STUDIES ON INTEGRATED WEED MANAGEMENT IN CHILLI (*Capsicum annum* L.)

THESIS

Submitted to the
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
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BY
NEMADE SURESH UTTAM

UNIVERSITY DEPARTMENT OF AGRONOMY,
POST GRADUATE INSTITUTE,

Dr. PANJABRAO DESHMUKH KRISHI VIDYAPEETH
AKOLA (M.S.) INDIA

Enrolment No. I / 355 2003

DECLARATION OF STUDENT

I hereby declare that the experimental work and its interpretation of the thesis entitled **"Studies on integrated weed management in chilli (*Capsicum annum* L.)"** or part thereof has not been submitted for any other degree or diploma of any University, nor the data have been derived from any thesis/publication of any University or scientific organization. The source of materials used and all assistance received during the course of investigation have been duly acknowledged.

Place: Akola
Date: 25/2/2003

(S.U. Nemade)
Enrolment No. I/355

CERTIFICATE

This is to certify that the thesis entitled "**Studies on integrated weed management in chilli (*Capsicum annum* L.)**" submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Agriculture (Agronomy) of the Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafide research work carried out by **Shri. Nemade Suresh Uttam** under my guidance and supervision. The subject of the thesis has been approved by the student's advisory committee. No part of the thesis has been submitted for any other degree or diploma.

Countersigned

25/07/03

Associate Dean,
Post Graduate Institute,
Dr. Panjabrao Deshmukh, Krishi Vidyapeeth,
Akola

(R.N. Satao)
Chairman
Advisory Committee

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External Member (Dr. P. G. Bhoi)		

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LIST OF SYMBOLS / ABBREVIATIONS

@	-	at the rate of
ac.	-	acre/s
a.e.	-	acid equivalent
a.i.	-	active ingredient
Ala.	-	Alachlor
C.D. at 5%	-	Critical difference at 5 per cent
C.F.	-	Cited from
cm	-	Centimetre/s
DAT	-	Days after transplanting of chilli
dm^2	-	square decimatre
E.C.	-	Emulsifiable concentrate
et. al.	-	(*et al*ibi) and associated
etc.	-	Etcetera and so forth and others
Fig.	-	figure/s
Flu.	-	Fluchloralin
g	-	gramme
ha	-	hectare/s
H.W..	-	Hand Weeding
i.e.	-	that is
K	-	potassium
kg.	-	Kilogramme
L	-	litre
lb	-	pound
m	-	metre
m^2	-	square metre
mm	-	millimetre
max	-	maximum
M.W.	-	meteorological week
min.	-	minimum
N	-	Nitrogen
N.B.	-	nota bene(note well)
N.S.	-	not significant
No./no.	-	number/s

List of symbols/abbreviations contd.

P	-	Phosphorus
pic.	-	picking
PPI	-	Pre plant soil incorporation
P.C.	-	per cent
q	-	quintal/s
q ha^{-1}	-	quintal per hectare
R.H.	-	Relative humidity
Rs.	-	Rupees
S.E (m)$\pm$	-	standard error of mean
Sig.	-	significant
SL	-	soluble liquid
Sq.dm.	-	square decimetre
Sq.m.	-	square metre
t	-	tonne
temp.	-	temperature
Tri.	-	trifluralin
UWC	-	unweeded control
Viz.,	-	(videlicent) namely
WCE	-	weed control efficiency
WI	-	weed index
WP	-	wettable powder
WS	-	Wind speed
Wt.	-	Weight
^{0}C	-	degree celcius
/	-	per
%	-	per cent
$\sum$	-	summation
W	-	Hand weeding
&	-	and

CHAPTER I

INTRODUCTION

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CHAPTER I

INTRODUCTION

During the past three decades, India has made commendable progress in the field of vegetable research and development, enabling to secure second position in vegetable production in the world, next to China (Kallo and Pandey, 2002).

The daily per capita consumption of vegetables in India is still very low which in view of existing population works out to be 45 g against a minimum of 400g recommended by National Institute of Nutrition, Hyderabad (Nath, *et al.* 1994). With a view to meet the requirements of increasing population of country and improving the health and income standard of Indian people, it is very essential to increase the production of vegetables.

Among the vegetable crops, chilli (*Capsicum annum* L.) belonging to family Solanaceae is an important vegetable cum spice crop of sub-tropics and tropics. Chilli is actually said to be a native of South America and its cultivation was known to the people of Peru since prehistoric times. The introduction of Chilli into India is said to be due to the Portuguese. Chilli are commercially grown throughout the world, notably, Africa, India, Japan, Mexico, Turkey and USA etc. In India, Andhra Pradesh is the leading state in area and production, Karnataka is second in area while Maharashtra is second in production and third in area. The other states growing Chilli commercially are Orissa, Tamil Nadu, Madhya Pradesh, Rajasthan, Uttar Pradesh and Bihar. However, Chilli are grown practically all over India (Singh and Singh, 1996).

Though chilli is an introduced crop in India, India has the largest area of Chilli in the world, which shares nearly 47.11 per cent of world cultivation (Anonymous, 1992). But our productivity is negligible when compared to other countries (Raju and Luckose, 1991). In India the crop is grown on an area of about 9,15,200 hectares with an annual production of 10,18,000 tonnes of Chilli during the year 1999-2000 (Peter and Nybe, 2002). Maharashtra is one of the major chilli producing states of India. In the year 2000-2001 the total area under this crop in Maharashtra was 1,07624 hectares with an annual production of about 3,16,448 tonnes of Chilli. In Nagpur district alone, it has 23,691 hectares of area which was maximum and it takes the share of 22 per cent in area in comparision to all other districts of the state. But regarding the production Sangli and Kolhapur districts stand first and second in positioh respectively (Anonymous, 2002).

Chilli play a vital role in the Indian economy. It has become an essential item in our diet. It is popularly used in both the forms, fresh green and dry as ingredient in preparation of several spicy dishes, sauces, salads and in number of different preparations of daily diet. Chilli is well known for its flavour, pungency and also form an important source of vitamins. Green Chilli contain lot of vitamin 'C' and a good source of vitamin 'A' and 'B' (Venkateswara,1969). The pungency is due to an alkaloid "Capsaicin" contained in the pericarp and placenta. The Chilli seed contain only trace of pungency with a content of 0.005 per cent. The Capsaicin content in red Chilli varies between 0.7 to 0.9 per cent (Pankar and Magar,1978). It has significant physiological action which is used in many pharmaceutical preparation like linements and ointments for cold, sorethroat, chest congestion etc. It is also used in cosmetics, tonic and stimulatants (Singh and Singh, 1996).

The productivity of Chilli in India is very low compared to western countries, the production could not be achieved to a desired extent to meet the consumption as well as industrial need of country's growing population and quantity for export to earn more foreign exchange. For boosting the Chilli production, number of research workers, scientists, export organizations those engaged in development and export of Chilli have stressed the need to study the various hurdles in Chilli cultivation.

A large number of constraints limit the production of Chilli. Among them weeds constitutes one of the greatest hazard in the successful Chilli cultivation. In Kharif season, weed intensity would be more. Adoption of wider row spacing, slow germination and initial growth, coupled with adequate moisture, frequent rains, use of higher dose of fertilizers and intensive cropping system, leading to heavy infestation of weeds and severe crop-weed competition. The weeds compete with Chilli for water, light, nutrient and space. Apart from this weeds also harbour some of the insect pests and diseases, which further cause drastic reduction in fruit yield (Mariappan and Narayansamy, 1977 and Alegbejo, 1987). Adigun *et al.* (1987) reported, unchecked weed growth throughout the crop life cycle resulted in 86-90 per cent reduction in potential Chilli fruit. In Israel, losses of about 36-56 per cent in pepper fruit yields were reported by Eshel *et al.* (1973) when weeds were allowed to compete with the crop for 30 days after transplanting. In Nigeria, Uwannah (1982) and Falalu (1983) reported 95 per cent and 100 per cent losses in pepper fruit yield due to unchecked weed growth throughout the crop life cycle. So timely and effective weed management practices play an important role in increasing the production of Chilli. To obtain a sustained crop productivity, elimination of crop weed competition is of prime and major importance.

The general practice of hoeing followed by one or two manual weedings is the common practice in India. But, these methods are tedious, expensive and time consuming. Moreover with advancement of monsoon rains, these methods are inefficient and hindered by wet field conditions due to continuous and heavy rains. Thus crop suffers for want of timely removal of weeds. Hence, managing the weeds meticulously in early stage is an imperative task to get better weed control and higher yield through use of herbicides. In areas where labour is scarce and expensive during critical period of crop weed competition, weed management became a great problem. Critical period of crop weed competition is from 30 to 45 days after planting (Singh *et al.*, 1993). During critical stages field becoming inaccessible for weeding due to rains. However, majority of the farmers in India are reluctant to use herbicides mainly due to lack of knowledge regarding the dose, time and method of application and non-availability with prohibitive cost of herbicides.

An alternative measure would be the integrated method of weed management which offers a practically effective and economic means of reducing weed competition at right time and right method to obtain higher yield. It is observed that the herbicides when used in combination with mechanical weed control are more effective. Pre-emergence herbicides are useful to keep the crop free from weed in the early stage. During later stages mechanical weeding helps to reduce the cost of weeding and to keep the weed population below the economic threshold level throughout the crop growth period. Sharma *et al.* (1991) observed significantly higher bell pepper yield with fluchloralin at 0.48 Kg a.i. ha^{-1} coupled with hoeing 25 days after transplanting compared to the control. Pre-plant application of Alachlor at 2 L a.i. ha^{-1} + one hand weeding was the most effective weed control treatment in chilli crop (Bhalla and Nakhtore, 1980).

Sharma *et al.* (1988) reported, highest net returns of Rs. 13,000 ha^{-1} as recorded when fluchloralin was applied @ 0.48 Kg a.i. ha^{-1} in combination with one hoeing. At Coimbatore, Pre- plant applied of Basalin @ 1.0 Kg a.i. ha^{-1} + one hand weeding was highly remunerative which recorded the higher cost:benefit ratio of 1:4.58 (Anonymous, 2001a).

Among the four regions of Maharashtra, Vidarbha grows Chilli in more than 42 per cent area of state but the productivity of dry Chilli in Vidarbha (4.66 q ha^{-1}) is very low as compared to productivity of Maharashtra (5.35 q ha^{-1}) and also country's productivity (7.53 q ha^{-1}) More *et al.*, 1996. Disparity in productivity of Chilli in Vidarbha is mainly attributed to the lack of appropriate production technologies. Weeds are considered to be one of the major production constraints. In Chilli, information on weed management in Chilli is limited and no work has been done on weed management in Chilli crop perticularly in newly released variety "Jayanti" (AKC 86-39). Hence, a project with different weed control methods was undertaken so as to get best and an economical method to overcome the problem of weed management in Chilli crop.

The above literature indicated, integrated approach is the most effective as well as economical , to control weeds in Chilli than the single use of either herbicides or cultural methods. In view of this background the project "Studies on integrated weed management in Chilli (*Capsicum annum L.*)" was planned and carried out with the following objectives.

1. To screen out the best herbicide: for minimising the weed menace in Chilli
2. To evaluate the effect of herbicides separately and in combination with mechanical method
3. To study the effect of weed control, on growth and yield of Chilli
4. To study the economics of weed control in Chilli

CHAPTER II

REVIEW OF LITERATURE

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CHAPTER II

REVIEW OF LITERATURE

Indian economy is primarily an agrarian one. Agricultural production depends on various factors and any set-back in these factors severely affect the yield of crops. Among all the pests (insects, animals, diseases and weeds) in India, weeds alone are responsible for one-third loss in crop production. In India, till seventies, manual and mechanical removal of weeds was one of the best options available with the farmers to manage weeds in their fields but with increase in labour cost and advent of herbicides, its use started to get the preference over manual weeding and now good amount of herbicides are being produced and utilized in India (Bhan and Sushil Kumar, 1998).

At present, the weed menace is tackeld by various cultural, mechanical, chemical and integrated methods with different degrees of success.

In this chapter, an attempt is made to compile technical information on the use of herbicides to control weeds in chilli, in addition to the conventional methods of weed control. The work done in the past has been reviewed and presented under the following heads.

1. Losses caused by weeds
2. Critical period of crop-weed competition in chilli
3. Weed flora associated with chilli
4. Methods of weed control and their effect on growth and yield of chilli

I. Cultural method of weed control

II. Chemical method of weed control

a. Trifluralin

b. Fluchloralin

c. Alachlor

III. Integrated method of weed control

5. Effect of weeds on nutrient uptake

6. Weed control efficiency

7. Economics of weed control

2.1 Losses caused by weeds

According to Klingmen (1961) the reduction in fruit yield was occur as a result of competition between the crop and weed for nutrients, water, space and light.

In the USA, a complete loss in fruit yield was reported in seeded pepper when weeds competed with the crop throughout its life cycle (Taylorson, 1965). In Israel, Losses about 36 to 56 per cent in pepper fruit yields were reported by Eshel and Katan (1972), when weeds were allowed to compete with the crop for 30 days after transplanting.

Mendt (1979) reported 35 per cent reduction in bell pepper yields from only four number of cocklebur (*Xanthium strumarium* L.) weeds per 15 m of row.

Bhalla (1980) reported the losses in yield of rainfed Chilli due to weeds were to an extent of 60 to 70 per cent. In Nigeria, Uwannah (1982) and Falalu (1983) reported 95 per cent and 100 per cent losses in pepper fruit yield due to unchecked weed growth throughout the crop life cycle.

Labrada and Paredes (1983) observed weed growth from 20 to 40 days after transplanting of Chilli and reported reduced fruit yield upto 7.2 t ha^{-1} and after 40 days it was negligible. Tei (1986) noted in pepper weed competition decreased Leaf area index, dry weight and fruit dry weight. Yield reductions were mainly due to a decrease in the number of fruits per plant. Adigun *et al.* (1987) found that unchecked weed growth throughout the crop life cycle resulted in 86 to 90 per cent reduction in pepper fruit yield potential.

