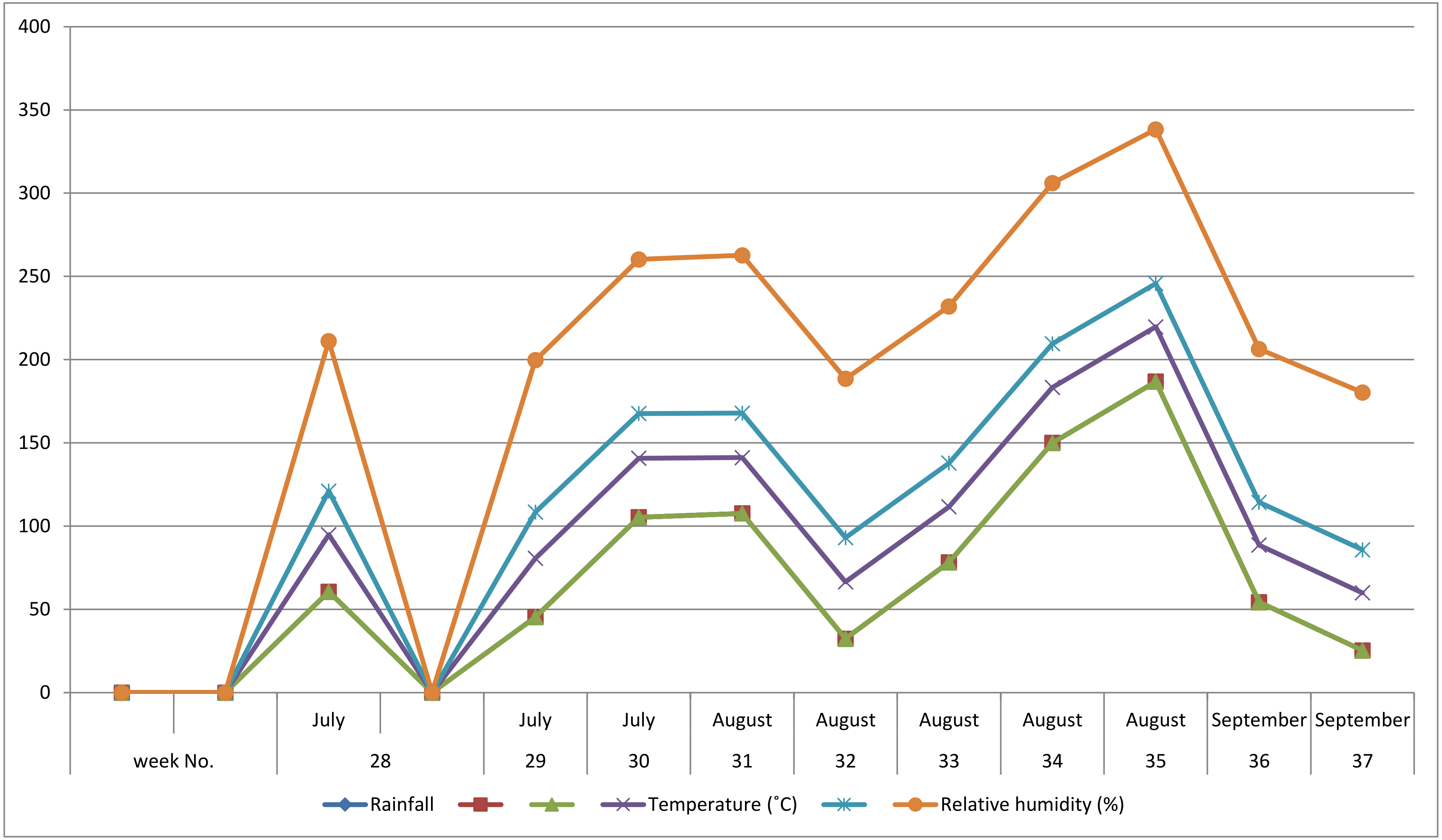


Table: 3.2 : Mean week-wise meteorological data during crop season rainy (*kharif*), 2013



Chapter IV

EXPERIMENTAL FINDINGS

An attempt has been made to ascertain the degree of variation exhibited by various crop and weed parameters due to treatments in the experiment entitled "Effect of weedicide in Mungbean under guava based agri-horticultural system in Vindhya Region". The data collected during the course of investigation have been statistically analyzed and presented in tables. The analysis of variance calculated for various characters has been given in appendices. The treatments effects have been described in this chapter in light of statistical interpretation.

Studies on weed

To assess the effect of different treatments on weed growth, weed density and their dry weight and weed control efficiency were recorded at 20, 40 DAS and at harvest.

4.1 WEED FLORA

Weed flora of the experimental plot was collected, identified and classified as grasses, sedges and broad leaved weeds (Table 4.1). There were 13 weed species belonging to 9 families were in the experimental plot. Among the grasses *Cynodon dactylon* (L.) *pers* was the predominant weeds followed by *Echinochloa colonum* (L.) link and *Digitaria sanguinalis* (L.) *scop*. The predominant sedges were *Cyperus rotandus* (L.) followed by *Fimbristylis miliaceae* (L.) vahl. Whereas, the *Trianthema monogyna* (L.) was the predominant broad leaved weed followed by the *Parthenium hysterophorus* (L.) and *Commelina benghalensis* (L.).

Table 4.1 : Weed flora of the experimental plot

Botanical name	Common name	family	Habit and characteristics
Grasses			
*Cynodon dactylon (*L.) Pers	Bermuda grass	poaceae	Perennial, hardy branched
Echinochloa colonum (L.) Link	Jungle rice	poaceae	Slender/prostrate annual grass herb
Digitaria sanguinalis (L.) Scop	Large crab grass	poaceae	Semi-spreading annual grass herb
Sedges			
Cyperus rotundus (L.)	Purple nutsedge nutgrass	Cyperaceae	Perennial erect, glabrous herb with purple inflorescence.
Fimbristylis miliaceae (L.)	Globefingerrush	Cyperaceae	Leafy fibrous annual herb
Broad leaved weeds			
Trianthema monogyna (L.)	Purslane	Aizoaceae	Annual prostrate broad-leaved herb
Parthenium hysterophorus (L.)	Parthenium, congress grass	Asteraceae	Annual much branched broad-leaved herb
Commelina benghalensis (L.).	Tropical spiderwort, garden spurge	Commelinaceae	Fleshy branches annual broad-leaved grass herb
Euphorbia hirta (L.)	Pillpodspurge, garden spurge	Euphorbiaceae	Hardy deep rooted prostrate annual
Phyllanthus niruri	Phyllanthus	Phyllanthaceae	Glabrous Annual broad-leaved herb
Digera arvensis Forks.	Digera, kondra	Amaranthaceae	Annual-erect broad-leaved with pink flowers
Physalis minima (L.)	Wild gooseberry, ground cherry	Solanaceae	Annual herb with forking branches
Ageratum conyzoides (L.)	Billgoat weed, tropic ageratum	Asteraceae	Erect branched annual broad-leaved herb

4.2 Weed density (Number m^{-2})

The data pertaining to density of weed were significantly influenced by different weed control treatments are presented in corresponding table.

4.2.1 Effect of herbicide on density of *Echinochloa colonum*

The effect of weed control treatment on density of *Echinochloa colonum* have been presented in Table 4.2. It is obvious from the data that density of *Echinochloa colonum* was significantly influenced by different weed control treatments.

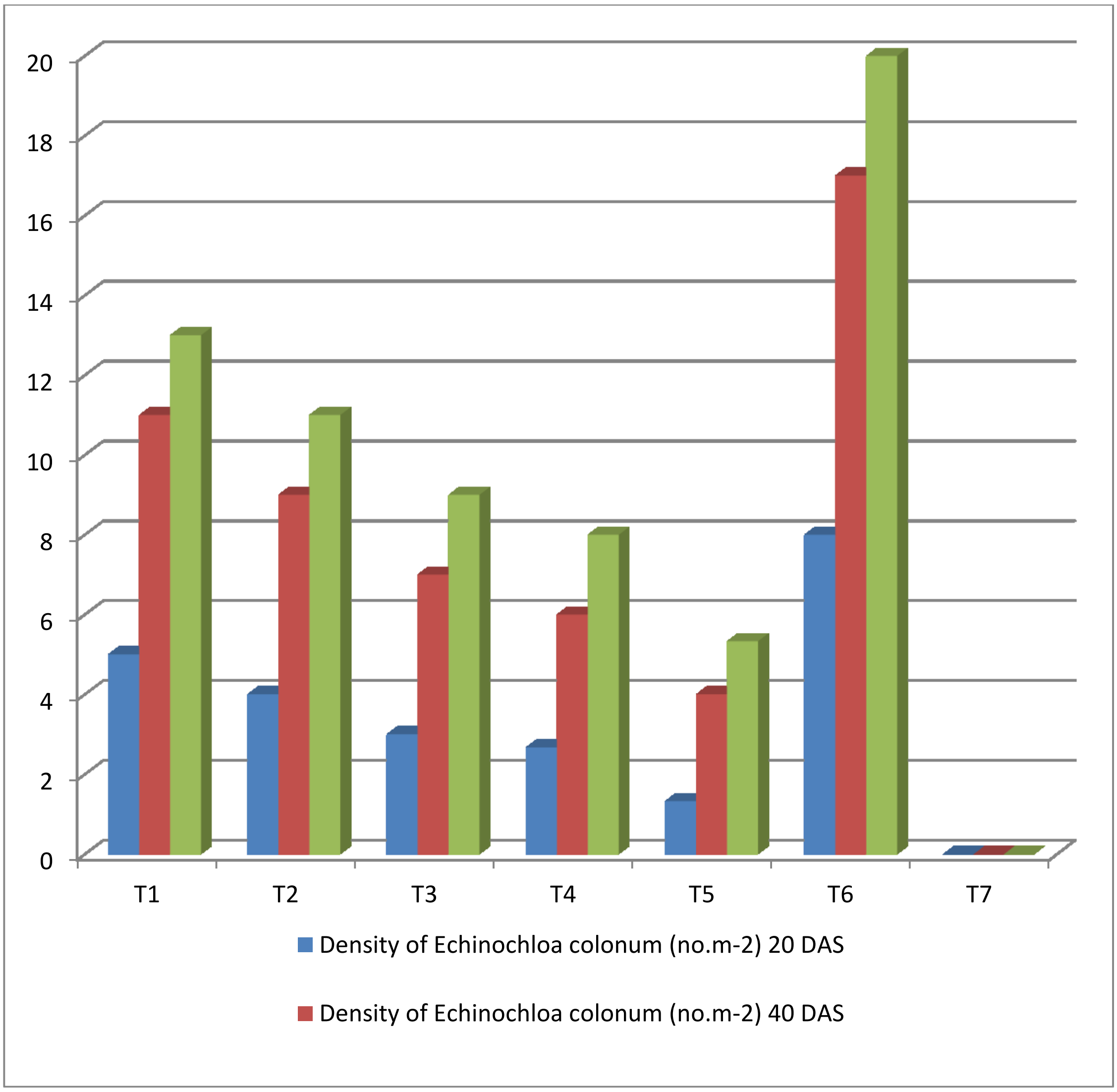
Considerable variations in density of *Echinochloa colonum* under different weed control treatment have been recorded at all the stages of observation. Among all the treatments weed free treatment proved superior to the other treatment in reducing the density of *Echinochloa colonum* at all the crop growth stages. The treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) was significantly superior to weedy check in reducing the density of *Echinochloa colonum* at all the crop growth stages.The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to the treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) in reducing the density of *Echinochloa colonum* at all the crop growth stages. The treatment pendimethalin 1 l a.i. ha^{-1} (T_3) was significantly superior to the treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) in reducing the density of *Echinochloa colonum* at all the crop growth stages.The treatment pendimethalin 1.5 l a.i. ha^{-1} (T_4) was superior to the treatment pendimethalin 1 l a.i. ha^{-1} (T_3) in reducing the density of *Echinochloa colonum* at all the crop growth stages. Application of pendimethalin 2 l a.i. ha^{-1} (T_5) was significantlysuperior to all herbicidal treatment except weedy checkin reducing the density of *Echinochloa colonum* at all the crop growth stages.

Table 4.2 : Effect of different treatments on density of *Echinochloa colonum* (no. m^{-2})

Treatment	Density *of Echinochloa colonum* (no.m^{-2})		
	20 DAS	40 DAS	At harvest
T_1	* 2.34 (5.00)	3.39 (11.00)	3.67 (13.00)
T_2	2.12 (4.00)	3.08 (9.00)	3.39 (11.00)
T_3	1.87 (3.00)	2.73 (7.00)	3.08 (9.00)
T_4	1.78 (2.67)	2.54 (6.00)	2.91 (8.00)
T_5	1.35 (1.33)	2.12 (4.00)	2.41 (5.33)
T_6	2.91 (8.00)	4.18 (17.00)	4.52 (20.00)
T_7	0.70 (0.00)	0.70 (0.00)	0.70 (0.00)
SEm (±)	0.30	0.49	0.56
C.D. (P=0.05)	0.94	1.50	1.74

* The actual population figure are given in parenthesis

Fig 4.1: Effect of different treatments on density of *Echinochloa colonum* (no.m^{-2})



4.2.2 Effect of herbicide on density of Sedges

The data related to density of sedges at different stages of crop growth have been presented in table 4.3 it is clear from data that density of sedges increased up to harvest stage irrespective of experimental variables. Considerable variations in density of sedges under weed control treatment have been recorded at all the stages of observation.

Among all the treatments weed free treatment proved superior to the other treatment in reducing the density of sedges. The treatment propaquizafop 50 ml a.i. ha^{-1} (T_1) was significantly superior to weedy check at all the crop growth stages in reducing the density of sedges. The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to the treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) at all the crop growth stages in reducing the density of sedges. The treatment pendimethalin 1 l a.i. ha^{-1} (T_3) was significantly superior to the treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) at all the crop growth stages in reducing the density of sedges. The treatment pendimethalin 1.5 l a.i. ha^{-1} (T_4) was significantly superior to the treatment pendimethalin 1 l a.i. ha^{-1} (T_3) at all the crop growth stages in reducing the density of sedges. Application of pendimethalin 2 l a.i. ha^{-1} (T_5) was significantly superior to all the herbicidal treatment except weedy check.

4.2.3 Effect of herbicide on dry weight of Sedges

The data related to dry weight of sedges have been presented in Table 4.4. Considerable variations in density of sedges under weed control treatment have been recorded at all the stages of observation

Among all the treatments weed free treatment proved superior to the other treatment in reducing the dry weight of sedges. The treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) was significantly superior to weedy check at all the crop growth stages in reducing the dry weight of sedges.The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to the treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) at all the crop growth stages in reducing the dry weight of sedges. The treatment pendimethalin 1 l a.i. ha^{-1} (T_3) was significantly superior to the treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) at all the crop growth stages in reducing the dry weight of sedges. The treatment pendimethalin 1.5 l a.i. ha^{-1} (T_4) was significantly superior to the treatment pendimethalin 1 l a.i. ha^{-1} (T_3) at all the crop growth stages in reducing the density of sedges

Application of pendimethalin 2 l a.i. ha^{-1} (T_5) was significantly superior to all the herbicidal treatment except weedy check.