Frank *et al.* (1988) observed that when weeds covered 72 to 94 per cent of plots, foliage damage due to insects was from 5.8 to 12.1 per cent. As the weed cover increases, the pepper fruit yield was reduced, at high per cent weed cover the insects reduced yield up to 99 per cent.

Due to crop - weed competition, the number of fruits per Chilli plant, seed numbers per fruit and fruit weight decreased in weedy check plots (Sharma *et al.*, 1988).

Season long competition by weeds caused severe yield reduction ranging from 40 to 90 per cent in Chilli fruits (Lankroo *et al.*, 1990).

Sweet pepper (*Capsicum annum*) growth was severely affected by *Datura stramonium* after 30 to 40 days competition (Medina and Zaragoza, 1992). Schroeder (1992) reported, the extent of Chilli yield reduction differed with the type and number of weeds *Physalis wrightii* and *Amaranthus blitoides* reduced Chilli yield by 33 per cent, *Flaveria trinervia* by 19 per cent and *Physalis wrightii*, *Amaranthus palmeri*, *Chenopodium album* by 61 to 76 per cent in untreated plots.

Torner and Gonzalezandujar, (1993) concluded, presence of one black night shade (*Solanum nigrum*) weed with every 50 cm in the crop rows of transplanted pepper resulted in yield loss of 48 per cent. Gonzalez *et al.* (1995) reported, pepper fruit yield was reduced, whenever, *Solanum nigrum* weed reached a greater height than the crop plants.

Ajay Kumar *et al.* (1995) observed, the largest population of weeds in weedy check produced the maximum dry weight of weeds and thus removed highest amount of nitrogen, phosphorus and potassium from soil.

At Kanpur, field studies revealed, weedy crop throughout season caused 75 to 86 per cent reduction in dry pod yield of Chilli (Anonymous, 1997 b). Josep *et al.* (1997) reported, purple nutsedge densities up to 200 plants m^{-2} linearly reduced shoot dry weight of bell pepper at flowering and fruit yield about 32 per cent.

Pyon *et al.* (1999) concluded, the pepper yield was greatly reduced by 62.8 per cent in the weedy check as compared to weed free plot. Season long crop-weed competition reduced the average dry fruit yield by 91.9 per cent (Ved Prakash *et al.*, 1999).

Anonymous (2001a) summarized the findings of the experiment conducted at Almora, Coimbtore and reported, the 60.53 per cent losses in Chilli fruit yield due to unchecked weed growth throughout the crop life cycle. Heighest population of weeds in weedy check plot caused 75.08 per cent yield reduction in Chilli fruits (Anonymous, 2001b).

2.2 Critical period of crop-weed competition

The critical period of weed competition is the period of time during which weeds must be controlled to prevent substantial yield losses.

Palletier and Coilier (1969) stated, peppers were very susceptible to weed competition.

Bhalla (1980) reported, in general the critical period of crop-weed competition lies between 4 to 8 weeks after transplanting for most of the vegetable crops.

In field trial, highest pepper fruit yields were obtained when the crop was weeded during the first 70 days. Weed growth from 20 to 40 days reduced fruit yield upto 7.2 t ha^{-1} and after 40 days it was negligible (Labrada and Paredes, 1983). Tei (1986) observed, the critical period of *Echinochloa crusgalli* competition in peppers was from 25 to 35 days after transplanting.

Frank *et al.* (1988) opined, the weed interference period is approximately 40 to 60 days after transplanting, if crop was not weeded during that period, reduce the pepper fruit number and weight drastically. Crop-weed competition was maximum during this period. Lagoke *et al.* (1988) found, the critical period of weed interference in *Capsicum frutescens* was 3 to 9 weeks after transplanting.

Singh *et al.* (1993) reported in Chilli, the most critical period for crop-weed competition was from 30 to 45 days after transplanting and weed must be removed during this period.

Anonymous (1997 a) summarized the findings of the experiment conducted in Chandrashekhar Azad Univ. of Agri. and Tech., Kanpur and reported, a weed-free period of 60 days after transplanting was required for obtaining optimum yield of Chilli crop. A field experiment was conducted at

MAU, Parbhani and it was noted that the Crop-weed competition lies in between 20 to 60 days from transplanting (Anonymous, 1997 b) in chilli.

Pyon *et al.* (1999) concluded, the critical period of weed competition in red pepper was between 2 and 6 weeks after transplanting.

In the fields studies conducted in Spain, Suso *et al.* (1999) observed that sweet pepper especially those direct drilled, were very sensitive to weed interference, showed long critical periods of competition 3 months, particularly for peppers.

2.3 Weed Flora associated with Chilli

Weed species are vary with the season and type of cultivation. Persistance of weeds in a location is largely influenced by climatic, edaphic and biotic factors which affect their occurance, abundance, range and distribution. To evolve a satisfactory weed management strategy, identification and understanding of weeds associated with Chilli crop is a pre-requisite.

Ashley and Rahn (1966) reported , in Chilli dominant weed species were *Digitaria Sanguinalis, Amaranthus retroflexus. Panicum dichotomiflorum* and *Ambrosia artemisifolia*. Magnifico (1973) reported, dominant weeds were *Amaranthus retroflexus, Portulaca oleracea, Digitaria sanguinalis, Echinochloa crus-galli* and *Setaria viridis*.

In Panjab, *Cyperus rotundus* L., *Tribulus terrestris* Linn., *Celosia argentea* L., *Digera arvensis* Forsk., *Digitaria Sangainalis* L., *Eragrostis* spp., *Eleusine aegyptium* and *Eleusine indica* L., were observed in Chilli field (Saimbhi and Randhawa, 1976). Weeds associated with Chilli crop in Tamil Nadu were

Trianthema portulacastrum, Gynandropsis phentophylla L. *Cynodon dactylon, Cyperus rotundus* (Rajagopal *et al.*,1976).

Bhalla and Nakhtore (1980) observed seventeen weed species, observed out of that *Cynodon dactylon* (L), *Eleusine indica* L., *Cyperus rotundus* L., *Lagasca mollis* cav., *Sonchus arvensis* L., *Xanthium strumarium* L., *Tridex procumbens* L., *Euphorbia hirta* L., *Euphorbia geniculata* L., *Solanum nigrum* L., and *Daucus carota* L., were pre-dominating ones.

According to Labrada and Paredes (1983), the important weed flora in Cuba was *Aeschynome americana, Parthenium hysterophorus, Argemona maxicana, Ipomoea* sp., *Phyllanthus amarus, Sonchus oleraceus, Oxalis* Sp., *Eleusine indica, Echinochloa colonum* , *Rottboellia exallata, Brachiara extensa, Cyperus rotundus, Cynodon dactylon, Sorghum halepense, Amaranthus dubius* and *Portulaca oleracea*. Bullock *et al.* (1984) observed, *Digitaria sanguinalis* (L.) scop, *Panicum dichotomiflorum* Michx., *Eleusine indica* (L.) Guertn, *Amaranthus retroflexus* L. and *Galinosoga* spp. in transplanted pepper plots.

Sharma *et al.* (1988) reported, *Cyperus rotundus* L., *Cynodon dactylon* (L.) pers., *Commelina nudiflora* L., *Digitaria sanguinalis* (L.) scop, *Echinochloa colonum* (L) Link., *Setaria glauca, Eleusine indica* (L.) Gaertn., *Chenopodium album* L. and *Ageratum conyzoides* L., were associated with chilli. Dangol *et al.* (1989) observed, *Digitaria* sp., *Amaranthus viridis* L., *Eleusine indica* (L) Gaertn., and *Cynodon dactylon* (L.) pers.

Amaranthus retroflexus, Chenopodium album, Portulaca oleracea, Solanum nigrum, Echinochloa crus-galli and *Setaria* Sp. were the dominant weed species infesting chilli crop, found in Bulgaria (Georgieva, 1989). The predominant weed species observed in capsicum plots by Masiunas (1989) were *Digitaria* spp., *Panicum dichotoniflorum*, *Eleusine indica* (L.) *Gaertn.*, *Chenopodium album* L., *Amaranthus* spp. and *Portulaca oleracea*.

Singh *et al.* (1991) observed, the most problematic weeds were *Digitaria sanguinalis*, *Echinochloa colonum*, *Echinochloa crus-galli* and *Setaria glauca* in chilli field.

Datura stramonium L. (Medina and Zaragoza, 1992). *Physalis wrightii* and *Amaranthus blitoides* were the common weeds observed in chilli field (Schroeder, 1992). Hosmani (1993) found, the most predominant weed species in chilli fields were *Cynodon dactylon* (L) Pers., *Cyperus rotundus* L., *Convolvulus arvensis* L., *Digitaria maginata* Link., *Dactyloctenium aegyptium* Beauv., *Dinebra retroflexa* (Vahl) panz., *Panicum isachne* Roth., *Commelina benghalensis* L., *Cynotis* spp., *phyllanthus niruri* Linn., *Sida* spp., *Celosia argentia* L., *Acanthospermum hispidum* DC., *Tranthema portulacastrum* L., *Ageratum conyzoides* L., *Cuscutta* spp. and *Orobanche* spp.

At Haryana, Ajay Kumar and Thakral (1993) observed that the weed species infested in the chilli field were *Trianthema portulacastrum*, *Tribulus terrestris*, *Convolvulus arvensis*, *Chenopodium album*, *Chenopodium murale* and *Melilotus indica* among dicots and *Echinochloa crusgalli*, *Sporobolus diander* and *Cyperus rotundus* among the monocots. Rajender Singh *et al.* (1993) found, in *Capsicum annum*, the most problematic weeds were *Amaranthus viridis*, *Trianthema portulacastrum*, *Digitaria adscendens* and *Dactyloctenium aegyptium*.

Lanini and Strange (1994) observed, *Echinochloa crus-galli* (L.) Beauv., *Amaranthus retroflexus* L., *Chenopodium album* L., *Portulaca oleracea* L. and *Solanum nigrum* L., were the dominant weeds in bell pepper fields.

In Hungary, the pepper field was infested with *Echinochloa crus-galli, Setaria, Digitaria, Panicum, Amaranthus, Chenopodium, Ambrosia elatior, Datura Stramonium, Mercurialis annua, Solanum nigrum, Hibiscus trionum, Convolvulus arvensis, Agropyron repens* and *Cirsium arvense* (Reisinger, 1996).

At Akola location, Irfan Raza (1998) observed, in chilli field *Cynodon dactylon, Cyperus rotundus, Dinebra retroflexa, Partherium hysterophorus, Anagalis arvensis, Lagasca mollis, Chenopodium album* and *Digera arvensis* were prominent weeds.

Biradar (1999) noticed, during Kharif season, *Cynodon dactylon* pers., *Cyperus rotundus* L., *Dinebra retroflexa* panz., *Echinochloa crus-galli, Setaria italica, Commelina benghalensis* L., *Amaranthus viridis* L., *Convolvulus arvensis, Digera arvensis, Euphorbia* spp., *Parthenium hysterophorus, Phyllanthus nirurii, Portulaca oleracea* and *Tridax procumbens* were predominant weeds at Dharwad (Karnataka).

Ved Prakash *et al.* (1999) reported, in chilli field *Echinochloa colonum* (L.) Link., *Brachiaria ramosa* (L.), *Eleusine indica, Setaria glauca, Digitaria sanguinalis* (L.), *Panicum* spp., *Commelina benghalensis* (L.), *Cyperus rotundus* (L) and *Setaria glauca* were more predominant.

2.4 Methods of weed control and their effect on growth and yield of chilli

2.4.1 Cultural method of weed control

The cultural method of weeding is most common method of weed control. Although herbicides are fast replacing the traditional methods, cultural methods are still practiced in India. Cultural methods include tillage, hoeing, hand weeding, digging, burning and flooding.

Labrada and Paredes (1983) found, unweeded and hand weeded fruit yields were 0.28 and 7.38 t ha^{-1} respectively. Rangaswami (1984) concluded, tractor ploughing followed by harrowing reduced weed weight (44.00 g $plot^{-1}$), increased root weight (11.98 g $plot^{-1}$) and yield (11.10 q ha^{-1}) of chilli, as compared to no tillage (9.0 q ha^{-1}).

Adigun *et al.* (1987) found, hoe-weeded thrice at 3, 6 and 9 weeks after transplanting recorded the highest pepper fruit yield (9.14 t ha^{-1}) followed by hoe-weeded twice at 3 and 6 weeks after transplanting (8.49 t ha^{-1}). Narayana Rao (1988) stated that dry matter production, yield and yield components of chilli crop were significantly improved by two hand weedings, resulting in maximum green pod yield (170.65 q ha^{-1}), an increase of 81.45 per cent over unweeded control.

Georgieva (1989) observed, three hand weedings during the growth period of chilli was found to be best for controlling most of weed species. Lanini and Strange (1994) reported, weed cover in hand weeding at 2, 4, 6 and 8 weeks after transplanting was significantly lower and produced highest green chilli yield.

Irfan Raza (1998) concluded, among the weed control treatments weed free (cultural method) resulted in highest yield of chilli and gave more additional profit. Narasalagi (1999) reported, the lowest weed dry weight, highest weed control efficiency and fruit yield were noticed in weed free check (3 hoeings + 3 weedings).

Yadav *et al.* (2000) concluded, in chilli nursery, highest weed control efficiency (100%) and maximum dry weight per 20 chilli plant was obtained in conventional method of two hand weedings. In the trial conducted at Coimbatore, revealed that weed free treatment recorded significantly higher chilli fruit yield (22.85 q ha^{-1}) and weed control efficiency (Anonymous, 2001a).

2.4.2 Chemical method of weed control

Employing herbicides for weed control constitutes chemical method of weed control. Use of chemicals as weed control became an effective method in recent years.

Brief review is presented in the following pages under three group of chemicals Viz., Trifluralin, Fluchloralin and Alachlor.

2.4.2.1 Trifluralin

Trifluralin is a selective, belonging to dinitroanilines group of herbicide. Orsenigo and Ozaki (1962) found, trifluralin applied to peppers four days after sowing, retarted the emergence of peppers, but did not significantly affect the number of plants. It was also reported, trifluralin was the most effective against broad leaf weeds. Ashley and Rahn (1966) concluded, in peppers (Chilli) trifluralin 1.12 Kg a.i. ha^{-1} incorporated pre-planting gave season long control of broad leaved weeds and also annual grasses.

Treflan at the rate of 1.5 and 0.5 Kg a.i. ha^{-1} of the commercial product both controlled a wide range of species without injury to crop species (Gosen and Vincenzoni, 1969).

Lange (1969) found that lowest rate of trifluralin 1.12 Kg a.i. ha^{-1} showed good crop tolerance but failed to control Puncture vine and Rassian thistle. However, Trifluralin at 1.2 Kg a.i. ha^{-1} ensured satisfactory control over the weeds (Palletier and Coilier, 1969).

In peppers trifluralin at 0.9 to 1.3 Kg a.i. ha^{-1} was safe when applied before or very close to the time of transplanting and resulted in excellent weed control throughout the season and also gave good crop yields (ELal *et al.*, 1970). Whiting *et al.* (1970) reported, trifluralin at 2.24 Kg a.i. ha^{-1} gave excellent control of both broad and narrow leaf weeds.

According to Ignatov (1972) treflan @ 3 Kg ha^{-1} was applied in capsicum gave the best weed control without causing crop injury. Trifluralin at 2 L a.i. ha^{-1} of commercial product was more effective alone than mixed with Fenam, chlornidine at 8 L ha^{-1} (Magnifico, 1973). Hammerton (1974) stated, in transplanted peppers, trifluralin at 1 Kg a.i. ha^{-1} incorporated pre-planting gave excellent weed control for 6 weeks without damaging the crop.

Pre-planting application of trifluralin at 0.67 L a.i. ha^{-1} gave 95.2 per cent control of weed flora followed by mechanical weeding (Pimpini, 1974). In trials on an alluvial soil, trifluralin at 0.8 to 1.2 Kg a.i. ha^{-1} was applied 10 days before transplanting peppers. Control of weeds (mostly broad leaved) ranged from 78 per cent for the high rate of trifluralin (Kostov, 1975). Jaruzelski and Zdziechowski (1976) stated, Treflan EC2 (Trifluralin 60 per cent) was incorporated into light soil at 3 litres (product) per hectare 14 days before or just before transplanting proved to be the best weed control and highest fruit yield. Filippov and Inshakova (1979) revealed, good weed control was obtained with pre-planting applications of treflan (Trifluralin) at 0.9 to 1.5 Kg a.i. ha^{-1} in both capsicum and egg plant.

Pre-emergence incorporated trifluralin at 0.48-0.96 Kg a.i. ha^{-1} to a depth of 3-5 cm in soil gave excellent results in controlling weeds (Labrada and Paredes, 1979).

According to Metwally *et al.* (1979) trifluralin at 2.38 L a.i. ha^{-1} proved effective in controlling broad leaved weeds in chilli crop. The optimum rate of trifluralin for application to transplanted capsicum was 4 L a.i. ha^{-1}, it slightly decreased seedling survival, decreased weed population by 80 to 87 per cent and increased the yield by 4.23 t ha^{-1} (Varopai, 1981).

Bullock *et al.* (1984) reported, trifluralin incorporated pre-planting at the rate of 1.12 Kg a.i. ha^{-1} controlled *Digitaria sanguinalis, Panicum dichotomiflorum, Eleusine indica, Amaranthus retroflexus* and *Galinsoga ciliata* effectively in transplanting peppers.

Stoian *et al.* (1984) reported, trifluralin at 4 L ha^{-1} soil incorporated before planting gave the best weed control and yielded 30.3 t ha^{-1} compared with 17.5 t ha^{-1} in the non treated control. Beste (1985) found, application of 0.56 Kg trifluralin ha^{-1} gave 100 per cent grass control and was the only treatment to control *Ipomoea hederacea*.

Trifluralin 1.12 Kg a.i. ha^{-1} was the best herbicide for the chilli crop (Mattson, 1985). Georgieva (1987) concluded, highest yield obtained with the combination 0.96 Kg a.i. trifluralin and 0.36 Kg a.i. oxyfluorfen ha^{-1} applied pre-planting of chilli.

Weston and Jones (1990) found, Trifluralin (Treflan) at 1.1 Kg a.i. ha^{-1} incorporated pre-planting and followed by napropamide at 1.1 Kg a.i. resulted in upto 90 per cent higher yield than those obtained on uncultivated control.

Irfan Raza (1998) reported, weed free treatment resulted in highest yield ha^{-1} followed by treatment in which trifluralin @ 1.0 Kg a.i. ha^{-1} was applied at the time of transplanting. Trifluralin application before transplanting @ 0.6 to 1.1 a.i. Kg ha^{-1} was helpful in controlling annual weeds (Chadha, 2001).

2.4.2.2 Fluchloralin

Fluchloralin is a selective type of herbicide, belonging to dinitroanilines group of herbicides same as trifluralin. It used as pre-plant incorporated herbicide due to its high volatility.

Fluchloralin was safe on transplanted peppers but required to be used with other herbicides such as butralin, profluralin and dinitramine to provide adequate control throughout the growing season (Monaco, 1975).

Samdyan and Banerjee (1979) reported, fluchloralin (1.25 Kg a.i. ha^{-1}) applied before transplanting was the most effective herbicide for controlling weeds. Singh and Singh (1980) found, fluchloralin @ 1.5 Kg a.i. ha^{-1} resulted in higher onion bulbs yield and was at par with weed free plot. Khurana *et al.* (1985) stated, application of fluchloralin @ 1 Kg a.i. ha^{-1} to onions gave excellent control of broad leaved weeds.

Singh *et al.* (1985) reported, fluchloralin 1.25 Kg a.i. ha^{-1} gave most effective control of weeds and increased the growth and yield of Chilli.

Narayana Rao (1988) stated that maximum net profit of Rs. 14536 per hectare was obtained with hand weeding twice followed by pre-planting application of fluchloralin @ 1.25 Kg ha^{-1} (Rs. 10,024 ha^{-1})

Lankroo *et al.* (1990) concluded, Basalin was the best herbicide among the other herbicides tested in capsicum.

Fluchloralin @ 1.0 Kg ha^{-1} resulted in increased onion yield than untreated control (Porwal and Singh, 1993). Pre-plant incorporated Fluchloralin at 1.0 Kg ha^{-1} just before transplanting the crop, caused significant reduction in weed dry weight and higher yield was obtained as compared to weedy check (Rajender Singh *et al.*, 1993).

2.4.2.3 Alachlor

Alachlor is a selective, amides type of herbicide. According to Burgis (1972) alachlor at 2.24 Kg ha^{-1} applied after transplanting, gave the highest yield in transplanted peppers. Application of alachlor at 2.24- 4.48 Kg ha^{-1} gave good weed control and was tolerated by transplanted peppers (Ogle, 1972).

In a trial capsicums, alachlor was applied one day before transplanting, either alone or preceded by EPTC at 3.75 Kg ha^{-1}, soil incorporated 10 DBT, the best control of weeds, including *Cyperus rotundus* was obtained with alachlor at 2.5 Kg ha^{-1} preceded by EPTC (Saimbhi and Randhawa, 1976). Sweet *et al.* (1980) found, capsicums were tolerant to alachlor at about 1.12 Kg ha^{-1} was very effective when weeds were just emerging.

Bagley and Beste (1982) observed, alachlor at 1.12 Kg ha^{-1} + trifluralin at 0.56 Kg ha^{-1} + pebulate at 3.36 Kg ha^{-1} gave the highest pepper yield.

O'sullivan (1983) reported, in transplanted peppers night shade control in the range of 86 to 94 per cent was obtained with pre-emergence application of alachlor at 1.5 Kg a.i. ha^{-1} and also no crop injury was recorded with this treatment on peppers. Bullock *et al.* (1984) reported, alachlor incorporated pre-planting at the rate of 2.24 Kg a.i. ha^{-1} controlled *Digitaria sanguinalis, Panicum dichotomiflorum, Eleusine indica, Amaranthus retroflexus* and *Galinsoga ciliata* effectively in transplanted peppers.

According to Beste (1985) grass control was better with alachlor in transplanted bell peppers. In field trial at Bogor, Indonesia, plots handweeded or treated with alachlor gave higher yield of red peppers than unweeded control, alachlor effectively suppressed grasses, sedges and broad leaved weeds (Sutater *et al.*, 1987).

Good control of annual weeds was obtained in peppers with 1.6 Kg a.i. ha^{-1} alachlor (Cavero *et al.*, 1990). Joshi *et al.* (1995) concluded, pre-emergence application of alachlor at 1.25 to 2.5 Kg a.i. ha^{-1} significantly reduced weed count and dry matter and gave better control than the post-emergence application of alachlor.

2.4.3 Integrated method of weed control

Integrated weed management means combination of two or more than two weed control methods can be used to achieve effective and economic weed control with least hazard or pollution to environment.

Rajagopal *et al.* (1976) reported, pre-emergence application of alachlor @ 1.5 Kg a.i. ha^{-1} plus one hand weeding on 30 DAT recorded numerically higher fruit yield of pepper.

Bhalla (1980) reported, pre-emergence application of alachlor 50EC @ 2 L a.i. ha^{-1} or pre-plant incorporation of trifluralin 25 per cent @ 4 L ha^{-1} each followed by one hand weeding was more effective to control a broad spectrum of weeds and gave maximum yield of Chilli.

Bhalla and Nakhtore (1980) noticed that pre-plant application of alachlor at 2 L a.i. ha^{-1} + one hand weeding at 60 DAT was the most effective weed control treatment in chilli crop. This treatment increased the yield by 5.17 per cent over the conventional method (3 weeding). The trial conducted at Himachal Pradesh Sharma *et al.* (1988) concluded, fluchloralin at 0.48 and 0.9 Kg a.i. ha^{-1} both with one hoeing 25 DAT recorded higher weed control efficiency and pepper fruit yield.

Lankroo *et al.* (1990) reported, fluchloralin at 0.48 Kg a.i. ha^{-1} applied 5 days after transplanting followed by one hoeing 25 DAT proved the best treatment in terms of weed control and crop yield of bell pepper.

Singh and Tripathi (1990) revealed, pre-plant incorporation of fluchloralin @ 1.0 Kg a.i. ha^{-1} + one manual weeding at 45 DAT were decreased the weed population and dry weight of weed and also gave the highest fruit yield of chilli (41.7 q ha^{-1}).

Singh *et al.* (1991) reported, pre-emergence fluchloralin at 1.0 to 1.5 Kg a.i. ha^{-1} with one hand weeding 30 DAT increased the crop yield and control the weed effectively. In chilli, the pre-transplant application 2 days before either of pendimethalin 1 Kg a.i. ha^{-1} or Fluchloralin 1.0 Kg a.i. ha^{-1} supplemented with hand weeding at 45 DAT is the best substitute to a traditional practice of weed management of 3 hand weedings and 3 hoeings (Anonymous , 1997 b).

The experiment conducted at UAS, Dharwad found that pre-emergence application of alachlor @ 2 Kg ha^{-1} + 2 intercultural recorded higher green chilli yield (Anonymous, 1998).

Biradar (1999) found, significantly higher dry chilli fruit yield was noticed in weed free check which was on par with alachlor @ 2 Kg ha^{-1} combination with intercultivation at 40 and 60 DAT + hand weeding at 45 and 75 DAT.

Ved Prakash *et al.* (1999) reported, alachlor at 3.0 Kg ha^{-1} combined with hand weeding at 45 DAT registered the highest fruit yield per plant which, however, was at par with alachlor (2 Kg ha^{-1}), fluchloralin (1.0 Kg ha^{-1}) or fluchloralin (2.0 Kg ha^{-1}) each followed by a hand weeding at 45 DAT.

At Coimbatore, the weed free treatment recorded significantly higher yield (22.85 q ha^{-1}) which was at par with Basalin 1.0 Kg ha^{-1} + one hand weeding and Basalin 2.0 Kg ha^{-1} + one hand weeding at 45 DAP (Anonymous, 2001 a). Anonymous (2001 b) stated, the highest chilli fruit yield (45.68 q ha^{-1}) was noticed in preplant soil incorporation of trifluralin @ 1 Kg ha^{-1} with one hand weeding at 45 DAT.

2.5 Effect of weeds on nutrient uptake

Yaroslaskaya *et al.* (1970) noticed, weeds deplete enormous amount of plant nutrients from the soil, pre-plant application of trifluralin @ 4.00 Kg ha^{-1} increased organic matter content in soil.

Rao and Agarwal (1984) reported, the weeds in general accumulated greater nutrients particularly nitrogen and potassium when compared to crop plants. Under competitive situation the weeds with greater ability dominate over others in respect of quantum of resources utilized including the available nutrients.

Vijay Kumar *et al.* (1992) found, the N, P and K uptake by weeds was directly proportional to the dry matter accumulation of weeds at harvest. The highest amount of N, P and K was removed by the weeds in the weedy check plots.

Ajay Kumar *et al.* (1995) stated, the largest population of weeds in weedy check produced the maximum dry weight of weeds and thus removed highest amount of nitrogen, phosphorus and potassium from the soil. Pendimethalin at 1.25 Kg ha^{-1} with or without hoeing recorded significantly lower dry weight, nutrient uptake by the weeds and resulted in highest chilli yields.

Biradar (1999) reported, all the weed control treatments recorded significantly higher nutrient uptake by the chilli crop and lower nutrient uptake by weeds, while unweeded check recorded the highest nutrient uptake by weedsand the lowest by crop.

2.6 Weed control efficiency

Bhalla and Nakhtore (1980) reported, maximum weed control efficiency (92 per cent) was found in alachlor 2 L ha^{-1} + one hand weeding. Mishra *et al.* (1986) found, fluchloralin @ 1.0 Kg ha^{-1} as pre-plant soil incorporation was very effective in reducing dry weight of weeds m^{-2} and resulted in highest weed control efficiency and yield. Singh and Tripathi (1990) stated, pre-plant incorporation of fluchloralin @ 1.0 Kg ha^{-1} + one manual weeding at 45 DAT gave significantly higher fruit yield of chilli (55.2 q ha^{-1}) and highest weed control efficiency (74.4 per cent).