4.2.4 Density of broad leaved weeds (BLW)

Statistical analysis of data (Table 4.5) clearly indicated that density of broad leaved weed increased up to at harvest stages.

Considerable variations in density of broad leaved weeds under weed control treatment have been recorded at all the crop growth stages. Among all the treatments weed free treatment proved superior to the other treatment in reducing the density of broad leaved weeds. The treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) was significantly superior to weedy check at all the crop growth stages in reducing density of broad leaved weeds. The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to the treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) at all the crop growth stages in reducing density of broad leaved weeds. The treatment pendimethalin 1 l a.i. ha^{-1} (T_3) was significantly superior to the treatment propaquizafop 75 ml a.i. ha^{-1} (T_2) at all the crop growth stages in reducing density of broad leaved weeds. The treatment pendimethalin 1.5 l a.i. ha^{-1} (T_4) was superior to the treatment pendimethalin 1 l a.i. ha^{-1} (T_3) at all the crop growth stages in reducing density of broad. Application of pendimethalin 2 l a.i. ha^{-1} (T_5) was significantly superior to all the herbicidal treatment except weedy check in reducing density of broad leaved weeds.

Table 4.3 : Effect of different treatments on density of Sedges (no. m^{-2})

Treatment	Density of Sedges (no.m^{-2})		
	20 DAS	40 DAS	At harvest
T_1	3.93 (15.00)	5.33 (28.00)	6.20 (38.00)
T_2	3.53 (12.00)	4.74 (22.00)	5.70 (32.00)
T_3	3.24 (10.00)	4.30(18.00)	5.33(28.00)
T_4	2.91 (8.00)	3.80(14.00)	4.88 (23.33)
T_5	2.54 (6.00)	3.53(12.00)	4.18 (17.00)
T_6	5.04 (25.00)	6.84 (46.33)	7.53 (56.33)
T_7	0.70 (0.00)	0.70 (0.00)	0.70 (0.00)
SEm (±)	0.50	0.71	0.79
C.D. (P=0.05)	1.53	2.20	2.44

* The actual population figure are given in parenthesis

Fig.4.2: Effect of different treatment on density of sedges m^{-2}

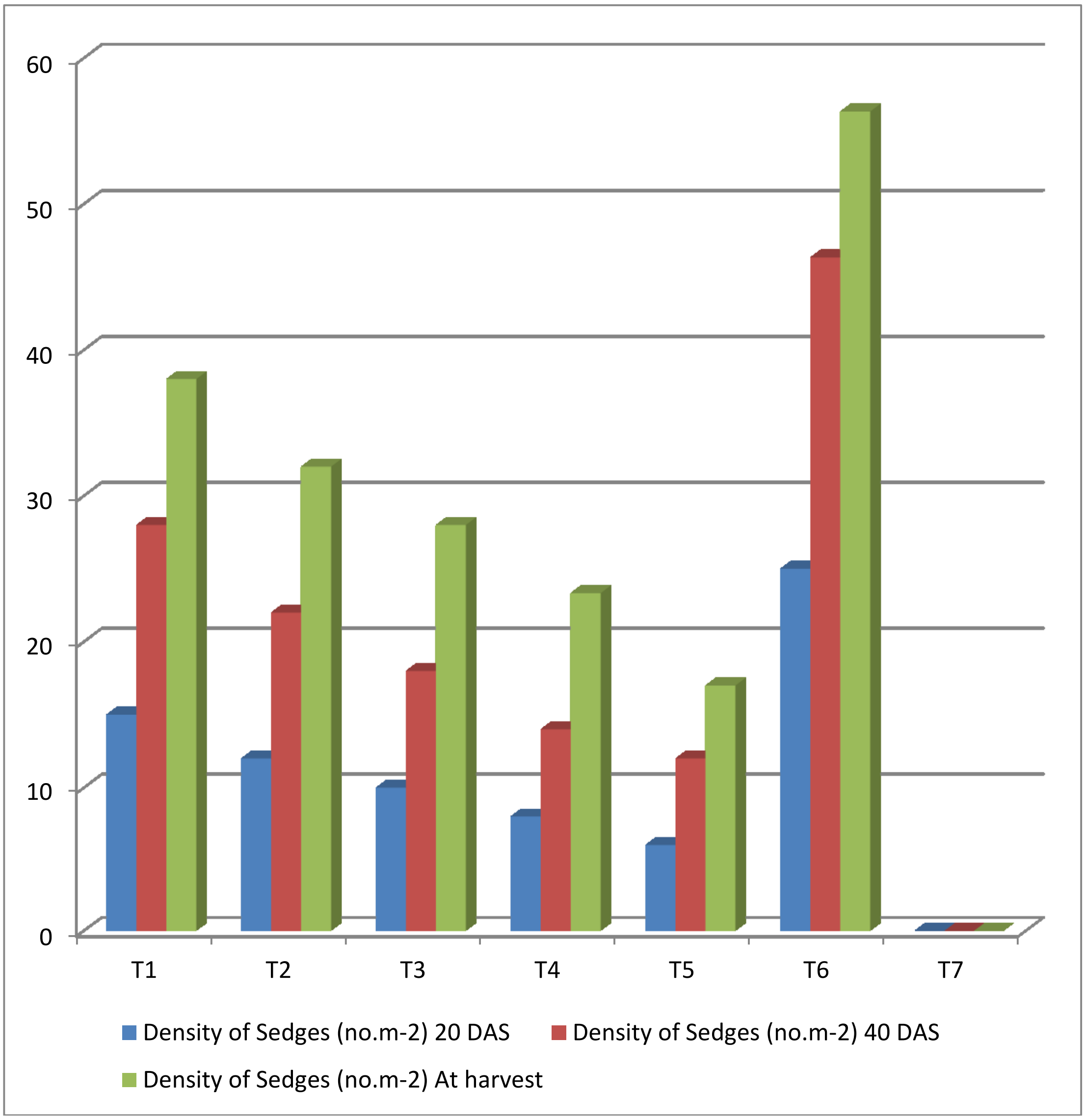


Table 4.4 : Effect of different treatments on dry weight of Sedges ($g.\ m^{-2}$)

Treatment	Dry weight of Sedges ($g.m^{-2}$)		
	20 DAS	**40 DAS**	**At harvest**
T_1	1.56 (1.95)	2.16(4.20)	2.41 (5.32)
T_2	1.43 (1.56)	1.94 (3.30)	2.23(4.48)
T_3	1.16 (1.30)	1.78(2.70)	2.10 (3.92)
T_4	1.24(1.04)	1.61(2.10)	1.94 (3.27)
T_5	1.12(0.76)	1.22(1.00)	1.69 (2.38)
T_6	1.93 (3.25)	2.72(6.95)	2.89 (7.89)
T_7	0.70 (0.00)	0.70 (0.00)	0.70 (0.00)
SEm (±)	0.07	0.11	0.11
C.D. (P=0.05)	0.20	0.34	0.34

* The actual population figure are given in parenthesis

Fig 4.3 : Effect of different treatment on dry weight of sedges (g. m^{-2})

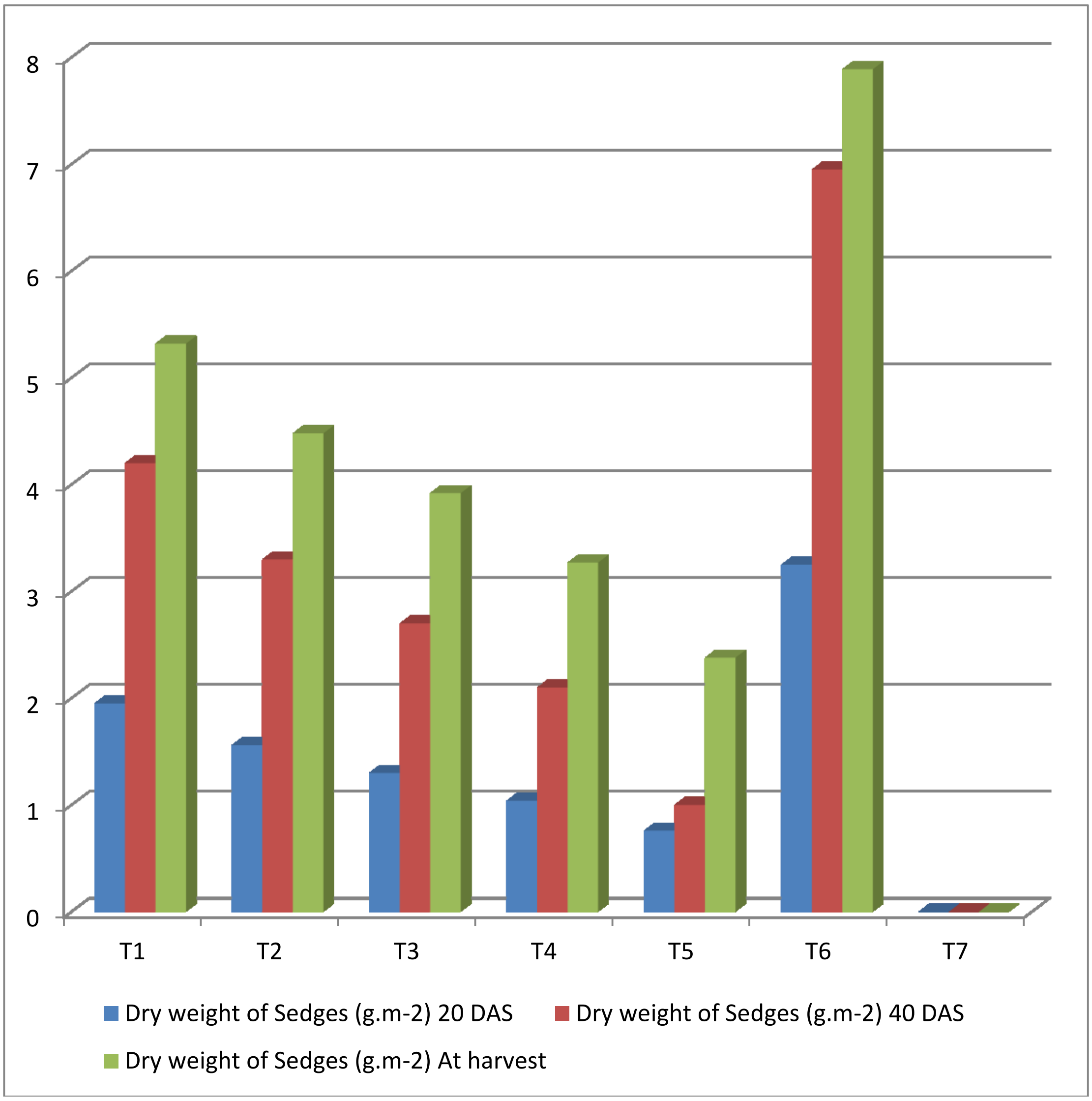
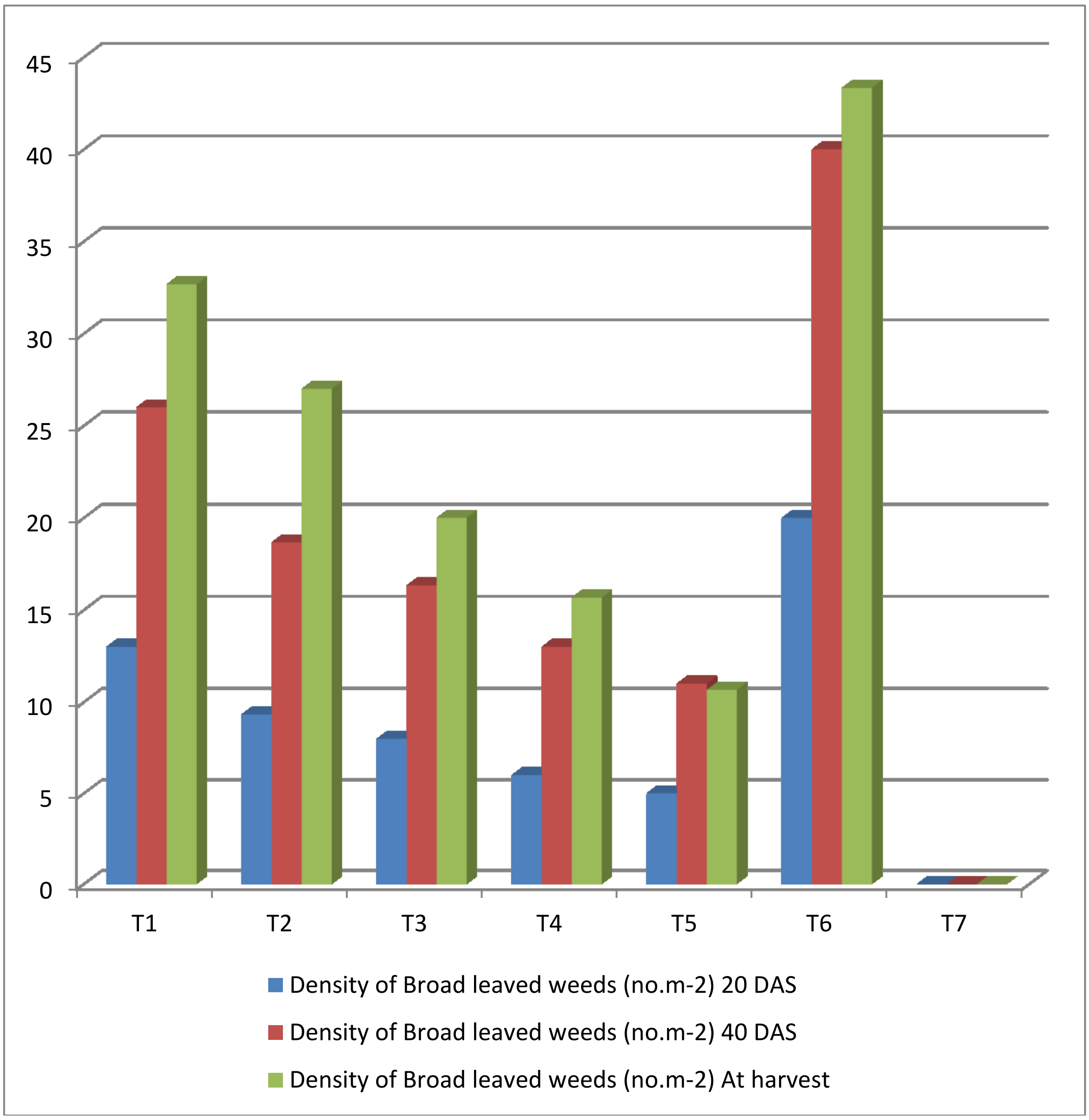


Table 4.5 : Effect of different treatments on density of Broad leaved weeds (no. m^{-2})

Treatment	Density of Broad leaved weeds (no.m^{-2})		
	20 DAS	40 DAS	At harvest
T_1	3.67 (13.00)	5.14 (26.00)	5.75 (32.67)
T_2	3.13 (9.33)	4.37 (18.67)	5.24(27.00)
T_3	2.91 (8.00)	4.10 (16.33)	4.52 (20.00)
T_4	2.54 (6.00)	3.67 (13.00)	4.02 (15.67)
T_5	2.34 (5.00)	3.39 (11.00)	3.34(10.67)
T_6	4.52 (20.00)	6.36 (40.00)	6.62 (43.33)
T_7	0.70 (0.00)	0.70 (0.00)	0.70 (0.00)
SEm (±)	0.30	0.77	1.20
C.D. (P=0.05)	0.91	2.37	3.70

* The actual population figure are given in parenthesis

Fig 4.4 : Effect of different treatments on density of broad leaved weed ($n.m^{-2}$)



4.2.3 Dry weight of broad leaved weeds (BLW)

Statistical analysis of data (Table 4.6) clearly indicated that dry weight of broad leaved weed increased up to harvest stages.

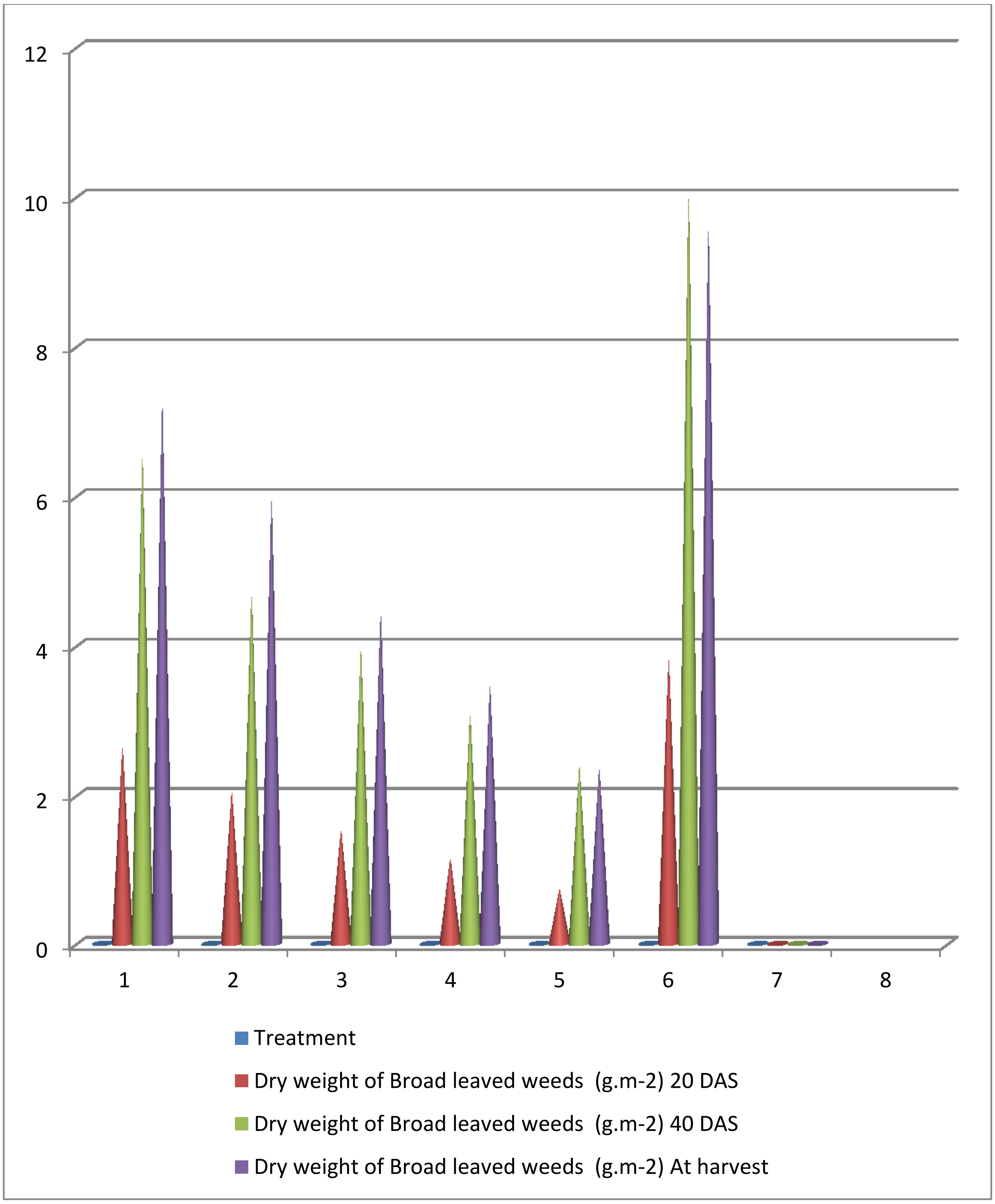
Considerable variations in dry weight of broad leaved weeds under different weed control treatment have been recorded at all the crop growth stages. Among all the treatments weed free treatment was proved significantly superior to the other treatment in reducing the dry weight of broad leaved weeds at all the crop growth stages. The treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) was significantly superior to weedy check at all the crop growth stages in reducing the dry weight of broad leaved weeds. The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to the treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) at all the crop growth stages in reducing the dry weight of broad leaved weeds. The treatment pendimethalin 1 l a.i. ha^{-1} (T_3) was significantly superior to the treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) at all the crop growth stages in reducing the dry weight of broad leaved weeds. The treatment pendimethalin 1.5 l a.i. ha^{-1} (T_4) was significantly superior to the treatment pendimethalin 1 l a.i. ha^{-1} (T_3) at all the crop growth stages in reducing the dry weight of broad leaved weeds. Application of pendimethalin 2 l a.i. ha^{-1} (T_5) was significantly superior to all the herbicidal treatments except weedy check in reducing the dry weight of broad leaved weed.

Table 4.6 : Effect of different treatments on dry weight of Broad leaved weeds (g. m^{-2})

Treatment	Dry weight of Broad leaved weeds (g.m^{-2})		
	20 DAS	40 DAS	At harvest
T_1	1.76 (2.63)	2.64 (6.50)	2.77 (7.19)
T_2	1.59 (2.03)	2.27 (4.67)	2.53(5.94)
T_3	1.42 (1.52)	2.10 (3.92)	2.21 (4.40)
T_4	1.28 (1.14)	1.89 (3.08)	1.98 (3.45)
T_5	1.10 (0.73)	1.69 (2.38)	1.68 (2.35)
T_6	2.07 (3.80)	3.24 (10.02)	3.16 (9.53)
T_7	0.70 (0.00)	0.70 (0.00)	0.70 (0.00)
SEm (±)	0.08	0.18	0.26
C.D. (P=0.05)	0.24	0.54	0.81

* The actual population figure are given in parenthesis

Fig 4.5 : Effect of different treatments on dry weight of broad leaved weed (g.m^{-2}).



4.2.4 Density and biomass of Grasses

The data related to density and biomass of grasses at different stages of crop growth has been presented in (table 4.7 and 4.8). It is clear from data that density and biomass of grasses increased up to harvest stage. Considerable variations in density and dry weight of grasses under weed control treatment have been recorded at all the stages of crop growth.

Among the all treatments weed free treatment was proved superior to the other treatment in reducing the density and dry weight of grasses at all the crop growth stages. The treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) was significantly superior to weedy check at all the crop growth stages in reducing the density and dry weight of grasses. The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to the treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) at all the crop growth stages in reducing the density and dry weight of grasses. The treatment pendimethalin 1 l a.i. ha^{-1} (T_3) was significantly superior to the treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) at all the crop growth stages in reducing the density and dry weight of grasses. The treatment pendimethalin 1.5 l a.i. ha^{-1} (T_4) was superior to the treatment pendimethalin 1 l a.i. ha^{-1} (T_3).In reducing the density and dry weight of grasses at all the crop growth stages. Application of pendimethalin 2 l a.i. ha^{-1} (T_5) was significantly superior to all the herbicidal treatments except weedy check in reducing density and dry weight of grasses at all the crop growth stages.

Table 4.7 : Effect of different treatments on density of Grasses (no. m^{-2})

Treatment	Density of grasses (no.m^{-2})		
	20 DAS	40 DAS	At harvest
T_1	4.06 (16.00)	5.52 (30.00)	6.64 (43.67)
T_2	3.67 (13.00)	4.94 (24.00)	5.90 (34.33)
T_3	3.39 (11.00)	4.52 (20.00)	5.36 (28.33)
T_4	3.08 (9.00)	4.06 (16.00)	4.77 (22.33)
T_5	2.54 (6.00)	3.24 (10.00)	3.71 (13.33)
T_6	5.95 (35.00)	8.07 (64.67)	9.46 (89.00)
T_7	0.70 (0.00)	0.70 (0.00)	0.70 (0.00)
SEm (±)	0.41	0.47	1.79
C.D. (P=0.05)	1.26	1.45	5.53

* The actual population figure are given in parenthesis

Fig 4.6: Effect of different treatments on density of grasses (no.m^{-2})

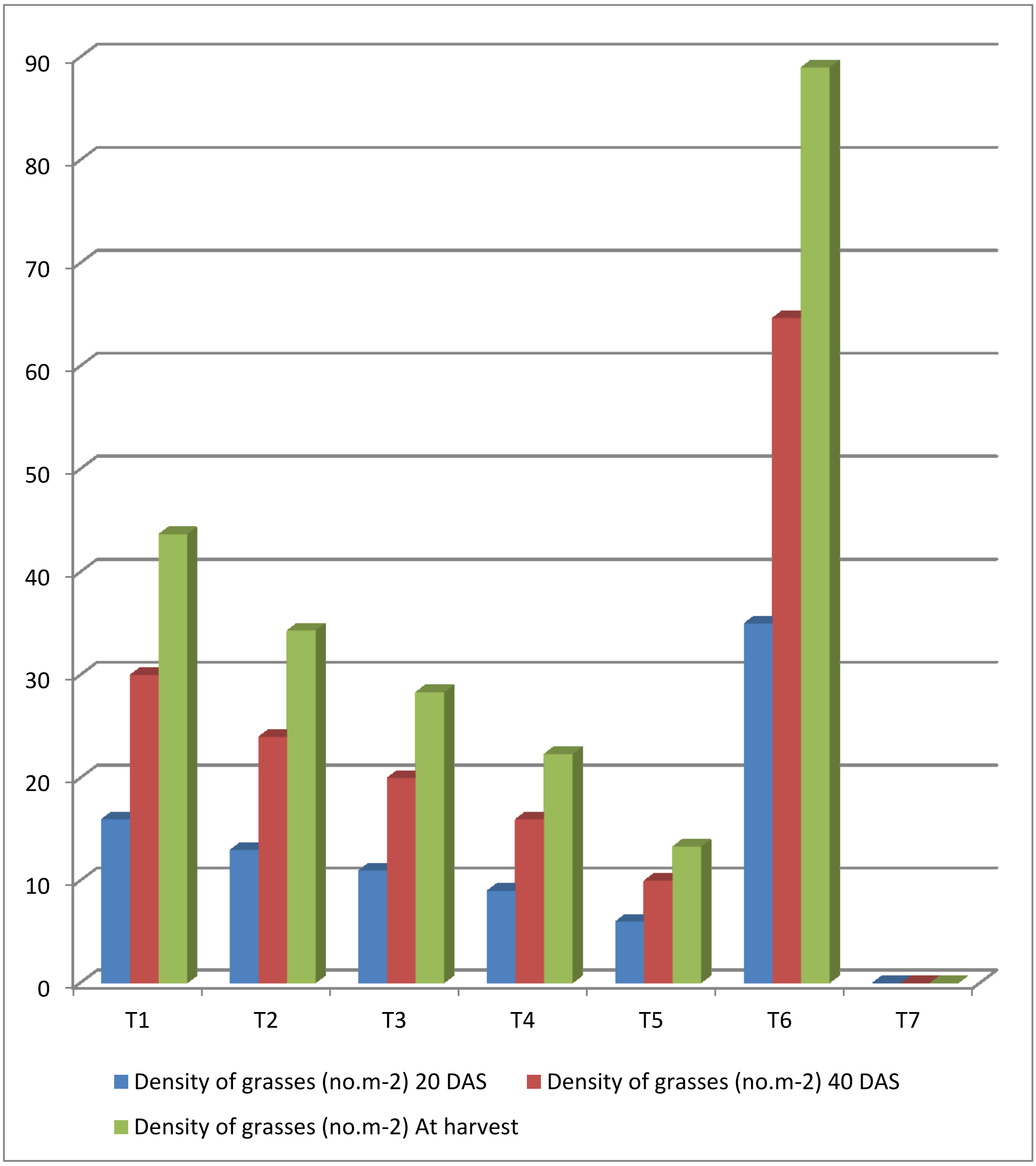
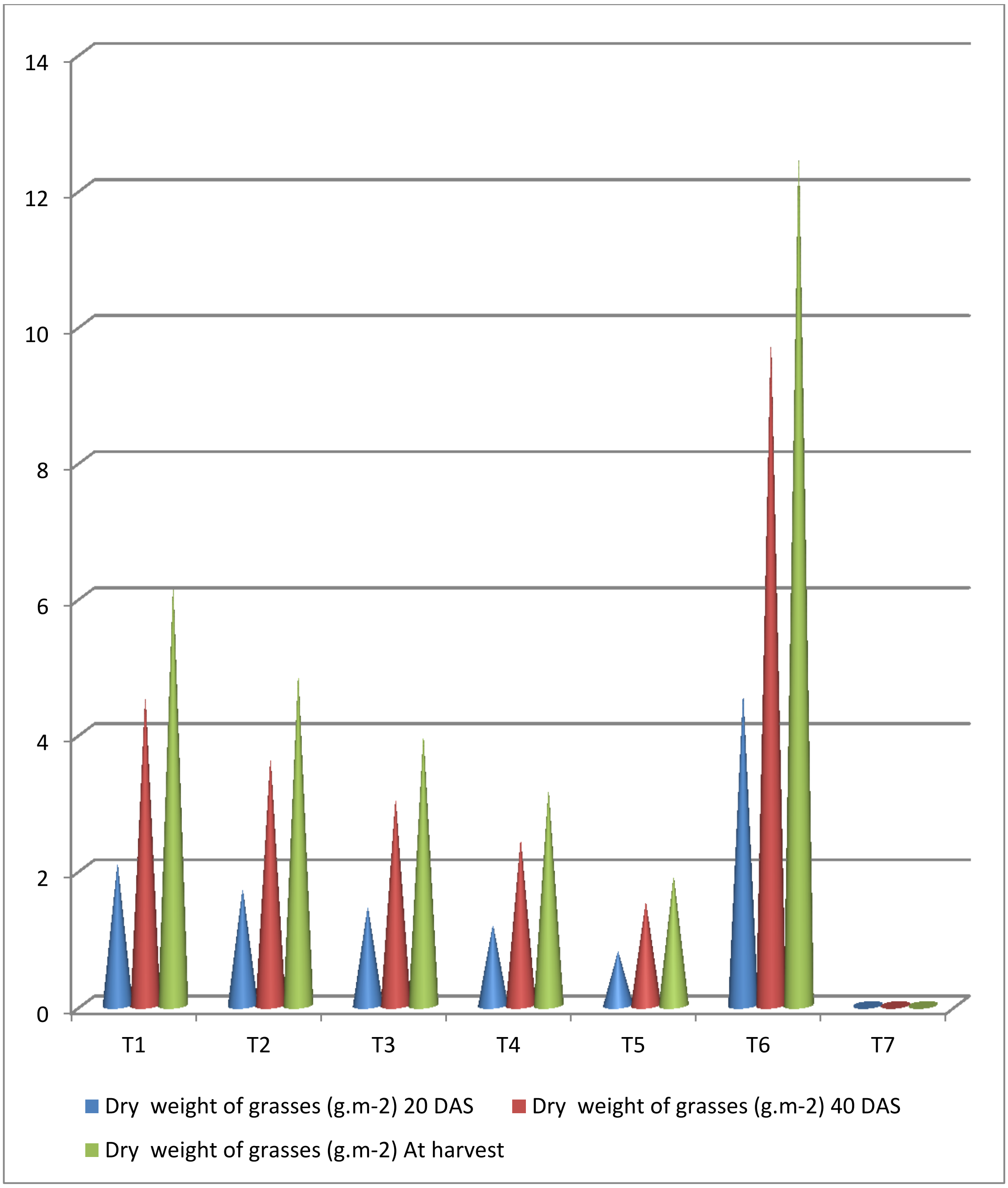