Irfan Raza (1998) concluded, maximum weed control efficiency at harvest (93.72 per cent) was recorded under weed free treatment followed by trifluralin @ 1.0 Kg ha^{-1} (78.09 per cent).

Narasalagi (1999) found, the lowest weed dry weight and highest weed control efficiency were noticed in weed free check followed by butachlor 1.0 Kg ha^{-1} coupled with hand weeding at 45 DAT. Conventional method of two hand weedings for weed control in chilli nursery was found better in controlling weeds and recorded 100 per cent weed control efficiency (Yadav *et al.*, 2000).

Among the various treatments, weed free treatment recorded significantly higher yield and highest weed control efficiency, which was at par with Basalin 1.0 Kg ha^{-1} + one hand weeding and Basalin 2.0 Kg ha^{-1} + one hand weeding (Anonymous, 2001 a).

2.7 Economics of weed control

Ignatov (1972) found, trifluralin @ 3 Kg ha^{-1} gave the best weed control without causing crop injury to capsicum and was economical. Application of herbicide in combination with hand weeding resulted in increased income compared to hand weeding alone (Anonymous, 1980).

Patel *et al.* (1986) stated, fluchloralin @ 0.9 Kg ha^{-1} + one hand weeding at 40 DAT recorded maximum additional income of Rs. 4398 ha^{-1} followed by fluchloralin @ 1.35 Kg ha^{-1} (Rs. 3986 ha^{-1}) over the control.

Narayana Rao (1988) concluded, maximum net profit of Rs. 14,536 ha^{-1} (mean of two years) was obtained with hand weeding twice followed by pre-planting application of fluchloralin @ 1.25 Kg ha^{-1} (Rs. 10,024 ha^{-1}) with cost benefit ratios of 3.19 for hand weeding and 2.58, 2.78 for fluchloralin in the two years respectively.

Sharma *et al.* (1988) reported, highest net returns of Rs. 13,000 ha^{-1} was recorded when fluchloralin was applied as pre-plant application @ 0.48 Kg a.i. ha^{-1} plus one hoeing at 25 DAT and this treatment was closely followed by fluchloralin @ 1.44 Kg a.i. ha^{-1} and fluchloralin @ 0.96 Kg a.i. ha^{-1} with one hoeing in descending order. Singh *et al.* (1991) found, highest net profit of Rs. 18,379 ha^{-1} were obtained from pre-emergence application of pendimethalin @ 1.0 Kg a.i. ha^{-1} + oxyfluorfen @ 0.15 Kg a.i. ha^{-1} which was on par with fluchloralin @ 1.0 Kg a.i. ha^{-1} + pendimethalin @ 1.0 Kg a.i. ha^{-1}.

Lanini and Strange (1994) reported, when weeds were excluded by hand weeding for entire season recorded the highest bell pepper yield and gave more net returns.

Irfan Raza (1998) concluded, maximum additional profit of Rs. 47950 ha^{-1} was recorded under weed free treatment followed by trifluralin @ 1.0 Kg a.i. ha^{-1} (Rs. 43750 ha^{-1}) over the unweeded control.

Highest net income was recorded in weed free check followed by glufosinate ammonium @ 0.90 Kg a.i. ha^{-1} and alachlor @ 2.0 Kg a.i. ha^{-1} both in combination with intercultivation at 40 and 60 DAT + hand weeding at 45 and 75 DAT (Biradar, 1999).

At Coimbatore, in the experiment conducted on weed management in chilli revealed that Basalin @ 1.0 Kg a.i. ha^{-1} + one hand weeding was highly remunerative which recorded the highest cost benefit ratio of 1:4.58 (Anonymous, 2001 a).

CHAPTER III

MATERIALS AND METHODS

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CHAPTER III

MATERIALS AND METHODS

The present investigation entitled "Studies on integrated weed management in Chilli (*Capsicum annum* L.)" was conducted during Kharif season of 2000-01 and 2001-02. Details of the materials used and the techniques adopted during the course of investigation are described in this chapter.

3.1 Information about basic resources used

3.1.1 Experimental site

The investigation was carried out in field of the farm of Chilli and Vegetable Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The topography of the plot was fairly uniform and levelled.

3.1.2 Cropping history of the experimental plot

The cropping patterns followed in the experimental field for preceding three years are given in Table 1.

Table 1: Cropping history of the experimental plot

Year	Crop	
	Kharif season	Summer season
1997-1998	Chilli	-
1998-1999	Chilli	-
1999-2000	Chilli	-
2000-2001	Present investigation	-
2001-2002	Present investigation	-

3.1.3 Soil

In both the yearsof investigation prior to treatments application and transplanting of chilli, four soil samples from 0-30 cm soil layer were drawn from randomly selected representative spots in each replication and a composite sample was prepared which was used for analysing physico- chemical properties of soil. The standard methods were used and the results of the analysis are presented in Table 2.

Table 2: Physico- chemical properties of the experimental soils

Sr. No.	Particulars	Values		Method used
		2000	2001	
(A)	Mechanical Analysis			
1.	Sand (%)	10.30	10.30	International Pipette Method (Jackson, 1979)
2.	Silt (%)	28.10	27.80	
3.	Clay (%)	61.60	61.90	
4.	Textural Class	Clayey	Clayey	
(B)	Chemical Analysis			
1.	Organic Carbon (%)	0.56	0.58	Walkley & Black's rapid titration method (Jackson, 1967)
2.	Total Nitrogen (%)	0.052	0.057	Modified Kjeldahl's method (Piper, 1966)
3.	Available Nitrogen (Kg ha^{-1})	214.24	225.40	Subbiah & Asija, (1956)
4.	Available P_2O_5 (Kg ha^{-1})	26.00	28.50	Olsen's method (Jackson, 1967)
5.	Available K_2O (Kg ha^{-1})	380.00	398.00	Flame emission spectro photometer (Jackson, 1967)
6.	Soil pH	7.8	7.7	Blackman's glass electrode pH meter (Jackson, 1967)

Table 2 indicates that, the soil was clayey in texture, low in total nitrogen and available P_2O_5. Whereas, high in K_2O and medium in organic carbon. The soil reaction was slightly alkaline.

3.2 Climate and weather conditions

Akola is situated in the subtropical region at 22^{O}42'N latitude and 72^{O}02'E longitude and at an altitude of 307.42M above mean sea level. Climate of Akola is semiarid and is characterised by three distinct seasons viz, hot and dry summer from March to May, warm and rainy mansoon from June to October and mild cold winter from November to February. The normal mean annual rainfall is 818 mm. May is the hottest month with mean monthly temperature varying from 40^{O}C to 42.4^{O}C, whereas, December has the lowest temperature with mean monthly minimum temperature varying from 8^{O}C to 10.5^{O}C. The mean daily evaporation reaches as high as 16.4mm in May and as low as 4.4mm in December.

Weekly weather data for the year 2000-01 and 2001-02 recorded at Agricultural Meteorological Observatory, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola are presented in Table 3 and 4 and graphically presented in Fig. 1and 2 respectively.

3.2.1 Weather and season 2000-2001

During the year of 2000-01, the total rainfall from June to September amounted to 534.3mm which was seems to be less than normal. The onset of monsoon at Akola was not satisfactory. Pre monsoon rains amounting to 75mm, received in seven rainy days during 22nd and 23rd M.W. On receipt of these rains, there was break in rains for 19 days from 11th to 29th June. During the crop season, there was three long dry spell, in June (11th to 29th June), second in July – August (20th July to 7th August) and third was in August – September (30th August to 14th September).

Table 3: Weekly weather data for the year 2000-2001 recorded at Agril.met observatory Dr. PDKV, Akola

MW	Dates	Tmax		Tmin		BSH		WS		RHI		RHII		Evap		RF		RainyDays	
		N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A
22	28-3 Jun	42.1	38.4	27.7	25.2	9.6	9.1	16.0	12.1	56	68	23	33	16.4	10.7	5.0	44.7	0.5	2
23	4-10	40.5	34.6	26.7	23.3	8.3	5.6	15.6	8.7	65	86	31	50	14.1	6.1	20.6	30.3	1.2	5
24	11-17	38.4	35.6	25.5	25.2	7.6	6.6	15.6	18.4	71	72	41	39	11.2	11.2	45.0	0.0	2.1	0
25	18-24	35.5	32.1	25.0	25.0	7.4	1.4	15.2	15.5	76	70	50	49	9.3	7.3	49.5	3.6	2.2	1
26	25-1 Jul	33.8	34.6	24.1	24.5	4.8	7.1	13.2	14.1	81	73	56	52	6.9	11.4	43.3	32.9	2.6	2
27	2-8	33.5	33.6	24.4	24.1	5.3	6.6	13.1	12.4	81	80	57	57	6.9	7.1	37.5	6.5	2.3	2
28	9-15	32.2	29.8	23.7	23.1	3.8	1.4	12.1	11.2	85	92	62	78	5.5	4.4	55.2	136.1	3.0	5
29	16-22	31.9	28.1	23.9	22.2	3.3	1.7	11.2	11.7	84	91	65	73	5.7	3.0	62.3	79.2	2.6	4
30	23-29	31.9	31.7	23.3	23.5	4.6	4.7	11.7	12.4	85	79	64	49	5.5	6.1	46.0	0.0	2.6	0
31	30-5 Aug	31.2	33.8	23.1	24.0	3.8	7.6	11.8	10.6	88	72	66	42	4.7	7.9	48.4	0.0	2.5	0
32	6-12	30.1	32.4	22.8	24.2	3.5	4.4	11.7	11.2	88	79	69	58	4.2	5.3	66.6	40.8	3.0	4
33	13-19	30.2	31.4	22.7	23.6	4.0	6.5	11.9	12.0	87	83	68	56	4.3	5.3	47.7	11.4	2.5	1
34	20-26	30.3	30.3	22.5	23.6	4.4	2.9	11.5	9.1	88	91	66	67	4.3	3.1	44.7	12.9	2.0	2
35	27-2 Sep	30.4	29.7	22.7	22.7	4.4	4.1	10.7	10.1	86	90	63	73	4.3	3.0	46.7	85.6	2.4	2
36	3-9	31.2	29.9	22.4	22.7	5.9	3.3	9.3	10.4	85	83	60	59	4.9	4.3	26.8	0.0	1.5	0
37	10-16	32.4	32.5	22.4	22.4	7.5	7.7	9.1	8.0	84	79	54	50	5.3	5.7	12.9	6.6	0.8	1
38	17-23	33.8	34.8	22.2	23.2	7.8	6.8	8.8	6.2	83	71	50	45	5.6	5.7	21.1	0.0	1.3	0
39	24-30	34.0	33.8	21.7	22.0	7.8	8.0	5.6	3.1	83	82	48	47	5.1	4.6	25.0	48.4	1.5	1
40	1-7 Oct	34.1	35.7	20.0	20.3	8.1	8.8	8.2	2.9	81	72	44	31	5.7	5.9	19.8	0.0	0.9	0
41	8-14	34.2	35.3	18.3	22.6	3.4	6.9	4.2	4.1	75	74	39	37	5.3	5.8	17.3	0.0	0.9	0
42	15-21	34.1	35.7	18.0	18.4	8.8	7.6	4.4	3.5	74	65	35	24	5.6	6.3	1.9	0.0	0.3	0
43	22-28	33.4	36.6	18.5	16.1	8.7	9.9	4.1	3.5	72	52	33	15	5.6	6.1	7.4	0.0	0.4	0
44	29-4 Nov	33.2	34.5	15.6	15.1	8.8	9.3	4.9	4.1	72	52	30	16	5.5	5.6	2.0	0.0	0.2	0
45	5-11	32.4	33.8	14.3	15.5	8.8	8.9	4.6	4.3	70	52	28	19	5.3	6.0	1.7	0.0	0.2	0
46	12-18	31.8	33.0	13.4	14.5	8.7	8.2	4.8	4.1	69	54	29	19	5.0	5.7	1.3	0.0	0.2	0
47	19-25	31.1	33.1	13.1	13.3	8.7	8.5	4.6	3.2	71	58	29	20	4.8	4.6	8.5	0.0	0.2	0
48	26-2 Dec	30.4	32.2	12.3	12.9	9.0	8.1	4.7	3.6	71	57	30	27	4.4	4.9	4.6	0.0	0.2	0
49	3-9	29.9	30.7	11.1	8.3	8.9	9.0	4.8	3.3	69	52	28	23	4.5	4.7	0.9	0.0	0.2	0
50	10-16	29.6	31.6	10.5	8.9	8.8	8.7	4.6	2.7	71	53	27	20	4.3	4.8	1.4	0.0	0.2	0
51	17-23	29.7	31.6	10.5	9.7	9.0	9.0	4.9	1.3	69	49	28	17	4.4	4.6	1.0	0.0	0.1	0
52	24-31	29.2	30.3	10.5	10.8	8.8	8.4	5.0	3.3	70	46	30	24	4.4	5.2	3.1	0.0	0.2	0