Table 4.8 : Effect of different treatments on dry weight of Grasses ($g. m^{-2}$)

Treatment	Dry weight of grasses ($g.m^{-2}$)		
	20 DAS	**40 DAS**	**At harvest**
T_1	1.60 (2.06)	2.23 (4.50)	2.57 (6.11)
T_2	1.47 (1.69)	2.02 (3.60)	2.30(4.81)
T_3	1.38 (1.43)	1.87 (3.00)	2.10 (3.92)
T_4	1.29(1.17)	1.70 (2.40)	1.90 (3.13)
T_5	1.13(0.78)	1.41 (1.50)	1.53 (1.87)
T_6	2.24 (4.52)	3.19 (9.70)	3.60 (12.46)
T_7	0.70 (0.00)	0.70 (0.00)	0.70 (0.00)
SEm (±)	0.05	0.07	0.25
C.D. (P=0.05)	0.14	0.22	0.77

Fig 4.7 : Effect of different treatment on dry weight of grasses (g.m^{-2})



4.2.7 Density and dry weight of total weeds.

A perusal of data (Table 4.9) clearly indicates that density of grasses increased up to days harvest stages after sowing the crop of mungbean. Considerable variation in density of weeds under different weed control treatments have been recorded at all the stages of observation.

Amongst all the treatment weed free treatment significantly superior to other treatments in reducing the density and dry weight of weeds at all the crop growth stages. The treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) was significantly superior to weedy check at all the crop growth stages in reducing the density and dry weight of total weeds population. The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) at all the crop growth stages in reducing the density and dry weight of total weeds population. The treatment pendimethalin 1 l a.i. ha^{-1} (T_3) was significantly superior to the treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) at all the crop growth stages in reducing the density and dry weight of total weeds population. The treatment pendimethalin 1.5 l a.i. ha^{-1} (T_4) was superior to the treatment pendimethalin 1 l a.i. ha^{-1} (T_3) in reducing the density and dry weight of total weeds population at all the crop growth stages. Application of pendimethalin 2 l a.i. ha^{-1} (T_5) was significantly superior to all the herbicidal treatments except weedy check in reducing density of total weeds population at all the crop growth stages.

Table 4.9 : Effect of different treatments on total weeds density (no. m^{-2})

Treatment	Total weeds density (no.m^{-2})		
	20 DAS	40 DAS	At harvest
T_1	7.03 (49.00)	9.78 (95.33)	11.08 (122.33)
T_2	6.23 (38.33)	8.61 (73.67)	10.00(99.67)
T_3	5.70(32.00)	7.82 (60.67)	8.19 (66.67)
T_4	5.04(25.00)	6.84 (46.33)	7.53 (56.33)
T_5	4.52(20.00)	6.04 (36.00)	6.41 (40.67)
T_6	9.40 (88.00)	12.50 (157.00)	13.08 (170.67)
T_7	0.70 (0.00)	0.70 (0.00)	0.70 (0.00)
SEm (±)	1.15	3.16	3.96
C.D. (P=0.05)	3.55	9.73	12.20

* The actual population figure are given in parenthesis

Fig 4.8: Effect of different treatment on total weeds density (no.m^{-2}).

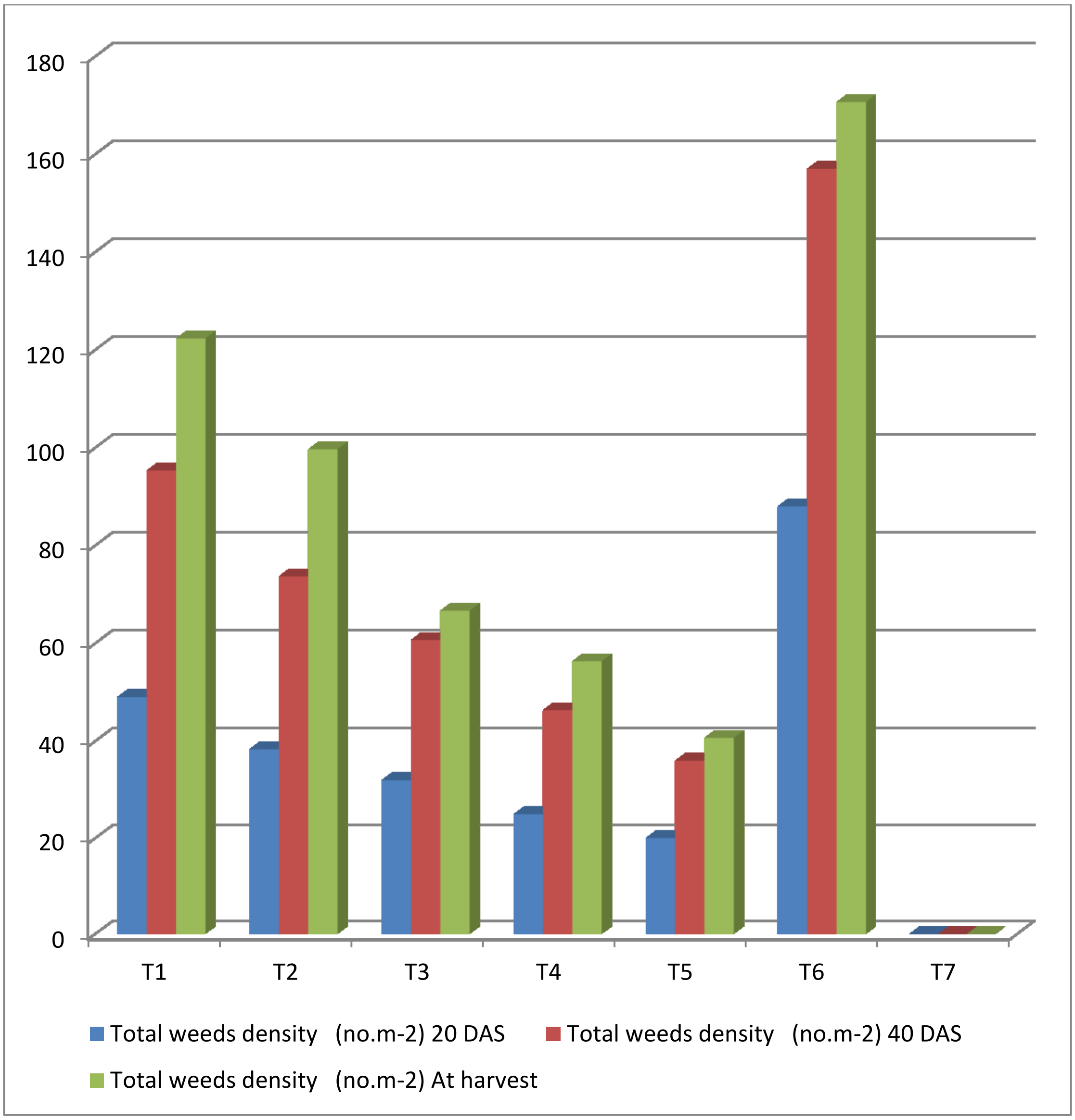
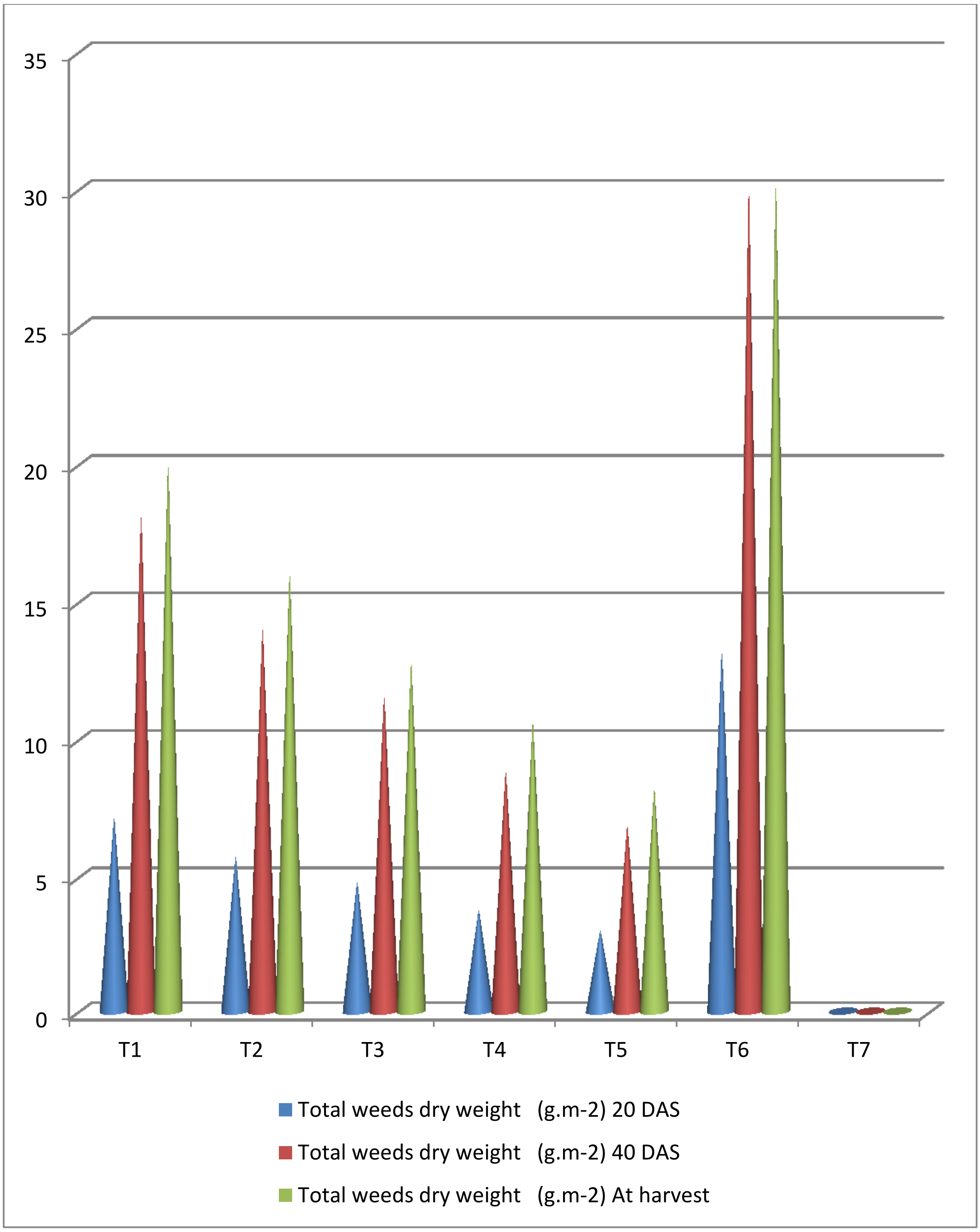


Table 4.10 : Effect of different treatments on Total weeds dry weight ($g. m^{-2}$)

Treatment	Total weeds dry weight ($g.m^{-2}$)		
	20 DAS	40 DAS	At harvest
T_1	2.76 (7.13)	4.31 (18.11)	4.52 (19.97)
T_2	2.49 (5.72)	3.80 (14.00)	4.05(15.95)
T_3	2.30 (4.80)	3.46 (11.53)	3.63 (12.73)
T_4	2.06 (3.75)	3.04 (8.80)	3.32 (10.57)
T_5	1.87 (3.00)	2.70 (6.84)	2.94 (8.17)
T_6	3.69 (13.17)	5.50 (29.83)	5.52 (30.07)
T_7	0.70 (0.00)	0.70 (0.00)	0.70 (0.00)
SEm (±)	0.19	0.60	0.62
C.D. (P=0.05)	1.59	1.85	1.92

* The actual population figure are given in parenthesis

Fig 4.9 : Effect of different treatment on total weeds dry weight ($g.m^{-2}$).



4.2.8 Effect of herbicide on weed control efficiency (WCE)

The data on weed control efficiency (%) as influenced by different weed control treatments has been presented in table 4.11 and figure 4.10 Weed control efficiency was calculated at 20, 40 and at harvest.

Application of pendimethalin (2 l a.i. ha^{-1}) recorded maximum weed control efficiency 77.22, 77.07 and 72.83 was superior to the rest of the treatment. Weed control efficiency of pendimethalin (1.5 l a. i. ha^{-1}) was 71.52, 70.49 and 64.84 was best to the application of pendimethalin (1 l a.i. ha^{-1}).Weed control efficiency of pendimethalin (1 l a.i. ha^{-1}) was 63.55, 61.34 and 57.66 The lowest weed control efficiency was recorded under application of propaquizafop (50 ml a.i. ha^{-1}) was 54.29, 39.28 and 26.28 it is followed by application of propaquizafop (75 ml a.i. ha^{-1}) 56.56, 53.06 and 26.28.

4.2.9 Weed index (WI)

The data pertaining to weed index as influenced by weed control treatment have been presented in Table 4.11 .The minimum weed index (0) was associated with weed free treatment whereas, maximum weed index.(71.37) was recorded under weedy check alone during investigation. In general, all the weed control treatments remained significantly superior to weedy check.

4.3 Growth characters

4.3.1 Plant height (cm)

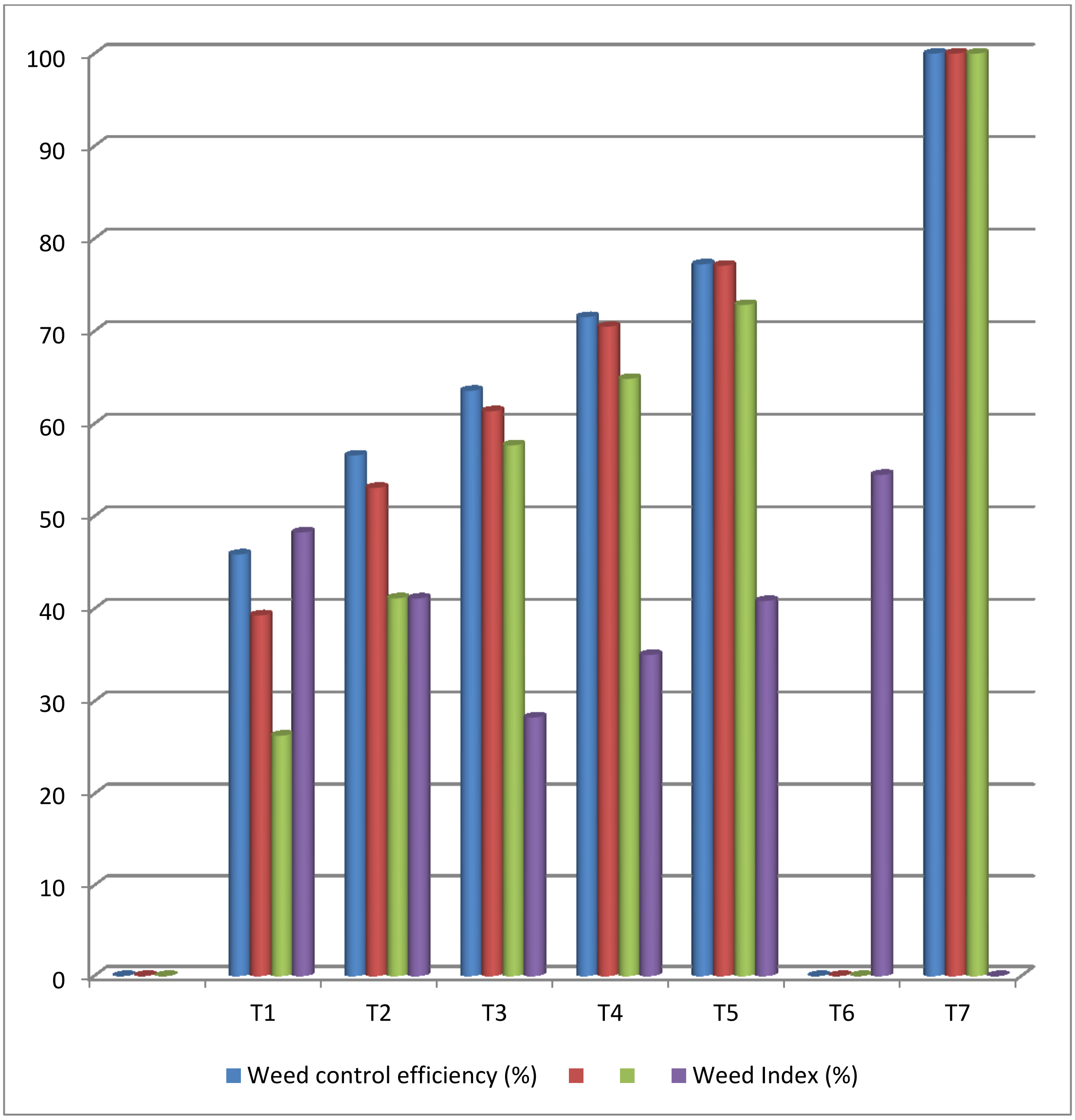
Statistical analysis of data (Table4.12) clearly indicate that plant height increased up to at harvest

Throughout the crop season maximum height was recorded with the weed free treatment. Amongst all the herbicidal treatment application of pendimethalin (1 l a.i. ha^{-1}) recorded maximum plant height. The next best treatment was pendimethalin (1.5 l a.i. ha^{-1}) was recorded maximum plant height and significantly superior to the treatment of pendimethalin (2 l a.i. ha^{-1}). The treatment propaquizafop (75 ml a.i. ha^{-1}) was recorded maximum plant height and significantly superior to the treatment propaquizafop (50 ml a.i. ha^{-1}). However all the treatment was significantly superior to the weedy check.

Table 4.11 : Effect of different treatment on weed control efficiency (%) and Weed index (%)

Treatment	Weed control efficiency (%)			Weed index (%)
	20 DAS	40 DAS	At harvest	
T_1	45.86	39.28	26.28	48.25
T_2	56.56	53.06	41.12	41.11
T_3	63.55	61.34	57.66	28.24
T_4	71.52	70.49	64.84	35.00
T_5	77.22	77.07	72.83	40.83
T_6	0	0	0	54.46
T_7	100	100	100	0

Fig 4.10 : Effect of different treatment on weed control efficiency (%) and Weed index (%)



4.3.2: Dry matter accumulation

Statistical analysis of data (Table4.13) clearly indicate that plant height increased up to at harvest

Throughout the crop season maximum dry matter accumulation was recorded with the weed free treatment. Amongst all the herbicidal treatment application of pendimethalin (1 l a.i. ha^{-1}) was recorded maximum dry matter accumulation. The treatment propaquizafop (75 ml a.i. ha^{-1}) was significantly superior to the weedy check. The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) at all the crop growth stages. The treatment pendimethalin 1 l a.i. ha^{-1} (T_3) was significantly superior to the treatment pendimethalin 1.5 l a.i. ha^{-1} (T_4) at all the crop growth stages The treatment pendimethalin 1.5 l a.i. ha^{-1} (T_4) was significantly superior to the treatment pendimethalin (2 l a.i. ha^{-1}) at all the crop growth stages However all the treatment was significantly superior to the weedy check

4.3.3 Number of nodules

Data pertaining to number of nodules indicated significant influence of different weed control treatments (Table 4.14). The number of nodule increased progressively till harvest, irrespective of treatments.

Throughout the crop season maximum number of nodules was recorded with the weed free treatment. Amongst all the herbicidal treatment application of pendimethalin (1 l a.i. ha^{-1}) was recorded maximum number of nodules. The treatment propaquizafop (75 ml a.i. ha^{-1}) was significantly superior to the weedy check. The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to the treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) at all the crop growth stages, while, the treatment pendimethalin 1 l a.i. ha^{-1} (T_3) was significantly superior to the treatment pendimethalin 1.5 l a.i. ha^{-1} (T_4) at all the crop growth stages, whereas, the treatment pendimethalin 1.5 l a.i. ha^{-1} (T_4) was significantly superior to the treatment pendimethalin (2 l a.i. ha^{-1}) at all the crop growth stages, however all the treatment was significantly superior to the weedy check

Table 4.12 : Effect of weedicides on plant height of Mungbean in Guava based agri-horticultural system.

Treatment	Plant height (cm)		
	20 DAS	**40 DAS**	**At harvest**
T_1	15.13	32.33	37.07
T_2	15.49	33.28	38.15
T_3	17.87	38.80	45.17
T_4	16.80	36.17	42.12
T_5	15.63	33.70	38.96
T_6	13.67	25.00	32.08
T_7	17.79	39.07	46.47
SEm (±)	0.35	0.79	0.45
C.D.(P=0.05)	1.06	2.43	1.39

Fig 4.11 : Effect of different treatments on Plant height (cm)

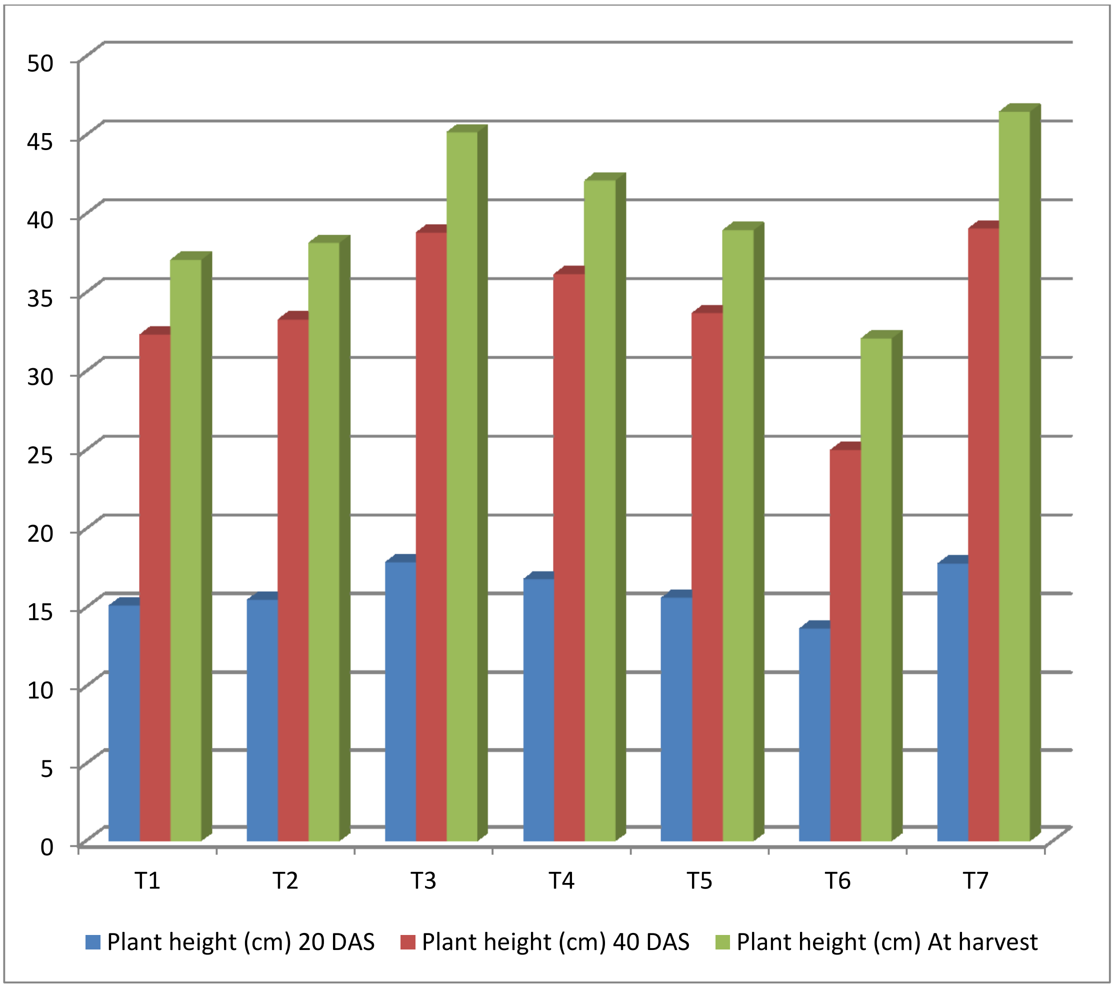
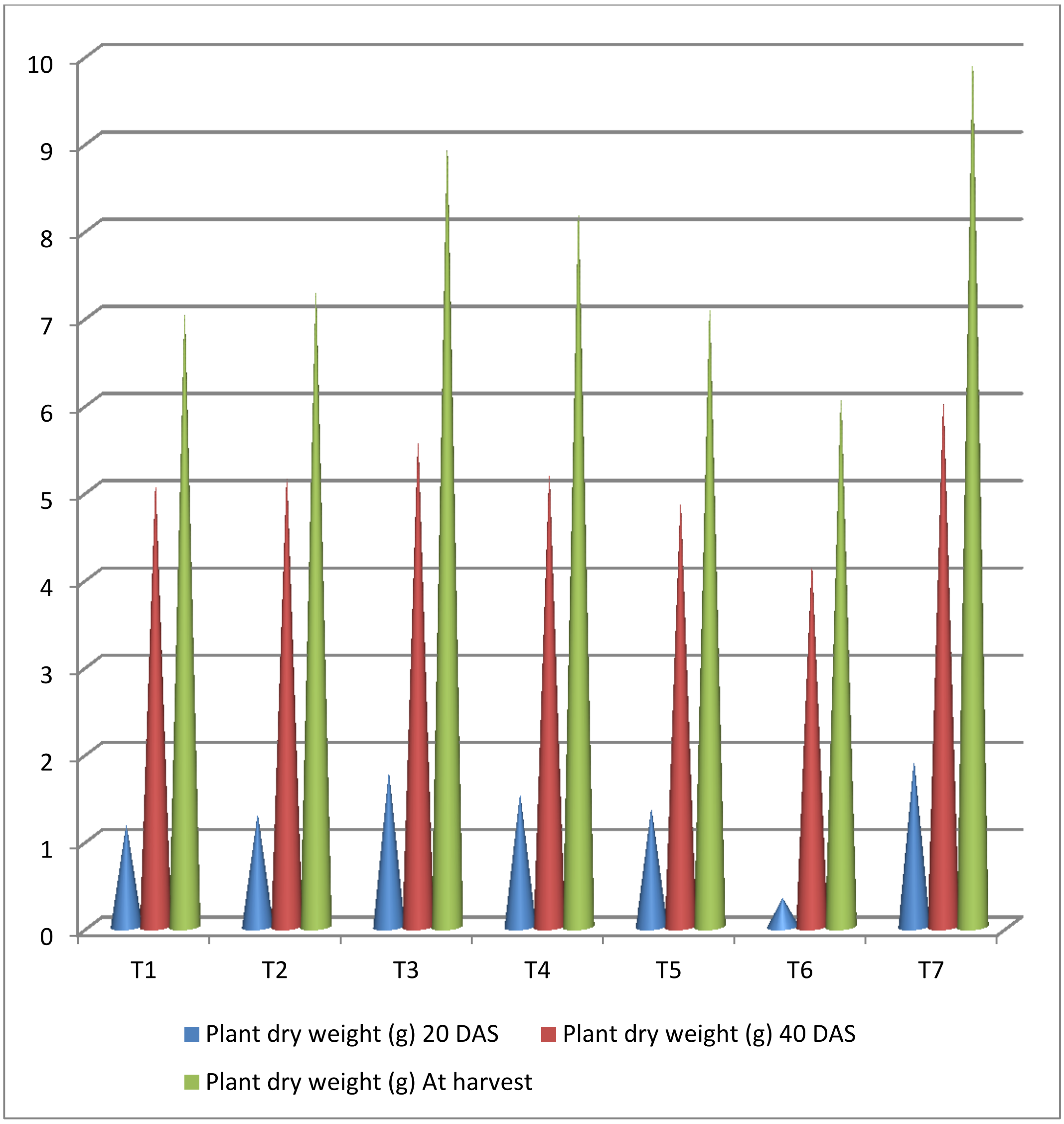


Table 4.13 : Effect of weedicides on plant dry weight of Mungbean in Guava based agri-horticultural system

Treatment	Plant dry weight (g)		
	20 DAS	**40 DAS**	**At harvest**
T_1	1.16	5.04	7.01
T_2	1.27	5.14	7.27
T_3	1.75	5.55	8.93
T_4	1.50	5.17	8.16
T_5	1.34	4.84	7.07
T_6	0.32	4.13	6.06
T_7	1.88	6.00	9.88
SEm (±)	0.05	0.08	0.20
C.D.(P=0.05)	0.16	0.23	0.61

Fig 4.12 : Effect of different treatments on Plant dry weight (g).