N – Normal 1971 to 1995, A – Actual 2000

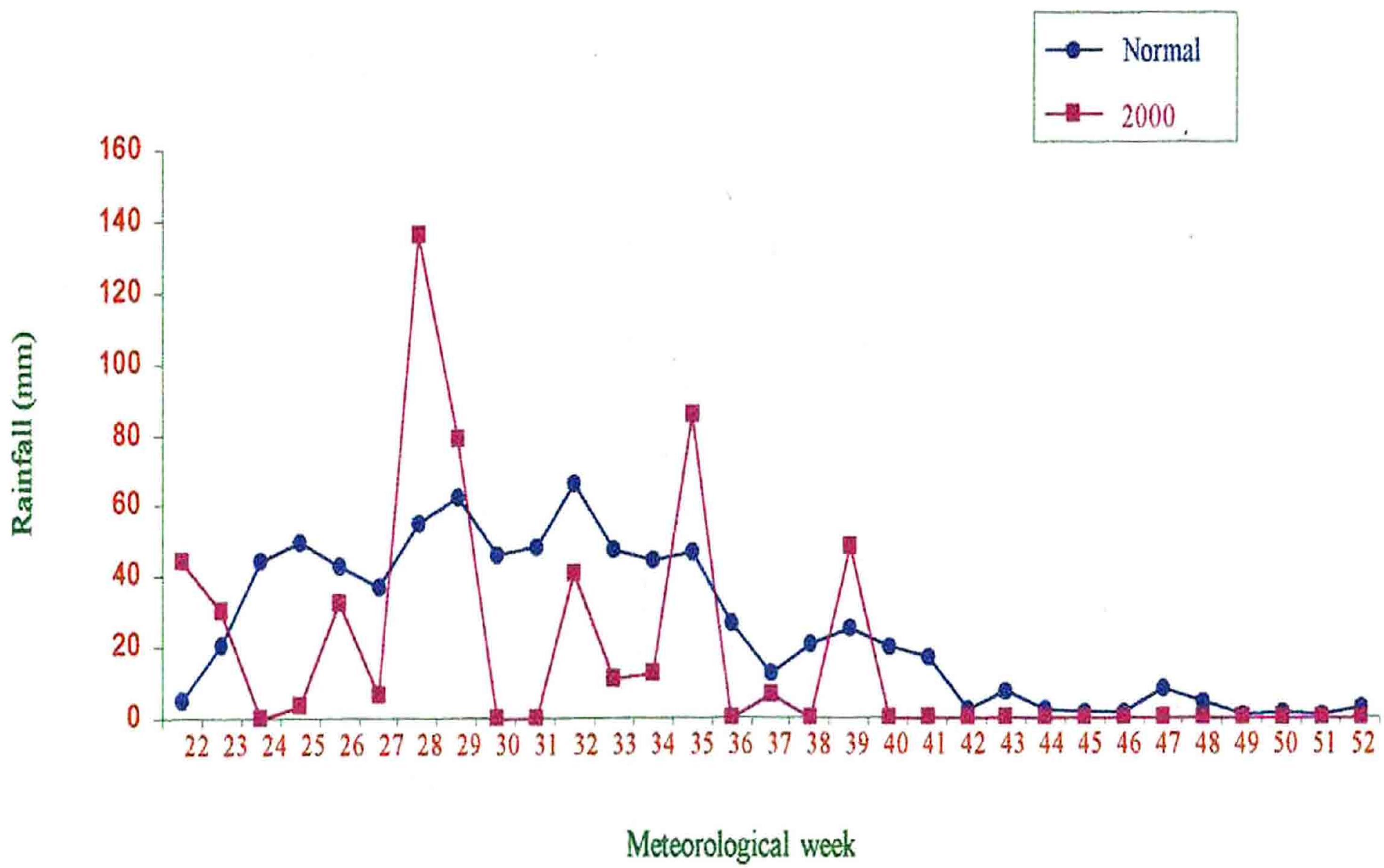


Figure 1: Weekly rainfall for the year 2000-01 at Akola

Table 4: Weekly weather data for the year 2001-2002 recorded at Agril.met observatory Dr. PDKV, Akola

MW	Dates	Tmax		Tmin		BSH		WS		RHI		RHII		Evap		RF		RainyDays	
		N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A
22	28-3 Jun	41.9	40.5	27.6	27.7	9.7	9.7	16.2	17.0	56	48	23	22	16.3	15.6	5.7	0.0	0.5	0
23	4-10	39.0	37.7	25.8	24.0	8.0	7.6	14.9	10.2	62	82	30	41	13.4	9.9	18.3	86.0	1.2	4
24	11-17	38.2	31.1	25.5	23.6	7.5	2.8	15.4	11.3	71	82	42	68	11.1	5.0	43.3	110.5	2.0	3
25	18-24	35.3	32.1	24.9	24.3	7.1	3.1	15.1	15.3	76	80	50	57	9.1	6.7	52.3	8.0	2.2	1
26	25-1 Jul	34.1	34.8	24.2	25.4	5.3	2.9	13.4	18.3	80	71	55	48	7.3	9.6	38.3	0.0	2.3	0
27	2-8	33.5	33.5	24.4	24.7	5.2	3.9	12.9	14.1	81	73	58	47	6.8	8.3	34.7	0.0	2.4	0
28	9-15	32.3	30.8	23.7	23.8	3.8	1.1	12.0	9.3	84	85	62	67	5.5	3.8	52.2	27.6	2.8	2
29	16-22	32.0	28.7	23.9	23.0	3.3	0.3	11.2	11.9	84	88	65	75	5.6	3.5	58.6	45.6	2.6	3
30	23-29	31.7	30.7	23.3	23.0	4.3	3.6	11.9	9.3	85	87	64	61	5.3	4.9	44.2	16.0	2.7	2
31	30-5 Aug	31.1	31.6	23.1	23.6	3.6	4.5	11.7	8.4	88	86	66	64	4.6	4.9	49.3	23.8	2.5	2
32	6-12	30.2	29.0	22.9	23.2	3.5	1.9	11.6	10.0	87	91	69	75	4.2	2.9	59.9	63.8	2.9	3
33	13-19	30.5	28.9	22.8	22.9	4.4	2.5	11.7	10.7	86	90	66	74	4.5	3.7	40.6	18.0	2.2	2
34	20-26	30.6	26.8	22.6	22.8	4.3	0.7	11.0	10.0	88	87	66	73	4.3	3.1	46.7	6.8	2.0	1
35	27-2 Sep	30.4	31.6	22.7	22.6	4.4	5.9	10.6	11.3	86	83	64	55	4.2	5.3	47.1	0.0	2.4	0
36	3-9	31.1	33.4	22.5	22.9	5.7	6.8	9.1	8.3	85	76	61	48	4.7	5.6	23.5	0.0	1.5	0
37	10-16	32.2	33.6	22.4	22.8	7.1	6.0	9.0	6.2	85	77	56	47	5.1	5.5	18.9	0.0	1.1	0
38	17-23	33.4	34.3	22.3	21.8	7.2	6.3	8.5	4.8	83	77	53	43	5.3	5.8	24.6	1.8	1.4	0
39	24-30	33.7	35.5	21.9	22.3	7.6	6.3	5.4	4.5	83	75	50	46	4.9	4.8	24.4	74.6	1.5	1
40	1-7 Oct	33.9	31.2	20.2	22.4	8.1	3.0	7.5	6.6	81	93	45	81	5.5	3.3	21.8	103.2	1.1	5
41	8-14	34.1	31.6	18.7	22.7	4.2	6.0	4.1	3.5	76	86	40	64	5.3	3.3	16.0	15.4	0.9	1
42	15-21	33.9	32.5	18.1	18.3	8.4	7.4	4.4	3.1	74	75	36	43	5.5	4.3	3.1	18.0	0.4	1
43	22-28	33.1	33.0	18.6	14.9	8.4	8.2	4.1	2.4	73	71	36	31	6.3	3.9	10.0	0.0	0.6	0
44	29-4 Nov	33.0	33.2	18.8	18.7	8.7	8.9	4.7	3.0	72	69	31	31	5.5	4.5	2.0	0.0	0.3	0
45	5-11	32.4	32.2	14.8	15.8	8.6	8.4	4.5	3.5	70	60	30	34	5.2	4.4	3.7	0.0	0.3	0
46	12-18	31.7	31.6	13.7	15.4	8.6	8.5	4.6	4.2	70	68	30	37	4.9	4.3	1.1	0.0	0.2	0
47	19-25	31.0	31.7	13.1	12.0	8.6	8.4	4.4	2.8	71	61	30	26	4.6	4.2	10.1	0.0	0.3	0
48	26-2 Dec	30.3	29.6	12.4	9.6	8.8	8.4	4.6	3.5	71	52	31	22	4.3	4.5	6.8	0.0	0.3	0
49	3-9	29.8	32.0	11.2	10.2	8.7	9.0	4.7	2.2	70	54	29	21	4.3	4.1	1.3	0.0	0.2	0
50	10-16	29.4	32.4	10.3	12.5	8.8	8.6	4.5	2.5	70	61	27	25	4.2	4.4	1.3	0.0	0.2	0
51	17-23	29.5	29.7	10.6	9.9	8.7	8.3	4.7	3.7	69	62	29	24	4.3	3.9	0.9	0.0	0.1	0
52	24-31	28.2	29.5	10.7	9.9	8.6	8.6	4.8	3.5	70	58	31	25	4.3	3.7	2.6	0.0	0.2	0

N – Normal 1971 to 2000, A – Actual 2001-2002

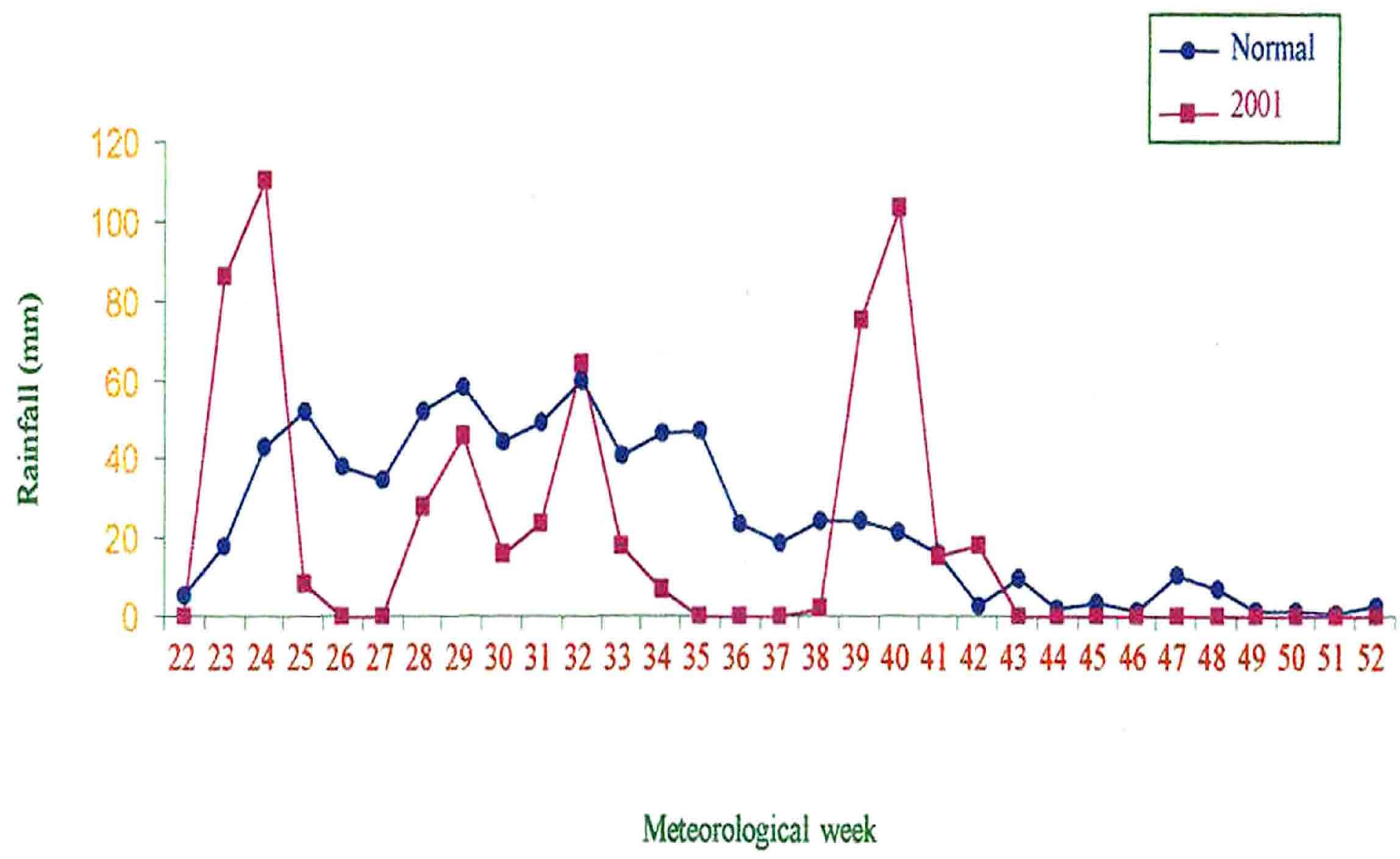


Figure 2: Weekly rainfall for the year 2001-02 at Akola

Maximum rainfall 226.3 mm was recorded in the month of July, followed by August (150.7 mm), June (102.3 mm) and September (55.0 mm). There were no post monsoon rains as against normal.

The average maximum and minimum temperature recorded during the year was 34.0^{O}C and 19.1^{O}C respectively as against normal values of 34.3^{O}C and 19.2^{O}C. Bright sunshine hours recorded were 7.5 hrs as against the normal value of 8.0 hours.

3.2.2 Weather and season 2001-02

Total rainfall received during this year was 731.2 mm as against the normal rainfall of 818.6 mm (last 30 years, 1971 to 2001) showing less rainfall as compared to normal rainfall.

Monsoon commenced from 23rd M.W. with rainfall 86.0 mm and continued upto end of 42nd M.W. Dry spell during 35th and 37th M.W., was recorded. Highest rainfall of 110.5 mm was recorded during 24th M. W.

Rainfall values during June, July, August and September 2001 were 204.5, 89.2, 112.4 and 76.4 mm respectively as against normal rainfall of 150.5, 212.2, 215.7 and 111.1 mm.

The average maximum and minimum temperature recorded during the year was 33.9^{O}C and 19.6^{O}C respectively as against normal values of 34.1^{O}C and 19.2^{O}C respectively.

3.3 Experimental details

3.3.1 Experimental treatments

Details of the treatments along with symbols used are given in the Table 5 and depicted as plan of layout in figure 3.

Table 5: Details of the experimental treatments

Sr. No.	Treatments	Symbol
1.	Pre-plant soil incorporation of Trifluralin @1Kg ha^{-1}	T_1
2.	Pre-plant soil incorporation of Fluchloralin @1Kg ha^{-1}	T_2
3.	Pre-plant soil application of Alachlor @2Kg ha^{-1}	T_3
4.	Pre-plant soil incorporation of Trifluralin @1Kg ha^{-1} + One hoeing at 45 days + one weeding at 60 days after transplanting	T_4
5.	Pre-plant soil incorporation of fluchloralin @1Kg ha^{-1} + One hoeing at 45 days + One weeding at 60 days after transplanting	T_5
6.	Pre-plant soil application of Alachlor @2Kg ha^{-1} + One hoeing at 45 days + One weeding at 60 days after transplanting	T_6
7.	One hoeing at 30 days + one weeding at 45 days after transplanting	T_7
8.	Unweeded control (weedy check)	T_8
9.	Two hoeings at 30 and 60 days followed by two weedings at 30 and 60 days after transplanting	T_9

3.3.2 Design of experiment

The design adopted was Randomised Block Design with nine treatments replicated four times. The allotment of the treatments to various plots was done randomly in a replication. The site of the experiment was the same for both the seasons, the plan of layout and randomization was the same for both the years which is shown in Figure 3.

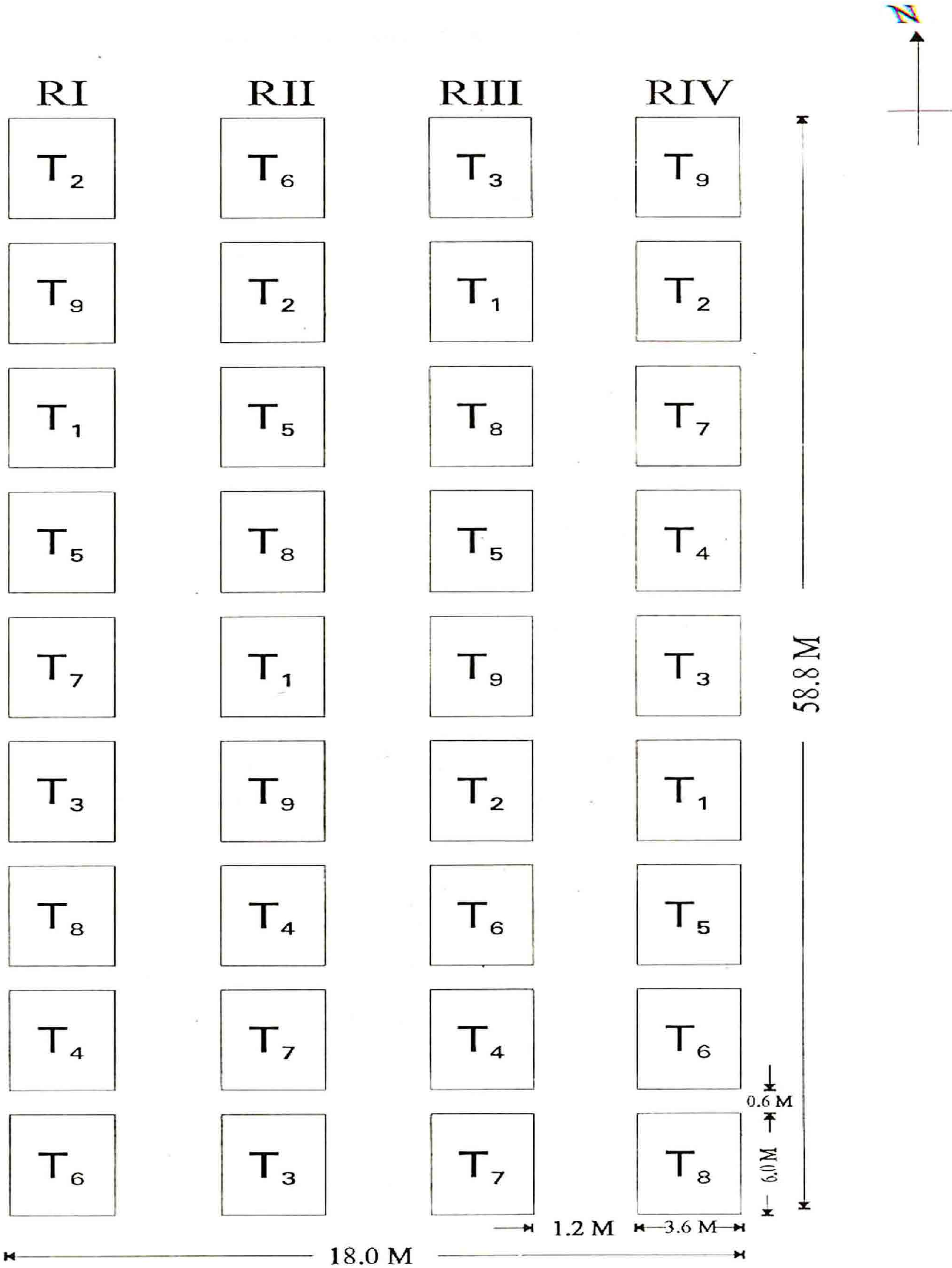


Figure 3: Plan of layout for the year 2000-01 and 2001-02

3.3.3 Other details of experiment

Layout and other details of experiment are given below

1.	Crop	:	Chilli
2.	Variety	:	Jayanti (AKC 86-39)
3.	Number of treatments	:	9
4.	Number of replications	:	4
5.	Number of plots	:	36
6.	Plot size		
	a. Gross	:	3.6 m x 6.0 m
	b. Net	:	2.4 m x 4.8 m
7.	Spacing	:	60 cm x 60 cm
8.	Seed rate (Kg ha^{-1})	:	1.250 Kg
9.	Method of sowing	:	Transplanting
10.	Manures and fertilizers	:	
	a. Manure	:	10 tonnes well decomposed FYM ha^{-1}
	b. Fertilizers	:	150:50:50 Kg NPK ha^{-1}
11.	Season	:	Kharif 2000-01 and Kharif 2001-02

3.3.4 Seed material

The chilli, Jayanti (AKC 86-39) variety was used in present investigation. The seed of Jayanti variety was obtained from Chilli and Vegetable Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. This variety was evolved by the population improvement methodology from chilli variety CA-960 and was released in the year May, 1994 under the project name AKC 86-39.

3.4 Nursery

3.4.1 Fertilizer and manuring

Well decomposed FYM at the rate of 2 Kg m^{-2} of the bed was applied and incorporated in the soil and fertilizer at the rate of 20 g N : 10 g P : 10 g K were given in two split doses. First dose at the rate of 10:10:10 g NPK was given prior to sowing and the remaining Nitrogen was given in the second dose 25 days after the sowing of chilli seeds in the nursery.

3.4.2 Plant protection

Granular phorate 10 per cent at the rate of 70 g m^{-2} was incorporated into soil before the sowing of chilli seed.

3.4.3 Seed treatment

Seed treatment of thirum at the rate of 2 g Kg^{-1} of seed was done.

3.4.4 Sowing

The treated seeds were sown on the nursery beds 2 m x 1 m x 0.20 m on 23rd May, 2000 and 31st May, 2001.

3.5 Details of field operations

The details of various operations were carried out in the experimental field during 2000-01 and 2001-02, are given in Table 6.

Table 6: Schedule of field operations during 2000-01 and 2001-02

Sr. No.	Operations	Frequency		Date of operations	
		2000-01	2001-02	2000-01	2001-02
(I)	Preparatory tillage				
1.	Ploughing	1	1	08.05.2000	14.05.2001
2.	Harrowing with blade harrows	2	2	24.05.2000	22.05.2001
3.	Stubble collection	1	1	26.05.2000	04.06.2001
4.	Layout of experiment	1	1	03.07.2000	06.07.2001
(II)	Nursery				
1.	Manure and fertilizer application				
a)	Application of manure	1	1	19.05.2000	28.05.2001
b)	Basal dose of fertilizers	1	1	23.05.2000	31.05.2001
c)	Second dose of fertilizers	1	1	17.06.2000	25.06.2001
2.	Plant protection	1	1	23.05.2000	31.05.2001
3.	Sowing	1	1	23.05.2000	31.05.2001
(III)	Transplanting				
1.	Opening of irrigation channels	1	1	04.07.2000	09.07.2001
2.	Transplanting of seedlings	1	1	10.07.2000	17.07.2001
3.	Gap filling	1	1	22.07.2000	30.07.2001
(IV)	Manure and fertilizer application to transplanted Chilli				
1.	Application of manure	1	1	19.05.2000	17.05.2001
2.	Basal dose of fertilizers	1	1	11.07.2000	18.07.2001
3.	Second dose of fertilizers	1	1	09.08.2000	16.08.2001
4.	Third dose of fertilizers	1	1	26.09.2000	01.10.2001
5.	Fourth dose of fertilizers	1	1	11.10.2000	18.10.2001
(V)	Hoeing and Weeding				
1.	Hoeing (As per treatment)				
a)	T_4	1	1	24.08.2000	31.08.2001
b)	T_5	1	1	24.08.2000	31.08.2001
c)	T_6	1	1	24.08.2000	31.08.2001
d)	T_7	1	1	09.08.2000	17.08.2001
e)	T_9	2	2	09.08.2000 08.09.2000	17.08.2001 15.09.2001
2.	Weeding (As per treatments)				
a)	T_4	1	1	08.09.2000	15.09.2001
b)	T_5	1	1	08.09.2000	15.09.2001
c)	T_6	1	1	08.09.2000	15.09.2001
d)	T_7	1	1	24.08.2000	31.08.2001
e)	T_9	2	2	09.08.2000 08.09.2000	17.08.2001 15.09.2001

Table 6 contd.

(VI)	Plant Protection				
1.	Seed treatment	1	1	23.05.2000	31.05.2001
2.	Spraying of pesticides (As recommended)	6	6	12.08.2000 04.09.2000 29.09.2000 19.10.2000 09.11.2000 27.11.2000	20.08.2001 10.09.2001 26.09.2001 23.10.2001 06.11.2001 22.11.2001
(VII)	Spraying of herbicides (As per treatment)				
1.	T_1	1	1	09.07.2000	16.07.2001
2.	T_2	1	1	09.07.2000	16.07.2001
3.	T_3	1	1	09.07.2000	16.07.2001
4.	T_4	1	1	09.07.2000	16.07.2001
5.	T_5	1	1	09.07.2000	16.07.2001
6.	T_6	1	1	09.07.2000	16.07.2001
(VIII)	Harvesting				
1.	Picking of Chilli	6	6	02.11.2000 20.11.2000 06.12.2000 27.12.2000 09.01.2001 23.01.2001	05.11.2001 29.11.2001 12.12.2001 29.12.2001 14.01.2002 30.01.2002

3.5.1 Land preparation and manuring

The experimental field was ploughed and followed by two harrowings, prior to harrowings well decomposed FYM at the rate of 10 tonnes per hectare was incorporated uniformly in the experimental plots.

3.5.2 Transplanting

The experimental plots were demarcated as per the plan of layout and the uniform, healthy seedling of chilli variety Jayanti were transplanted at a spacing of 60 cm x 60 cm.

3.5.3 Fertilizer application

The recommended dose of fertilizers 150 Kg N+50 Kg P_2O_5+50 Kg K_2O ha^{-1} was splitted into four doses. The first split dose was applied as entire quantity of P_2O_5, K_2O and half dose of N on the next day of transplanting in ring method 5cm away from the plant, the remaining half dose of N was equally splitted and given as second split after 4 weeks after transplanting, third split after 11 weeks and fourth split dose was applied 13 weeks after transplanting.

Nitrogen, phosphorus and potassium were applied in the form of Urea, Single super phosphate and muriate of potash respectively.

3.5.4 Irrigation

The irrigation was given during the dry spell as and when required.

3.5.5 Plant protection measures

The schedule of different plant protection measures taken up during the period of investigation given in Table 7.

Table 7: Schedule of plant protection measures

Sr. No.	Use of Pesticides	Concentration (ml /L)	Date of Spraying	
			2000-01	2001-02
1.	Monocrotophos + Copperoxychloride + Water	15 ml + 25 g + 10 L.	12.08.00	20.08.01
2.	Monocrotophos + Zirum + Water	15 ml + 20 g + 10 L.	4.9.00	10.9.01
3.	Monocrotophos + Zirum + Water	15 ml + 20 g + 10 L.	29.9.00	26.9.01
4.	Endosulphan + Copperoxychloride + Water	15 ml + 25 g + 10 L.	19.10.00	23.10.01
5.	Monocrotophos + Sulphur + Water	14 ml + 25 g + 10 L.	9.11.00	6.11.01
6.	Sulphur + Water	25 g + 10 L.	27.11.00	22.11.01

3.5.6 Hand weeding and hoeing

Hand weedings and hoeings were carried out during both the years as specified against each treatment.

3.5.7 Harvesting of chilli

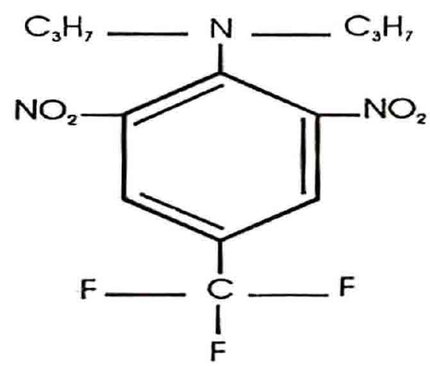
Chilli fruits were picked as and when they matured and turned red. Totally six pickings were made. Dates of chilli fruit pickings during both the years are given in Table 6.

3.6 Herbicides

Brief description of the herbicides used in experiment is given below

3.6.1 Trifluralin (Joshi, 1974)

Trade names	:	Elancolan, Treflan.
Origin	:	Elanco product company (1959)
Chemical name	:	2,6-dinitro-N-N-dipropyl-4-trifluromethyl aniline.
Structural formula	:	



Empirical formula	:	$C_{13}H_{14}F_3N_3O_4$
Type of herbicide	:	Selective. It inhibits germination and the activity of dividing meristems.
General dosage	:	0.5 to 1.5 Kg a.i. ha^{-1}
Uptake and mode of action	:	Absorbed by foliage and roots.

Properties:

Physical state : Crystaline solid

Formulation : 48 % EC

Solubility : In water 24 ppm, but in organic solvent the chemical is readily soluble.