4.3.4 Number of branches

Data pertaining to number of branches indicated significant influence of different weed control treatments (Table 4.14). The number of nodule increased progressively till harvest, irrespective of treatments

Throughout the crop season maximum number of branches was recorded with the weed free treatment. Amongst all the herbicidal treatment application of pendimethalin (1 l a.i. ha^{-1}) was recorded maximum number of branches. The treatment propaquizafop (75 ml a.i. ha^{-1}) was significantly superior to the weedy check. The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to the treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) at all the crop growth stages. The treatment pendimethalin 1 l a.i. ha^{-1} (T_3) was significantly superior to the treatment pendimethalin 1.5 l a.i. ha^{-1} (T_4) at all the crop growth stages The treatment pendimethalin 1.5 l a.i. ha^{-1} (T_4) was significantly superior to the treatment pendimethalin (2 l a.i. ha^{-1}) at all the crop growth stages However all the treatment was significantly superior to the weedy check

4.4 YIELD AND YIELD ATTRIBUTES

Yield attributes characters like number of pods per plant, pod length, number of grains per pod and 1000 grain weight showed positive correlation with yield. The increase in the value of yield attributes could be attributed to the increase in plant dry matter.

4.4.1 Pod count

The data pertaining to the number of pods per plant are presented in Table (4.15). It is evident from data that all the weed control treatments significantly increased the number of pods per plant over weedy check. Weed free treatment recorded the highest number of pods per plant.

In herbicidal treatments, application of Pendimethalin (PRE) 1 L. a.i. /ha was recorded maximum pods per plant and was significantly superior to other herbicidal treatments at all the growth stages. The minimum pods per plant were recorded under weedy check treatments. The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to the treatment propaquizafop 50 ml a.i.ha^{-1} (T_1). The treatment pendimethalin 1 l a.i. ha^{-1} (T_3) was significantly superior to the treatment pendimethalin 1.5 l a.i. ha^{-1} (T_4).The treatment pendimethalin 1.5 l a.i. ha^{-1} (T_5) was significantly superior to the treatment pendimethalin 2 l a.i. ha^{-1} (T_4).However all the treatment was significantly superior to weedy check.

4.4.2 **Length of pod**

The data pertaining to the length of pods per plant are presented in Table (4.15). It is evident from data that all the weed control treatments significantly increased the length of pods per plant over weedy check. Weed free treatment recorded the highest length of pods per plant.

In herbicidal treatments, application of Pendimethalin (PRE) 1 L a.i. /ha was recorded maximum length of pods per plant and was significantly superior to other herbicidal treatments. The minimum lengths of pods per plant were recorded under weedy check treatments. The treatment propaquizafop 75 ml a.i.ha^{-1} (T_1) was significantly superior to weedy check. The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to the treatment propaquizafop 50 ml a.i.ha^{-1} (T_1). The treatment pendimethalin 1.5 l a.i. ha^{-1} (T_3) was significantly superior to the treatment pendimethalin 2 l a.i. ha^{-1} (T_4). However all the treatment was significantly superior to weedy check.

4.4.3 Grain count

Data on grain count are presented in Table (4.15). It is evident from data that all the weed control treatments significantly increased the grain count over weedy check. Weed free treatment recorded the highest grain count. In herbicidal treatments, application of Pendimethalin (PRE) 1l a.i. /ha was recorded maximum grain count and was significantly superior to other herbicidal treatments at all the growth stages. The minimum grain counts were recorded under weedy check treatments.

The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to the treatment propaquizafop 50 ml a.i.ha^{-1} (T_1). The treatment pendimethalin 1.5 l a.i. ha^{-1} (T_3) was significantly superior to the treatment pendimethalin 2 l a.i. ha^{-1} (T_5). However all the treatment was significantly superior to weedy check

4.4.4 1000-grain weight.

A perusal of data pertaining to the test weight are presented in Table (4.15) It is evident from data that all the weed control treatments significantly increased the test weight over weedy check. Weed free treatment recorded the highest test weight. In herbicidal treatments, application of Pendimethalin (PRE) 1 L a.i. /ha was recorded maximum test weight and was significantly superior to other herbicidal treatments. The minimum test weight was recorded under weedy check treatments.

The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to the treatment propaquizafop 50 ml a.i.ha^{-1} (T_1). The treatment pendimethalin 1.5 l a.i. ha^{-1} (T_3) was significantly superior to the treatment pendimethalin 2 l a.i. ha^{-1} (T_5). However all the treatment was significantly superior to weedy check at all the crop growth stages.

4.4.5. Grain yield

Statistical analysis of data revealed that the treatments had significant effect on grain yield have been presented in (Table 4.16) An examination of data revealed that all the weed control treatments significantly increased the grain yield of greengram over weedy check. The weed free treatment recorded the maximum grain yield. In herbicidal treatments application of Pendimethalin (PRE) 1 l a.i. /ha recorded maximum grain yield and was significantly superior to other herbicidal treatments. The minimum grain yield was recorded in weedy check.

The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to the treatment propaquizafop 50 ml a.i.ha^{-1} (T_1). The treatment pendimethalin 1.5 l a.i. ha^{-1} (T_3) was significantly superior to the treatment pendimethalin 2 l a.i. ha^{-1} (T_5). However all the treatment was significantly superior to weedy check at all the crop growth stages

4.4.6 Straw yield

Statistical analysis of data straw yield is given in (Table 4.16) clearly showed that there was strong connection is relation to treatments and straw yield. Amongst herbicidal treatment, application of Pendimethalin (PRE) 1 l a.i. /ha was recorded maximum straw yield and remained significantly superior to over rest of the herbicidal treatments. However, all the herbicidal treatments were significantly superior over weedy check which had minimum straw yield

The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to the treatment propaquizafop 50 ml a.i.ha^{-1} (T_1). The treatment pendimethalin 1.5 l a.i. ha^{-1} (T_3) was significantly superior to the treatment pendimethalin 2 l a.i. ha^{-1} (T_5). However all the treatment was significantly superior to weedy check at all the crop growth stages

4.7 Biological yield

Statistical analysis of data biological yield is given in (Table 4.16) clearly showed that there was strong connection is relation to treatments and biological yield. Amongst herbicidal treatment, application of Pendimethalin (PRE) 1 l a.i. /ha was recorded maximum biological yield and remained significantly superior to over rest of the herbicidal treatments. However, all the herbicidal treatments were significantly superior over weedy check which had minimum biological yield.

.The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to the treatment propaquizafop 50 ml a.i.ha^{-1} (T_1) The treatment pendimethalin 1.5 l a.i. ha^{-1} (T_3) was significantly superior to the treatment pendimethalin 2 l a.i. ha^{-1} (T_5). However all the treatment was significantly superior to weedy check at all the crop growth stages

4.7 Harvest index

Statistical analysis of data harvest index is given in (Table 4.16) clearly showed that there was strong connection is relation to treatments and harvest index. Amongst herbicidal treatments, application of Pendimethalin (PRE) 1 l a.i. /ha was recorded maximum harvest index and remained superior to over rest of the herbicidal treatments. However all the herbicidal treatments was significantly superior weedy check.

The treatment propaquizafop 75 ml a.i.ha^{-1} (T_2) was significantly superior to the treatment propaquizafop 50 ml a.i.ha^{-1} (T_1). The treatment pendimethalin 1 l a.i. ha^{-1} (T_3) was at par with the treatment pendimethalin 1.5 l a.i. ha^{-1} (T_4). The treatment pendimethalin 1 .5 a.i. ha^{-1} (T_4) was at par with the treatment pendimethalin 2 l a.i. ha^{-1} (T_5).

Table 4.14 : Number of nodules plant^{-1} and Number of branches plant^{-1} as influenced by different methods of weed control treatments.

Treatment	Number of nodules plant^{-1}		Number of branches plant^{-1}	
	20 DAS	**40 DAS**	**20 DAS**	**40 DAS**
T_1	10.00	20.07	2.28	3.21
T_2	10.40	20.48	2.68	3.40
T_3	11.73	22.51	3.80	4.41
T_4	11.25	22.00	3.22	4.00
T_5	10.48	21.10	2.77	3.67
T_6	9.54	17.08	2.03	3.07
T_7	12.60	24.70	4.35	5.40
SEm±	0.09	0.05	0.07	0.01
C.D. at 5%	0.27	0.16	0.20	0.02

Fig 4.13 : Effect of different treatments on number of nodules plant^{-1} and number of branches plant^{-1}.

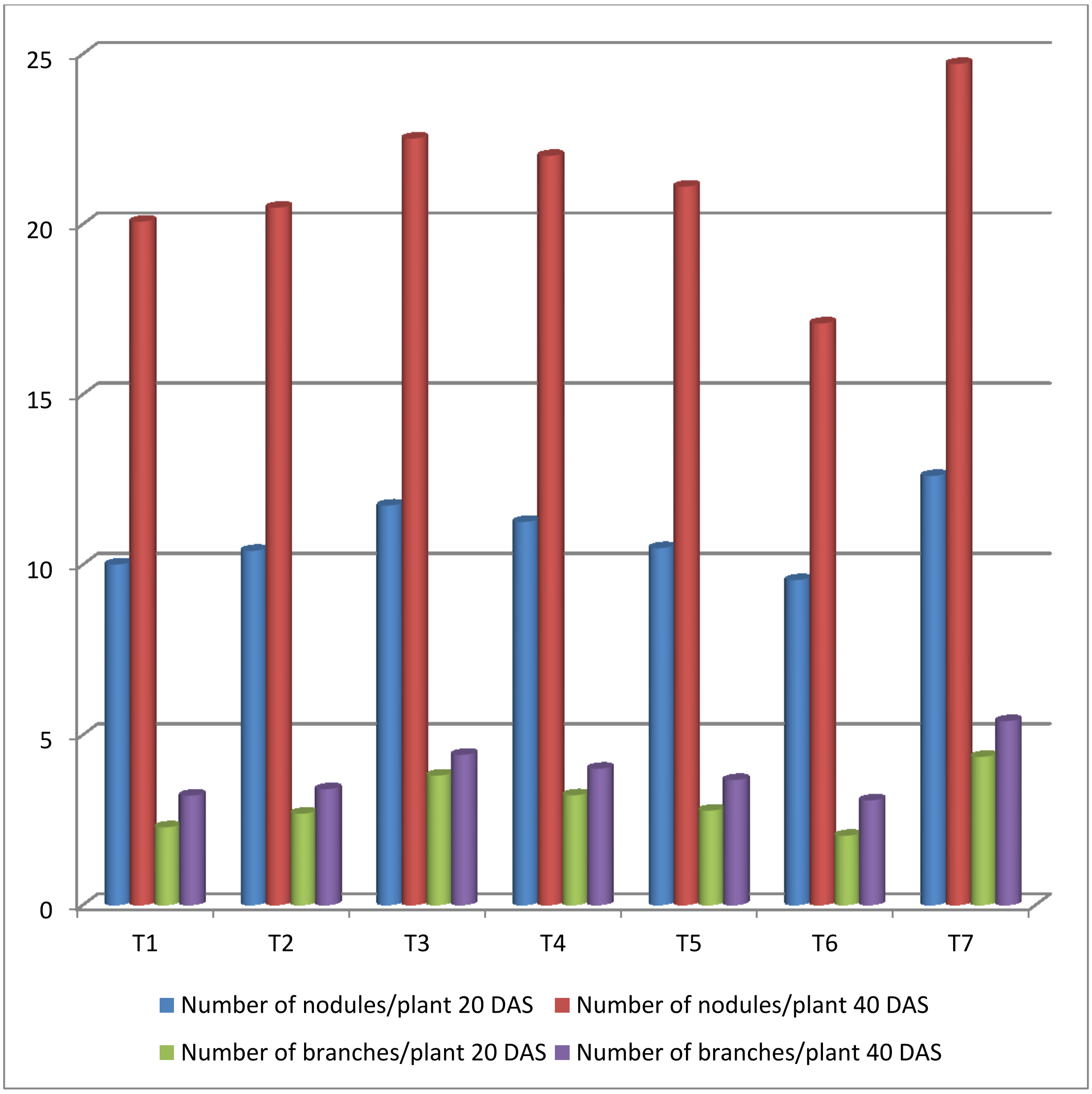


Table 4.15 : Number of pods plant^{-1}, pod length, number of grains pod^{-1} and 1000-grain weight as influenced by different method of weed control treatments.

Treatments	No. of pod plant^{-1}	Pod length (cm)	No. of grains pod^{-1}	1000-grain weight (g)
T_1	10.33	6.33	8.33	22.23
T_2	10.67	6.67	8.67	23.73
T_3	13.33	8.60	11.00	25.90
T_4	12.33	7.47	10.03	24.23
T_5	10.67	6.70	8.67	23.20
T_6	9.33	6.13	7.00	20.60
T_7	15.33	7.50	11.80	27.40
SEm±	0.33	0.17	0.22	0.23
C.D. at 5%	1.00	0.52	0.68	0.71

Fig. 4.14 : Number of pods plant^{-1}, pod length, number of grains pod^{-1} and 1000-grain weight as influenced by different method of weed control treatments.

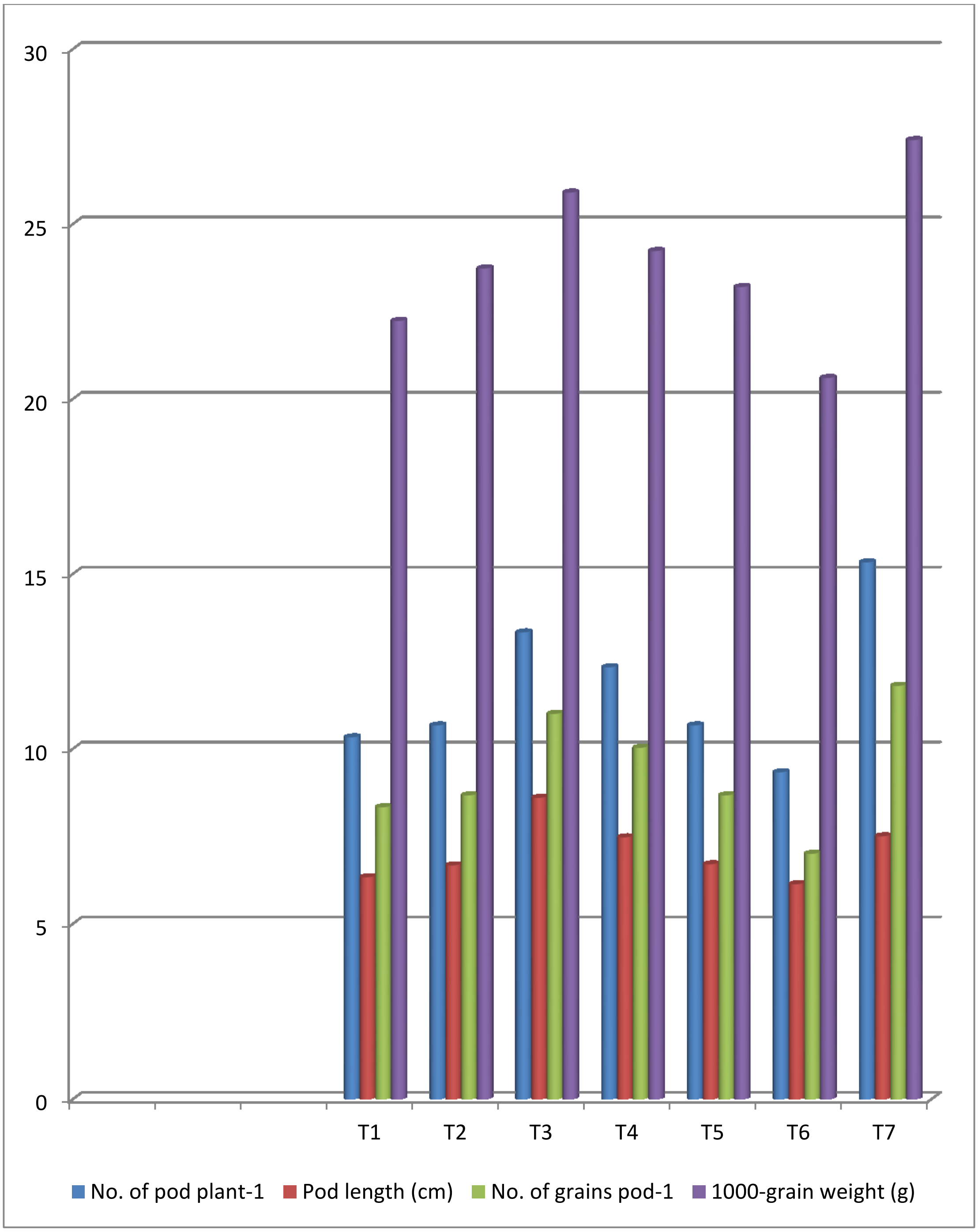


Table 4.16 : Grain yield, Straw yield, Biological yield and harvest index as influenced by different method of weed control treatments.

Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha-1)	Harvest index (%)
T_1	621.00	1693.00	2314.00	26.83
T_2	706.67	1740.00	2446.67	28.88
T_3	861.03	2047.37	2908.43	29.60
T_4	780.00	1904.33	2684.33	29.08
T_5	710.77	1752.13	2462.90	28.96
T_6	544.37	1384.00	1928.37	28.22
T_7	1200	2710.97	3910.97	30.70
SEm±	6.32	34.62	34.07	0.40
C.D.	19.48	106.66	104.97	1.25

Fig. 4.15 : Grain yield, Straw yield, Biological yield and harvest index as influenced by different method of weed control treatments.

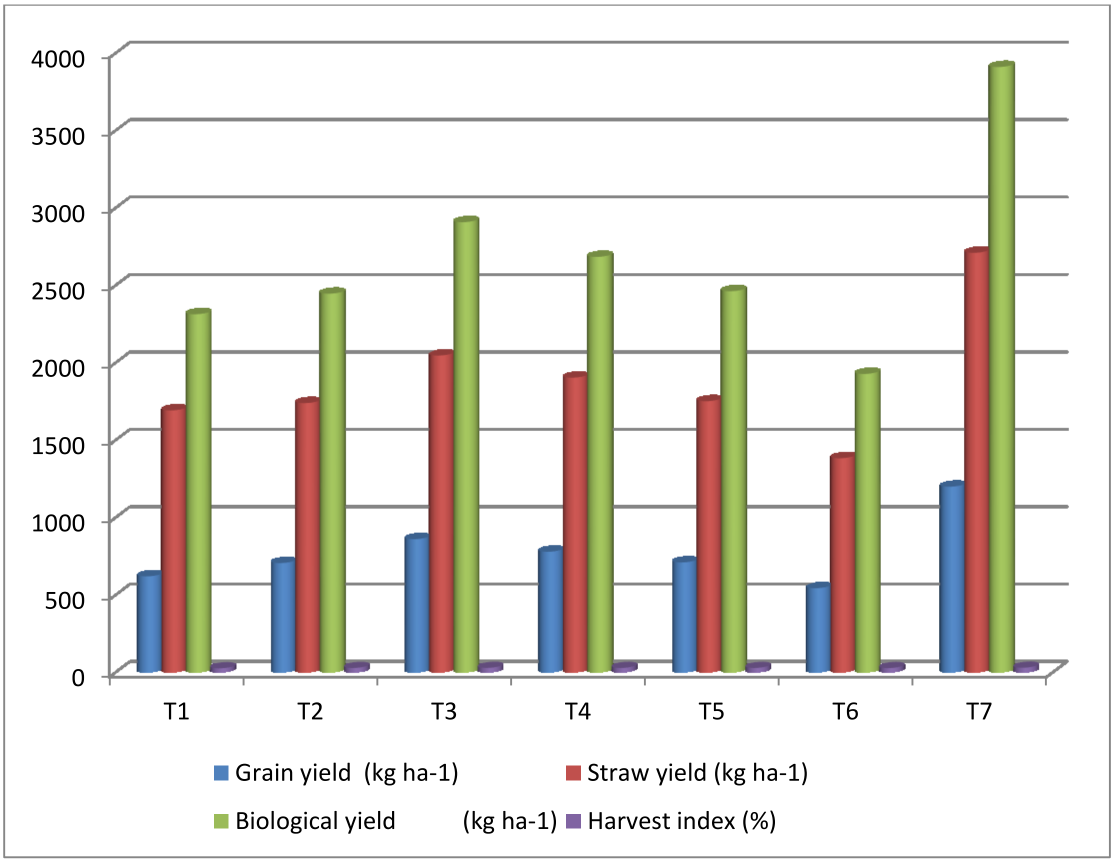
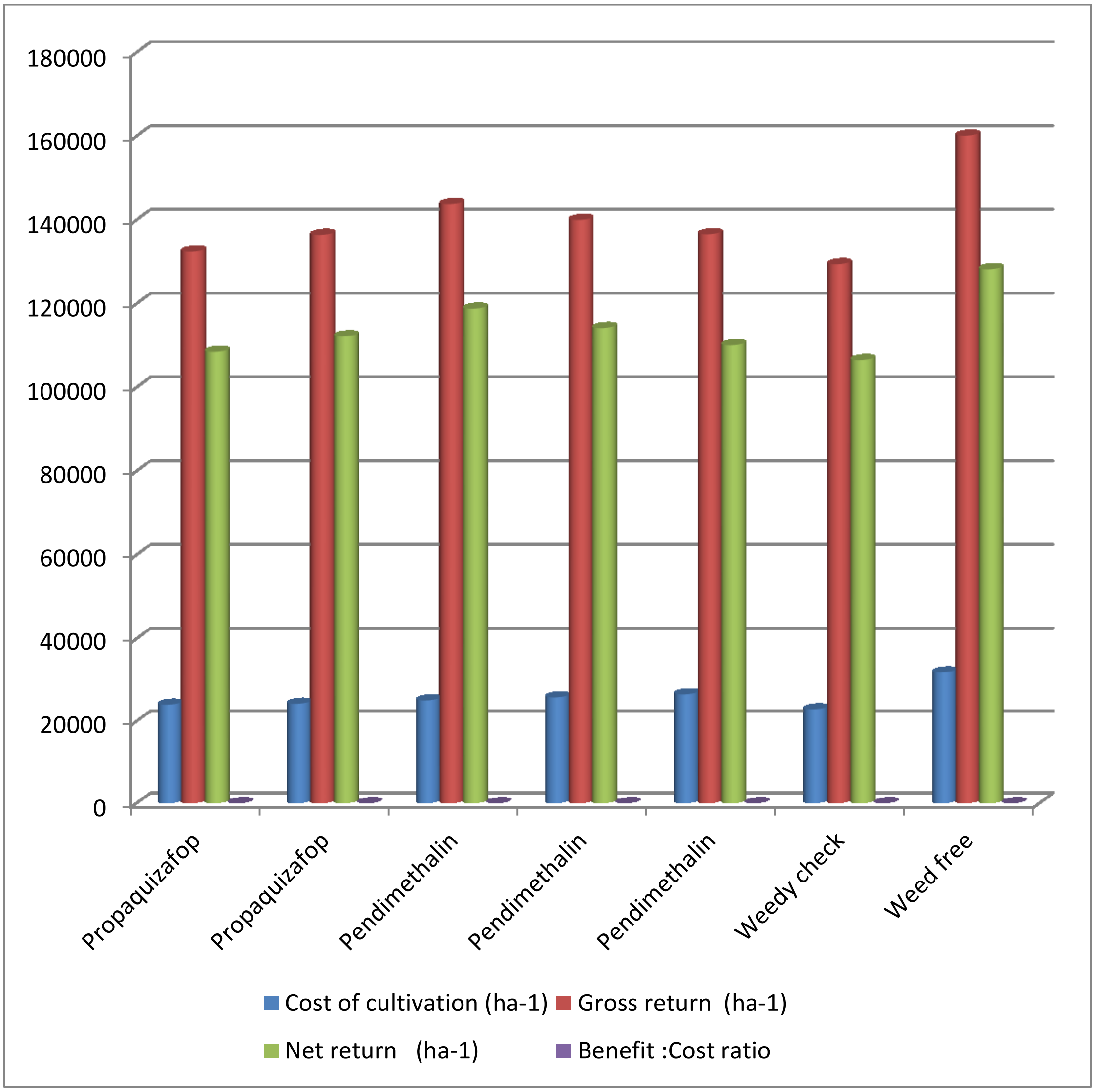


Table 4.17: Cost of cultivation, gross return, net return, and benefit: cost ratio as influenced by different weed control treatment.

Treatment	Rates (a.i./ha) Time of application	Cost of cultivation (ha^{-1})	Gross return (ha^{-1})	Net return (ha^{-1})	Benefit :Cost ratio
Propaquizafop	(POST) 500 ml	23999.50	132484.50	108485.00	4.52
Propaquizafop	(POST) 750 ml	24224.50	136410.00	112185.50	4.63
Pendimethalin	(PRE) 1 l a.i.	25044.50	143818.00	118772.90	4.74
Pendimethalin	PRE) 1.5 l a.i.	25777.00	139957.00	114180.00	4.42
Pendimethalin	PRE) 2 l a.i.	26519.50	136578.00	110058.50	4.15
Weedy check	-	22874.50	129389.00	106514.50	4.65
Weed free	-	31874.50	160066.00	128191.50	4.02

Fig 4.16: Cost of cultivation, gross return, net return, and benefit: cost ratio as influenced by different weed control treatment.



4.5 Economics

Research finding of any experiment may highly be useful from academic point of view but it will not be useful to formers unless these findings are economically feasible from the point of its adoption by beneficiaries. Result of agronomical research will be worthwhile provided technology has sound economic base.

In the present experiment seven treatments were subjected to analysis includes the cost of cultivation, gross return, net return, and B:C ratio for different treatment. The data in respect of economics have been summarized in Table 4.17 and figure 4.17.

4.5.1 Cost of cultivation

The data recorded under different components of cost of cultivation revealed that gross return increased with increasing grain and straw yield of green gram obtained under different treatments.

4.5.2 Gross return (Rs./ha)

Maximum gross return (160066/ha) was recorded with T_7 (weed free treatment). Amongst herbicidal treatment T_3 recorded maximum gross return (143818/ha) and next best treatments T_4 recorded maximum gross return (139957) followed by the T_2 (137091/ha). The lowest gross return was recorded in T_6 (129389/ha)

4.5.3 Net return (`/ha)

Maximum net return (128191.50/ha) was recorded with T_7 (weed free treatment). Amongst herbicidal treatment T_3 recorded maximum net return (118772.90/ha) and next best treatments T_4 recorded maximum net return (114180/ha) followed by the T_2 (112185.50/ha). The lowest net return was recorded in T_6 (106514.50/ha).

DISCUSSION

The experimental findings presented in preceding chapter provide a detailed account on "**Effect of weedicide in mungbean under Guava based agri-horticulture system in Vindhyan Region**" in terms of various quantitative indices, *viz*., plant height, number of branches per plant, number of nodules, s, dry matter accumulation and yield components *viz*., number of pods per plant, pod length, number of grains per pod, 1000-grain weight, grain yield and straw yield, biological yield and harvest index. An attempt has been made to evaluate and explain the salient findings recorded in the present investigation with a view to find out the cause and effect relationship as far as possible and to trace out the information of practical value. The essential aspect of the following discussion would pertain primarily to the type of weeds controlled and seed yield which has great importance in this context. For the case of discussion the effect of agri-horticulture system and weed control treatments on weeds and their subsequent effect on growth and yield are described under the separate heads.

5.1 EFFECT OF WEATHER CONDITIONS ON GROWTH AND YIELD OF CROPS

Results of field investigations are affected by weather conditions. Any discussion of the results would, therefore be not appropriate without taking into consideration the weather relationship with crop to arrive at correct interpretation.

The weather factors viz. rainfall, temperature (minimum and maximum), relative humidity, evaporation and sunshine recorded during crop duration of the present experimentation are given in (Table 3.1) and depicted in (fig.3.1). The variation in weather parameters has pronounced effect on growth and development of crop. For achieving the yield potential every crop has its own cardinal point of air temperature, relative humidity, vapour pressure and sunshine duration. If the fluctuation becomes too wide from optimum, the plants suffer leading to poor growth, development and yield. This effect is more pronounced in crops which are grown in diverse climatic and edaphic conditions.

Every crop requires a set of define environmental condition for its proper growth and development. Mungbean is basically a crop of warm region of the tropics and sub-tropics. It requires fairly hot conditions during growth to produce maximum yield. However, this crop is generally grown as rainy season crop in northern India. Heavy rainfall particularly during the flowering stage is harmful and adversely affects the production. Such crop requires hot and humid climate during growth and development phases. The unusual temperature severely affects germination and plant stand.

The meteorological data (Table 3.1) recorded during the crop season showed that the average temperature remained between 32.9 to 32.0 ^{0} C which was within the optimum range for growth of mungbean. The rainfall received during the investigation was low (104.2 mm) but well distributed and during the maturity phase occurrence of dry weather supported the growth and yield of mungbean.

5.2 EFFECT OF TREATMENTS

In general, all the weed control treatment exhibited profound influence on weeds and consequent effect on crop growth and yield when compared to weedy check treatment (Table 4.11, 4.12, 4.13, 4.14, 4.15 and 4.16). Weed free treatment was superior to obtain maximum height, yield etc. The results obtained are being discussed under the heading of growth attributes, yield attributes, yield, weed growth, and finally the economics.

5.3 STUDIES ON WEEDS

5.3.1 Weed flora

There were 13 important weed spp. belonging to 9 families that were found in the experimental plot. Among the grasses *Cynodon dactylon* was the predominant weed followed by *Echinochloa colona*. Among the sedges *Cyperus rotandus* was the predominant weed while *Trianthema monogyna* was the predominant broad leaved weed followed by *Parthenium hysterophorus* and *Commelina benghalensis*. Similar weed flora in the greengram field has also been reported by Dungarwal *et al.* (2003) and Chattha *et al.* (2009). S.S.Punia *et al*. (2011 and 2012) reported that weed flora in greengram was Twenty-two weed species (5 grassy, 3 sedges and 14 broad-leaved) belonging to12 families Broad-leaved weed *Digera arvensis* (L.) of family *Amarthanceae* was the most dominant and aggressive weed respectively. *Dactyloctenium aegyptium* (L.) was the most dominant grassy weed. Important broad-leaved weeds found in greengram were: *Trianthema portulacastrum, Mollugo distachya*, *Cleome viscosa, Cucumis callosus*, *Corchorus tridens, Corchorus aestuans* and *Tribulus terristeris*, whereas in blackgram *Commelina benghalensis, Physalis minima, Solanum nigrum* and *Chorchorus olitorious*.