LD 50 : 10,000 mg Kg^{-1} body weight to rat

Important weed controlled: *Echinochloa crusgalli, Stellaria* sp., *Digitaria* sp., *Setaria* sp., *Elusine* sp., *Sorghum halepens, Portulaca* sp., *Cenchrus* sp., *Bromus* sp. etc.

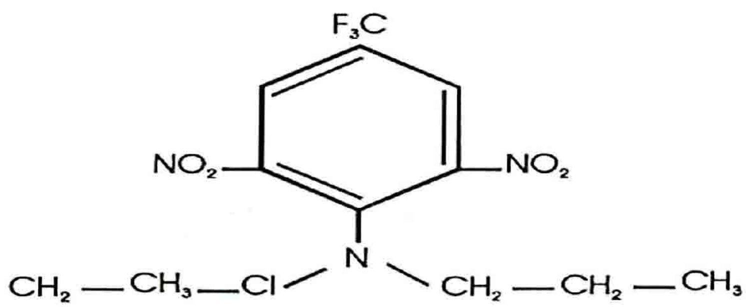
3.6.2 **Fluchloralin** (Joshi, 1974)

Trade name : Basalin.

Origin : BASAF of Germany (1970)

Chemical name : N-propyl-N(2-chloroethyl)-2,6-dinitro-n trifuoromethyl aniline

Structural formula:



Empirical formula : $C_{12}H_{13}ClF_3N_3O_4$

Type of herbicide : Selective.

General dose & application : 0.5 to 1.5 kg a.i. ha^{-1} to be incorporated in soil as pre-plant herbicide, incorporation to a depth of 1.5 inches within 8 hours of application.

Uptake and mode of action: The active ingredient penetrates germinating seedlings of weeds (both monocot and dicot) through the hypocotyl and roots preventing processes vital to their development. The seedling die before or shortly after emergence. The herbicide acts almost exclusively through radicle.

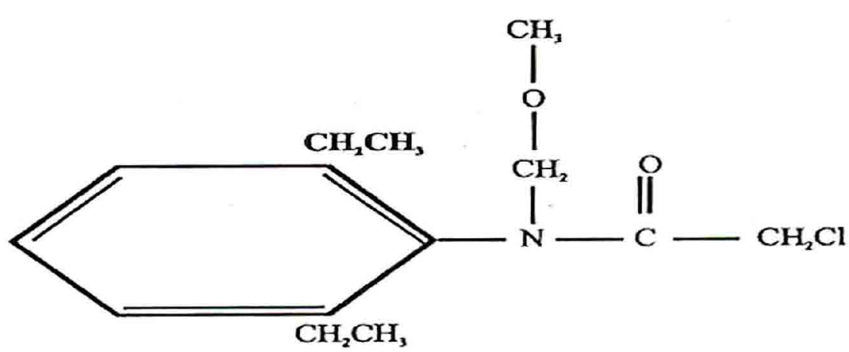
Properties:

Physical state	:	Crystalline solid
Colour	:	Orange yellow
Formulation	:	45 % EC, 5 % granules
Solubility	:	Sensitive.
LD 50 (Toxicity)	:	1550 mg kg^{-1} body weight of rat

Important weed controlled: *Amaranthus spinosus, Chenopodium album, Commelina benghalensis, Dactyloctenium aegyptium, Echinochloa crusgalli, Eleusine indica, Portulaca oleracea, Trianthema monogyna.*

3.6.3 Alachlor (Joshi, 1974)

Trade names	:	Lasso, CP 50144,Lazo.
Origin	:	Monsanto chemical campany.
Chemical name	:	2-chloro-2',6'-diethyl-N-(methoxy methyl) acetanilide.
Structural formula	:	



Empirical formula : $C_{14} H_{17} Cl NO_2$

Type of herbicide : Selective, pre-emergence application

General dosage : 1.5 Kg to 3 Kg a.i. ha^{-1}

Uptake and mode of action : Absorbed primarily between the seed and first mode of germinating seedling.

Properties:

Physical state : Liquid.

Formulation : 50 % emulsifiable liquid and 10 % granules available.

Solubility : 148 ppm in water but soluble in alcohol.

Toxicity (LD50) : 1200 mg Kg^{-1} body weight of rat.

Important weeds controlled: Most grasses and broad-leaf weeds in groundnut, soybean, cotton, maize, sugarcane, potatoes, vegetable, etc.

3.6.4 Source of herbicides used

Herbicides, Triuflurlin (Treflan 48 %EC) and Fluchloralin (Basalin 45 % EC) manufactured by De-Nocil crop protection Ltd., Mumbai and BASF India Ltd., Mumbai respectively, were received from weed science laboratory, Department of Agronomy, Dr. P.D.K.V., Akola. Herbicide, Alachlor (Lasso 50 % EC) manufactured by Monsanto chemical of India Ltd., Mumbai, purchased from local market and used in the present investigation.

3.6.5 Application of herbicides

Quantity of pre- plant herbicides, Trifulralin, Fluchloralin and Alachlor required for gross plot area (3.6 m x 6.0 m) was calculated as per the treatment and dissolved in 2 litre of water and sprayed uniformly over an area of

21.6 m^2 according to different treatments. Trifluralin and Fluchloralin were applied as pre-plant soil incorporation while, Alachlor was applied as pre-plant. The herbicies were sprayed uniformly with knapsack sprayer fitted with flat fan nozzle, one day before transplanting of chilli seedlings with minimum trampling.

3.7 Biometric Observations

Five plants were selected at random from the net plot area of each plot for recording biometric observations. The selected plants were labelled and the observations were recorded on these plants periodically at 30 days interval from transplanting till 120 days of the crop.

The details of biometric observations recorded in present investigation are given in Table 8.

3.7.1 Weed studies

3.7.1.1 Weed count per square metre

One representative spot measuring 0.5 m x 0.5 m was selected in each net plot and was marked by pegs. The weeds from each quadrat were counted at 30, 60, 90 & 120 days after transplanting as total weeds, monocot and dicot weeds were classified. The weed count per square metre was then worked out.

3.7.1.2 Dry weight of weeds

A quadrat of 0.5 m x 0.5 m was placed at random inside the net plot area of each plot. The weeds in the quadrat were removed from each plot at 30,60,90, 120 days after transplanting and at harvest. The weed samples were first sun dried and later oven dried to constant weight at 65^{O}C temperature and weights were recorded. These weights were converted to dry weight per square metre.

Table 8: Details of biometric observations recorded in field and laboratory

Sr. No.	Particulars	Freq-uency	Days after transplanting	Plant observed $Plot^{-1}$
(I)	Biometric observations			
(A)	Weed studies			
1.	Weed flora in chilli	-	Throughout crop duration	Each quadrat
2.	Weed count m^{-2}	4	30,60,90, & 120	Each quadrat
3.	Number of monocot weeds m^{-2}	4	30,60,90, & 120	Each quadrat
4.	Number of dicot weeds m^{-2}	4	30,60,90, & 120	Each quadrat
5.	Dry weight of weeds m^{-2}	5	30,60,90,120 & at harvest	Each quadrat
6.	Weed index (%)	1	After harvest	-
7.	Weed control efficiency (%)	1	After harvest	-
(B)	Crop Studies			
1.	Plant population	2	15 & 120	All hills in gross plot.
2.	Plant height (cm)	4	30,60,90 & 120	Five plants
3.	Dry matter accumulation $plant^{-1}$	1	At harvest	Five plants
4.	Number of fruits $plant^{-1}$	6	At each picking	Five plants
5.	Fruit weight $plant^{-1}$	6	At each picking	Five plants
6.	Fruit weight $plot^{-1}$	6	At each picking	All plants from net plot.
7.	Yield of fresh wet red fruit of chilli (q ha^{-1})	6	At harvest	-
8.	Yield of dry red fruit of chilli (q ha^{-1})	1	After harvest	-
9.	Economics of weed control treatment	-	After harvest	-
(II)	Chemical Studies			
1.	NPK content of soil	1	Before transplanting	-
2.	Uptake of NPK by weeds	1	After harvest	-
3.	Uptake of NPK by chilli crop	1	After harvest	-
(III)	Correlation and regression analysis			
1.	Simple correlation	1	After harvest	-
2.	Phenotypic correlation	1	After harvest	-
3.	Path analysis	1	After harvest	-
4.	Regression analysis	1	After harvest	-

3.7.1.3 Weed index (%)

The weed index was calculated by the formula proposed by Gill and Vijay Kumar (1969).

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

Where,

WI = Weed index in per cent.

X = Fruit yield from weed-free plot

Y = Fruit yield under the treatment for which weed index is to be worked out.

3.7.1.4 Weed control efficiency (%)

The weed control efficiency was calculated by adopting the formula given by Mani *et al.*(1976).

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

Where,

WCE = Weed control efficiency in per cent

DMC = Dry matter of weeds in unweeded plot.

DMT = Dry matter of weeds in treated plot.

3.7.2. Crop studies

3.7.2.1 Plant population

Plant count was taken at 15 days after transplanting, after the establishment of the crop. All the seedlings in each gross plot were counted. Further, the plant count was taken at harvest of the crop.

3.7.2.2 Plant height

During both the years, five plants per net plot were selected randomly and were labelled for biometric observations. Height of plant was measured in cm from the ground level to the topmost point of chilli plant at 30,60,90 and 120 days after transplanting and the mean of five plants was taken as the plant height.

3.7.2.3 Dry matter accumulation per plant

Five chilli plants were selected at random from the net plot area and cut to the ground level. The samples were air dried and later on oven dried at 70^{O}C till a constant weight was attained. Dry matter was taken at harvest. The mean weight was recorded and expressed in gramme per plant.

3.7.2.4 Number of fruits plant^{-1}

At the time of each picking number of fruits per plant of the selected observation plants from each net plot was harvested separately and counted.

3.7.2.5 Fruit weight plant^{-1}

At the time of each picking, fruits per plant of the selected observation plants from each net plot were harvested separately and weight was measured per plant.

3.7.2.6 Yield per plot and yield per hectare

Fruits obtained from each net plot were weighed, from total yield plot^{-1}, the yield per hectare was calculated by multiplying each figure with a constant.

3.7.2.7 Yield of dry fruit of chilli per hectare

The fruit yield per net plot was dried and weighed, then it was converted to yield of dry fruits per hectare and was expressed as quintal per hectare.

3.7.2.8 Economics of treatment

Economics of different treatments were worked out by taking into account the prevailing market price of inputs and outputs.It was calculated from the following formula given by Reddy and Reddi (1995).

Gross return (Rs. ha^{-1})= Cost of chilli + cost of stalk

Net return (Rs. ha^{-1}) = Gross return – total cost of cultivation.

$$\text{Net return per rupee invested} = \frac{\text{Net return}}{\text{Total cost of cultivation}}$$

$$\text{Cost: Benefit ratio} = \frac{\text{Gross return}}{\text{Total cost of cultivation}}$$

3.8 Chemical studies

3.8.1 NPK content of soil

Four soil samples were drawn from 0-30 cm depth from randomly selected representative spots spread over the experimental area prior to application of treatments. A composite sample was then prepared and subjected for chemical analysis. The percentages of total nitrogen, available Phosphorus and Potassium were recorded.

3.8.2 NPK uptake by chilli plant and weeds

Chilli plant (straw), fruits and weed samples collected at harvesting stage. These dried samples were ground and passed through 20 mesh sieve for estimation of nitrogen, phosphorus and potassium content in chilli plant (straw), chilli fruit and weeds, a sample of 0.5g each was taken from ground material and used for chemical analysis. Nitrogen was estimated by Kjeldahl's method (Jackson, 1967), phosphorus by Vandomolybdo phosphoric acid yellow colour method (tri-acid extract) by using spectronic 710 spectrometer. Potassium content was estimated (tri-acid extract) by using flame photometer (Jackson, 1967). Total

N,P and K uptake by chilli plant (straw), chilli fruit and by weeds at harvest was calculated by multiplying dry matter production of crop, dry yield of fruits and weeds with the corresponding values of nutrient content and was expressed as Kg ha^{-1}.

3.9 Statistical analysis

All the data collected during both the years were subjected to statistical analysis by appropriate methods of "Analysis of variance" as described by Panse and Sukhatme (1978). The data recorded on weed population and their dry matter were subjected to square root transformation ($\sqrt{x}$) before analysis to normalize their distribution. Where 'F' test revealed significance, critical difference (C.D.) was worked out at 5 per cent level of probability for treatments comparison.

3.9.1 Pooled analysis

The pooled analysis was carried out for chilli fruit yield of 2000-01 and 2001-02 seasons.

3.10 Correlation and regression studies

3.10.1 Simple correlation coefficient

Simple correlation studies were made to study the relationship between:

i. Total uptake of nitrogen by Chilli plant and by weed.

ii. Total uptake of phosphorus by Chilli plant and by weed.

iii. Total uptake of potassium by Chilli plant and by weed.

The procedure and the formula described by Snedecor and Cochran (1994) was followed:

$$r = \frac{\sum x\, y}{\sqrt{\sum x^2 \cdot \sum y^2}}$$

Where,

r = coefficient of correlation

x = Deviations from the arithmetic mean in the first series

y = Deviation in the second series.

3.10.2 Phenotypic correlation coefficients

To study the extent of association between different characters viz., 1) Plant height 2) Dry weight per plant 3) Number of fruits per plant 4) weight of fruits per plant and 5) yield of chilli fruits, phenotypic correlation coefficientswere worked out from the respective variances as per suggested by Hayes *et al.* (1955).

$$Phenotypic\ r_{1,2} = \frac{(Phenotypic\ Co-variance)_{1,2}}{\sqrt{Phenotypic\ variance\ of\ 1} \times \sqrt{Phenotypic\ variance\ of\ 2}}$$

Where,

r = correlation coefficient

1 and *2* = characters under study

3.10.3 Path analysis

The correlation coefficients were further partitioned into direct and indirect effects with the help of path analysis originally suggested by Wright (1921) and further outlined by Dewey and Lu (1959).

The five characters viz., 1) Plant height 2) Dry weight per plant 3) Number of fruits per plant 4) Weight of fruits per plant and 5) Yield of Chilli fruit, were considered for path analysis.