5.3.2 Total weed density

The susceptibility and tolerance of different type of seed (crop and weeds) to herbicides depend upon their size, shape, structure, permeability and placement of seed in soil. The weed density under present study (Table 4.10) was significantly reduced with the application of herbicides as compared to weedy check. Amongst herbicides, pendimethalin (2 l a.i. ha^{-1} was most effective herbicidal treatment in reducing density of weeds.

Total weed dry weight (g m^2)

In general total weed dry weight increased progressively up to harvest. Total weed dry weight was significantly influenced by weed management treatments at all the growth stages. Application of pendimethalin (2 l a.i. ha^{-1}) was most effective in minimizing dry matter of weeds, and was significantly superior to other herbicidal treatments at all the growth stages. However, different weed control treatments had significantly less dry matter accumulation by weeds than weedy check, irrespective of treatments at all the stages of observation.

Weed control efficiency (%)

Weed control efficiency denotes the relative efficacy of weed control treatments compared to weedy check. Amongst herbicidal treatments, Application of pendimethalin (2 l a.i. ha^{-1}) recorded highest weed control efficiency which was followed by pendimethalin (1 l a.i. ha^{-1} and 1.5 l a.i. ha^{-1}) However, minimum weed control efficiency was recorded under propaquizafop (75 ml a.i. ha^{-1}) which was followed by propaquizafop (50 ml a.i. ha^{-1}).

Weed index (%)

Weed index is the measure of crop yield reduction due to weed competition in comparison to hand weeding. On an average, weed index was lower under pendimethalin (1 l a.i. ha^{-1}) and next pendimethalin (1.5 l a.i. ha^{-1}) and followed by pendimethalin (2 l a.i. ha^{-1}) it is due to effect on germination of seed of the crop. The treatment propaquizafop (75 ml a.i. ha^{-1}) recorded minimum weed index.

5.4 GROWTH AND GROWTH ATTRIBUTES

The finding of present study indicated that growth attributes of crop such as plant height, number of branches, number of leaves, and dry matter accumulation of mungbean showed marked variation due to weed control treatments (Table 4.12, 4.13 and 4.14). The reduction in weed competition in mungbean by use of herbicides not only favored the crop plants with abundance availability of moisture, nutrients, light and space but also reduced over all weed interference, facilitating vigorous development of crop plants. Among the herbicidal treatments pendimethalin (1 l a.i. ha^{-1}) recorded maximum plant height, number of branches, number of leaves, and dry matter accumulation was followed pendimethalin (1.5 l a.i. ha^{-1} and 2 l a.i. ha^{-1}) compared to other herbicidal treatments. The reason for higher values of growth parameters can be discussed in the light of fact that crop under this treatment had comparatively less weed competition for nutrient, moisture, space and light and consequently resulted more availability of nutrients, moisture and light than other treatments for crop growth. Similar results have also been reported by Singh *et al.*

(2005)., Dhuppar *et al.* (2013) They reported that the treatment, which had minimum total weed dry weight, produced maximum mungbean dry matter accumulation.

5. 5 YIELD ATTRIBUTES

In order to assign possible reason of variation in yield, studies on yield attributes *viz*. Pod length, pod plant^{-1}, number of grain pod^{-1}, 1000 grain weight were made. The cumulative effect of all these characters ultimately led to higher grain and straw yield. All the herbicides significantly increased yield attributes and yield over untreated in the present investigation (Table 4.15) (Dungarwal *et al.*, 2003).

All the herbicidal treatments significantly influenced the yield attributes as compared to weedy check. Pendimethalin (1 l a.i. ha^{-1}) was significantly superior to other herbicidal treatments was followed pendimethalin (1.5 l a.i. ha^{-1} and 2 l a.i. ha^{-1}) and it is also followed by propaquizafop (50 ml a.i. ha^{-1} and 75 ml a.i. ha^{-1}) . In general all the weed control treatments significantly increased the grain yield and its components (grains per pod, pods per plant, pod length, 1000-grain weight), which can be attributed to reduced weed competition for nutrients, moisture, light and space. The result of Raman *et al.* (2005) and Krishnamoorthy (2005), Yadav *et al.* (2013) confirms the above findings.

5.5.1 Yield

Yield is the result of co-ordinated interplay of growth characters viz. number of branch plant^{-1}, number of leaves plant^{-1}, dry matter accumulation per unit area and yield attributes viz. number of pods plant^{-1}, length of pods, number of grains pod^{-1} and test weight (1000 grain weight).Grain and straw yield (Table 4.16) were significantly influenced by different weed control treatments. Pendimethalin (PRE) 1 l a.i. ha^{-1} showed greater efficacy in increasing the grain and straw yield in comparison to other herbicides. This result can be attributed due to marked improvement in dry matter accumulation, yield attributes and better weed control efficiency. The treatments, which had higher yield attributing components and weed control efficiency (Table 4.11), produced higher grain and straw yield. The minimum grain yield was recorded under weedy check which was attributed due to more weed growth, total weed dry weight and poor yield attributing characters. Results are in agreement with the finding of Dungarwal *et al*. (2003).

5.6 ECONOMICS

The adoption of any technology in modern agriculture can only be feasible and acceptable to farmers if it is economically viable. Economic viability is a function of gain and loss. The gross return obtained by yield of crop varied markedly due to different treatments, which ultimately influenced the net return and benefit: cost ratio. The data on economics of various herbicidal treatments revealed that the plot treated with sequential application of Pendimethalin (PRE) 1 l a.i./ha gave the maximum net return of ` 118772.90/ha and benefit: cost ratio of 4.74. This is mainly due to lower production cost and higher grain and straw yield. Rahmat Ullah Khan *et al*. (2006 and 2007) reported similar results.

Chapter VI

SUMMARY AND CONCLUSION

A field experiment entitled "**Effect of weedicide in mungbean under Guava based agri-horticulture system in Vindhyan Region**" was proposed during *kharif* season of 2013-14 at the research farm of Rajiv Gandhi South Campus, Banaras Hindu University, Barkachha, Mirzapur, Uttar Pradesh (India). The experiment was laid out in randomized complete block design (RBD) on leveled land of homogeneous fertility and uniform texture with seventh treatments each treatment replicated three times in keeping agri-horticultural system guava in plot the trial comprised different treatment weed control treatments- T_1 propaquizafop (POST) 50 ml a.i. ha^{-1}, T_2 propaquizafop (POST) 75 ml a.i. ha^{-1}, T_3 Pendimethalin (PRE) 1 l. a.i. ha^{-1}, T_4 pendimethalin (PRE) 1.5 l a.i. ha^{-1}, T_5 pendimethalin (PRE) 2 l a.i. ha^{-1}, T_6 weedy check, T_7 weed free. The treatments were replicated three. The observation on growth and development of crop and weeds were recorded and results are summarized as. Nitrogen, Phosphorus and Potassium were uniformly applied through diammonium phosphate, urea and Muriate of potash at the rate of 30, 60 and 30 kg ha^{-1} respectively. The weed control efficiency of the treatments was measured in terms of weed density and dry matter accumulation. Crop response to the treatments was measured in terms of various quantitative indices. For this purpose crop character like plant height, plant population, dry matter accumulation of shoot and root, trifoliate leaves $plant^{-1}$, leaf, branches $plant^{-1}$, number, seed and Stover yield and yield components viz. number of pods $plant^{-1}$, number of grains pod^{-1}, pod length, and 1000 grain weight and finally comparative economics of various treatments were computed.

The salient findings of investigation presented and discussed in the preceding chapter are briefly summarized here under:

Weed studies

The weed flora observed in the experimental plot consisted of 13 weed species belonging to 9 families. *Cynodon dactylon* (L.), *Cyperus rotandus* (L.) and *Trianthema monogyna* (L.) were the predominant weeds among grasses, sedges and broad leaved weeds respectively.

Grasses, sedges and broad leaved weeds comprised 32.62, 31.81 and 33.55% at 20 DAS and 32.22, 33.11 and 34.65% of total weed population at 40 DAS and at harvest respectively.

All the herbicidal treatments showed significant effect and had minimum weed density as compared to weedy check, which had maximum weed density, weed dry wright. Amongst herbicides, pendimethalin (2 l a.i. ha^{-1}) proved most effective in arresting weeds as compared to other herbicidal treatments. The next best treatment was pendimethalin (1 l a.i. ha^{-1} and 1.5 l a.i. ha^{-1}) in these respects.

Weed control efficiency computed 20, 40 DAS and at harvest on the basis of relative effect of weed control treatments in comparison to weedy check. The maximum weed control efficiency was recorded under the application of pendimethalin 2 l a.i. ha^{-1}.

Weed index is the measure of crop yield reduction due to weed competition in comparison to weed free. Among herbicides the minimum (35) weed index was observed under pendimethalin 2 l a.i. ha^{-1} treated plot. While maximum (48.25) was observed under propaquizafop 50 ml a.i. ha^{-1}.

Crop studies

The growth attributes of mungbean *viz*. plant height, number of branches $plant^{-1}$, number of leaves $plant^{-1}$, crop dry matter accumulation, as well as yield attributes *viz.* number of pods, pod length, number of grains pod^{-1},test weight, grain yield and straw yield were significantly influenced by weed control treatments.

Among herbicides, pendimethalin (1 l a.i. ha^{-1}) recorded maximum growth attributes, yield attributes and yield which was comparable to pendimethalin (1.5 l a.i. ha^{-1} and 2 l a.i. ha^{-1}), but significantly superior over rest of the treatments. However all the herbicidal treatments were found significantly superior over weedy check in respect of crop growth, yield attributes and yield.

ECONOMICS

In weed control treatments, the maximum net return was obtained in treatment (T1) pendimethalin (1 l a.i. ha^{-1}) followed by pendimethalin (1.5 l a.i. ha^{-1}) and propaquizafop (T_2) 75 ml a.i. ha^{-1}. However B:C ratio was obtained maximum in pendimethalin 1 l a.i./ha (T_3), propaquizafop 75 ml a.i./ha (T_2), followed by pendimethalin 2 l a.i/ha (T_4).

CONCLUSION

Application of pendimethalin T_5 (2 l a.i. /ha) was most effective in reducing the weed density their dry weight, minimizing crop weed competition comparison to treatment pendimethalin T4 (1.5 l a.i./ha) and treatment pendimethalin T_3 (1 l a.i./ha) but grain yield, net return and B:C ratio was maximum obtained from treatment pendimethalin T_3 (1 l a.i./ha) and treatment pendimethalin T4 (1.5 l a.i./ha) comparison to treatment pendimethalin T_5 (2 l a.i. /ha).

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Appendix

APPENDIX-I

Appendix I : Growth Parameters of Guava tree species at the time of crop sowing

At the time of crop sowing					
Fruit tree species	**Height (m)**	**Canopy diameter (m)**	**Stem girth (cm)**	**Shading area (m)**	
				Length	**Width**
Guava	4.10	4.35	37.80	3.70	3.32

Appendix II : Growth Parameters of Guava tree species at the time of 40 DAS

At the time of 40 DAS					
Fruit tree species	**Height (m)**	**Canopy diameter (m)**	**Stem girth (cm)**	**Shading area (m)**	
				Length	**Width**
Guava	4.75	4.53	38.20	3.75	3.40

Appendix III : Growth Parameters of Guava tree species at the time of harvest

At the time of harvest					
Fruit tree species	**Height (m)**	**Canopy diameter (m)**	**Stem girth (cm)**	**Shading area (m)**	
				Length	**Width**
Guava	5.00	4.65	38.43	3.82	3.41

APPENDIX-II

Appendix I : Common cost of cultivation for one hectare in Mungbean

Particulars	Input	Rate (`)	Cost (`)
Preparation of land			
Deep ploughing	One tractor (35 HP).	2800 ha^{-1}	2800
Harrowing and planking	One tractor (35HP)	2800 ha^{-1}	2800
Layout	4 man days	225 man $dayss^{-1}$	900
Sowing of crop	8 man days	225 man $dayss^{-1}$	1800
Cost of seed	20 kg	150 kg-^{1}	3000
Fertilizer			
• Urea (30kg N)	13 kg urea	6.5 kg^{-1}	85
• DAP (60 Kg P)	130.50 kg DAP	11 kg^{-1}	1434
• MOP (60 kg K)	50 kg MOP	6.5 kg^{-1}	325
Thinning	8 man days	225 man $dayss^{-1}$	1800
Plant protection measure	1 liter	700 L^{-1}	700
Harvesting and Bunding	15 man days	225 man $dayss^{-1}$	3375
Threshing	10 man days	225 man $dayss^{-1}$	2250
Land Revenue	6 months	10 per annum	60
Interest on working capital	3 months	14% per annum	1545.52
Total fixed cost			22874.50
Cost of (WMP) Weed Management Practices			
Pendimethalin	3.3 Liter	450 $Liter^{-1}$	1495
Pendimethalin	4.95 Liter	450 $Liter^{-1}$	2227.5
Pendimethalin	6.6 Liter	450 $Liter^{-1}$	2970
Propaquizafop	500 ml ha^{-1}	900 $Liter^{-1}$	450
Propaquizafop	750 ml ha^{-1}	900 $Liter^{-1}$	675
Hand weeding	12 man days	225 man $dayss^{-1}$	2700

APPENDIX-III

Appendix I : Cost of treatments and total cost

Treatment	Labor required for weeding/spraying	Cost of treatment (`)	Common cost (`)	Total cost (`)
T_1	3 Labor	1125	22874.50	23999.5
T_2	3 Labor	2350	22874.50	24224.5
T_3	3 Labor	2170	22874.50	25044.5
T_4	3 Labor	2902.5	22874.50	25777
T_5	3 Labor	3645	22874.50	26519.5
T_6	-	-	22874.50	22874.50
T_7	40 Labor	9000	22874.50	31874.5

Appendix II : Total Value of The Produce

Treatment	Value of produce (` ha^{-1})		
	Grain	**Straw**	**Total**
T_1 :Propaquizafop @ 500 ml weedicide ha^{-1}	665.90	1567.61	2233.51
T_2 : Propaquizafop @ 750 ml weedicide ha^{-1}	722.77	1710.93	2433.7
T_3 : Pendimethalin @ 3.3 L weedicide ha^{-1}	861.07	2047.37	2908.44
T_4 : Pendimethalin @ 4.95 L weedicide ha^{-1}	800.20	2000.30	2800.5
T_5 : Pendimethalin @ 6.6 L weedicide ha^{-1}	710.77	1755.27	2466.04
T_6 : Weedy check	544.37	1384.00	1928.37
T_7 : Weed free	1200	2710.37	3910.37