3.10.4 Regression analysis

Regression analysis was undertaken by using phenotypic correlation matrix between 1) Plant height 2) Dry weight per plant 3) Number of fruits per plant 4) Weight of fruits per plant and the yield of Chilli fruits (Y) as suggested by Steel and Torrie (1960).

A multiple linear regression analysis worked out and the relationship between the crop characteristics (X_1.........X_n) and yield of Chilli fruits (Y) were established by multiple linear regression equation (MLR) type

$$Y = a + b_1X_1 + b_2 X_2 + \ldots\ldots\ldots\ldots\ldots + b_nX_n$$

Where,

a = intercept

b_1 to b_n = regression coefficients of X_1 to X_n crop characters.

CHAPTER IV

EXPERIMENTAL FINDINGS

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CHAPTER IV

EXPERIMENTAL FINDINGS

The results of the investigation entitled "Studies on integrated weed management in Chilli (*Capsicum annum* L.)" are presented in this chapter. An attempt is made to elicit the influence of various treatments on the growth and yield of the crop as well as the weed count, dry matter accumulation by weeds and nutrients uptake by weeds.

4.1 Weed studies

4.1.1 Weed flora

In order to find out an effective weed control measure, it is very necessary to identify the weed species present in the experimental field. The correct identification helps to group them into different classes. The weeds of specific groups normally respond to a particular treatment because of their morphological characteristics, genetic make up and growth habit similarities. Efforts were made to identify the weeds present in the experimental plots. A list of the weeds found in the experimental field is given in Table 9.

Table 9: Common weeds noticed in the experimental plot

Sr.No.	Common Name	Botanical Name	Family
(A)	**Monocotyledonous weeds**		
1.	Nagar Motha	*Cyperus rotundus* L.	Cyperaceae
2.	Hariyali	*Cynodon dactylon* (L) pers.	Poaceae
3.	Kena	*Commelina benghalensis* L.	Commelinaceae
4.	Vinchu	*Cynotis oxilaries*	Commelinaceae
5.	Lona grass	*Dinebra arebica* Jacg.	Poaceae
6.	Shippi grass	*Echinochloa crusgalli* (L) Beauv.	Poaceae
7.	Sheprut	*Panicum* spp.	Poaceae
(B)	**Dicotyledonous weeds**		
1.	Bawanchi	*Psorulea corylifolia*	Leguminosae
2.	Wild Jute	*Corchorus acutangulus*	Tiliaceae
3.	Kunjar	*Digera arvensis* forsk.	Amaranthaceae
4.	Aghada	*Achyranthes aspera* L.	Amaranthaceae
5.	Chawali	*Amaranthus Viridis* L.	Amaranthaceae
6.	Kamarmodi	*Tridax procumbens* L.	Asteraceae
7.	Pathar	*Sonchus arvensis* L.	Asteraceae
8.	Gokharu	*Xanthium strumerium* L.	Asteraceae
9.	Pandharifuly	*Lagasca mollis*	Asteraceae
10.	Gajar gawat	*Parthenium hysterophorus* L.	Asteraceae
11.	Chandvel	*Convolvulus arvensis* L.	Convolvulaceae
12.	Undir kani	*Ipomea reniformis*	Convolvulaceae
13.	Hajardani	*Phyllanthus niruri* L.	Euphorbiaceae
14.	Dudhi	*Euphorbia hirta* L.	Euphorbiaceae
15.	Mothi dudhi	*Euphorbia geniculata* Orteg.	Euphorbiaceae
16.	Phuga	*Physalis minima* L.	Solanaceae
17.	Chikna	*Sida aculata*	Malvaceae
18.	Tarota	*Cassia tora* L.	Leguminosae
19.	Shewra	*Alysicarpus rugosus* DC.	Leguminosae
20.	Bathua	*Chenopodium album* L.	Chenopodiaceae
21.	Krisnaneel	*Anagallis arvensis* L.	Primulaceae
22.	Piladhotra	*Argemone mexicana*	Papaveraceae
23.	Ghol	*Portulaca oleracea* L.	Portulacaceae
24.	Ber	*Ziziphus rotundifolia* Lamk.	Rhamnaceae

4.1.2 Weed population

Observation recorded on population of weed was studied at 30, 60, 90 and 120 days after transplanting of chilli. The weeds were classified into two groups, monocot weeds and dicot weeds, to study the treatment effects separately on each group.

Table 10: Mean number of monocot weeds m^{-2} as influenced by different treatments during 2000-01 and 2001-02

Treat-ments	Mean number of monocot weeds m^{-2}							
	2000-01				2001-02			
	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT
T_1	5.68 (32.50)	6.37 (40.75)	7.29 (53.25)	7.15 (51.50)	6.87 (47.25)	6.72 (45.50)	7.54 (57.25)	8.68 (75.50)
T_2	6.39 (41.00)	7.03 (49.50)	8.15 (66.50)	8.33 (69.75)	8.01 (64.25)	7.95 (63.25)	8.84 (78.50)	9.51 (90.75)
T_3	6.37 (40.75)	7.12 (50.75)	8.31 (69.25)	8.48 (72.25)	8.35 (70.00)	8.27 (68.50)	8.59 (74.25)	9.61 (92.50)
T_4	5.40 (29.25)	4.60 (21.25)	4.96 (24.75)	5.32 (28.50)	6.69 (45.00)	4.93 (24.50)	3.84 (15.00)	5.84 (34.25)
T_5	6.36 (40.50)	6.01 (36.25)	5.18 (27.00)	5.45 (30.00)	8.26 (68.25)	5.78 (33.00)	4.28 (18.75)	6.27 (39.50)
T_6	6.72 (45.25)	6.19 (38.50)	5.35 (28.75)	5.60 (31.50)	8.39 (70.50)	6.38 (40.75)	4.14 (17.25)	6.58 (43.50)
T_7	7.62 (58.25)	4.08 (16.75)	6.02 (36.25)	6.49 (42.25)	9.40 (88.25)	4.68 (22.25)	6.71 (45.25)	7.45 (56.25)
T_8	7.36 (54.25)	8.89 (79.25)	9.71 (94.50)	9.50 (90.50)	9.19 (84.75)	10.15 (103.00)	10.57 (112.00)	10.74 (115.50)
T_9	7.85 (61.75)	3.68 (13.75)	3.03 (9.25)	4.02 (16.25)	9.70 (94.25)	4.43 (19.75)	2.68 (7.25)	3.48 (12.25)
S.E(m)±	0.20	0.21	0.22	0.27	0.23	0.24	0.32	0.27
C.D.at 5%	0.58	0.61	0.65	0.79	0.67	0.73	0.94	0.79
Mean	6.64	6.00	6.43	6.71	8.32	6.59	6.35	7.57

N.B.: (i) Figures in parenthesis are original values.

(ii) Upper values are transformed values ($\sqrt{x}$)

4.1.2.1 Effect of different treatments on monocot weeds

The data regarding mean number of monocot weeds m^{-2} as affected by various treatments are presented in Table 10.

From the data presented in Table 10, it is seen that various treatments showed significant variations in monocotyledonous weed population at all the stages of crop growth in both the seasons. In general, the mean population of monocot weeds were maximum at 30 days after transplanting of chilli and thereafter there was a decrease during both the seasons of investigation but slightly increase at 120 DAT. The mean number of moconot weeds were more during 2001-02 as compared to that in 2000-01 season at 30, 60 and 120 DAT.

Table 11: Per cent reduction in number of monocot weeds m^{-2} as influenced by different treatments during 2000-01 at 30 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 5.68 (22.83)	T_2 6.39 (13.18)	T_3 6.37 (13.45)	T_7 7.62 (-3.53)	T_9 7.85 (-6.66)	T_8 7.36 (-)
T_4 5.40 (26.63)	T_5 6.36 (13.59)	T_6 6.72 (8.70)	-	-	-
S.E.(m)±	0.20				
C.D. at 5%	0.58				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction of monocot weeds over UWC.

From the above Table 11, during 2000-01 at 30 DAT, the data indicated that significantly lowest weed population m^{-2} was under the integrated treatment PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4). However, this treatment was at par with the PPI of trifluralin @ 1 Kg a.i. ha^{-1} (T_1) treatment and recorded 26.63 and 22.83 per cent raduction of monocot weeds over UWC respectively and were followed by treatments T_5, T_3, T_2 and T_6 which were at par with each other and reduced 13.59, 13.45, 13.18 and 8.70 per cent population of monocot weeds over UWC respectively. Treatments T_8, T_7 and T_9 were at par and significantly inferior in reducing weed population.

Data relating to the number of monocot weeds as influenced by different treatments are presented in Table 12.

Table 12: Per cent reduction in number of monocot weeds m^{-2} as influenced by different treatments during 2000-01 at 60 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 6.37 (28.35)	**T_2** 7.03 (20.92)	**T_3** 7.12 (19.91)	**T_7** 4.08 (54.11)	**T_9** 3.68 (58.61)	**T_8** 8.89 (-)
T_4 4.60 (48.26)	**T_5** 6.01 (32.40)	**T_6** 6.19 (30.37)	-	-	-
S.E.(m)±	0.21				
C.D. at 5%	0.61				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).
(ii) Figures in parenthesis are per cent reduction of monocot weeds over UWC.

During 2000-01, at 60 DAT, all the treatments showed significant reduction in monocot weeds m^{-2} over unweeded control. Cultural treatment two hoeings + two weedings at 30 and 60 DAT (T_9) registered highest reduction in monocot weeds m^{-2} over all other treatments but was at par with one hoeing + one weeding at 30 and 45 DAT (T_7) treatment. Whereas, treatment T_7 was also at par with PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing + one weeding at 45 and 60 DAT (T_4) treatment. Treatment T_4 followed by T_5, T_6, T_1, T_2 and T_3 treatments. However, treatments T_5, T_6 and T_1 were at par. Treatments, T_2 and T_3 were also equal in effect. Treatment unweeded control (T_8) recorded the significantly inferior in reduction of weed population as compared to all other treatments. The reduction in population of monocot weeds over unweeded control was 19.91, 20.92, 28.35,30.37, 32.40, 48.26, 54.11 and 58.61 per cent due to T_3, T_2, T_1, T_6, T_5, T_4, T_7 and T_9 treatments respectively.

Table 13: Per cent reduction in number of monocot weeds m^{-2} as influenced by different treatments during 2000-01 at 90 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 7.29 (24.92)	**T_2** 8.15 (16.07)	**T_3** 8.31 (14.42)	**T_7** 6.02 (38.00)	**T_9** 3.03 (68.80)	**T_8** 9.71 (-)
T_4 4.96 (48.92)	**T_5** 5.18 (46.65)	**T_6** 5.35 (44.90)	-	-	-
S.E.(m)±	0.22				
C.D. at 5%	0.65				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction of monocot weeds over UWC.

From the above Table, it could be seen that during 2000-01 at 90 DAT, significantly superior in reduction of weed population m^{-2} was under the cultural treatment, two hoeings + two weedings at 30 and 60 DAT (T_9) which reduced monocot population by 68.80 per cent over UWC. However, this treatment followed by treatments T_4, T_5 and T_6, which were at par and reduced 48.92, 46.65 and 44.90 per cent of monocot weeds over UWC respectively. Similarly, treatments T_7, T_1, T_2 and T_3 recorded (38.00, 24.92, 16.07 and 14.42 per cent respectively) significantly less reduction in monocot weeds as compared to T_6. Treatments T_2 and T_3 were at par but significantly better than UWC (T_8) treatment, which recorded significantly highest weed population compared to all other treatments.

Table 14: Per cent reduction in number of monocot weeds m^{-2} as influenced by different treatments during 2000-01 at 120 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 7.15 (24.74)	T_2 8.33 (12.32)	T_3 8.48 (10.74)	T_7 6.49 (31.68)	T_9 4.02 (57.68)	T_8 9.50 (-)
T_4 5.32 (44.00)	T_5 5.45 (42.63)	T_6 5.60 (41.05)	-	-	-
S.E.(m)±	0.27				
C.D. at 5%	0.79				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction of monocot weeds over UWC.

AT 120 DAT during 2000-01,similar trend was observed as that of 90 DAT, next to T_9, treatments T_4, T_5 and T_6 recorded the lowest weed population m^{-2} but was at par and significantly superior over treatments T_7, T_1, T_2, T_3 and T_8. The order of reduction in population of monocot weeds m^{-2} over control was in the sequence of 10.74, 12.32, 24.74, 31.68, 41,05, 42.63, 44.00 and 57.68 per cent due to T_3, T_2, T_1, T_7, T_6, T_5, T_4 and T_9 treatments respectively (Table 14).

Table 15: Per cent reduction in number of monocot weeds m^{-2} as influenced by different treatments during 2001-2002 at 30 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 6.87 (25.24)	T_2 8.01 (12.84)	T_3 8.35 (9.14)	T_7 9.40 (-2.29)	T_9 9.70 (-5.55)	T_8 9.19 (-)
T_4 6.69 (27.20)	T_5 8.26 (10.12)	T_6 8.39 (8.71)	-	-	-
S.E.(m)±	0.23				
C.D. at 5%	0.67				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction of monocot weeds m^{-2} over UWC.

The data from Table 15 revealed that, during 2001-02 at 30 DAT, treatments T_4 and T_1 were significantly superior over all other treatments and were at par in reduction of monocot weeds m^{-2}, 27.20 and 25.24 per cent respectively over UWC. They were followed by treatments T_2, T_5, T_3 and T_6, which were at par with each other. Treatments T_8, T_7 and T_9 were similar in effect and having highest in population of monocot weeds m^{-2}.

Table 16: Per cent reduction in number of monocot weeds m^{-2} as influenced by different treatments during 2001-02 at 60 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 6.72 (33.79)	**T_2** 7.95 (21.67)	**T_3** 8.27 (18.52)	**T_7** 4.68 (53.89)	**T_9** 4.43 (56.35)	**T_8** 10.15 (-)
T_4 4.93 (51.43)	**T_5** 5.78 (43.05)	**T_6** 6.38 (37.14)	-	-	-
S.E.(m)±	0.24				
C.D. at 5%	0.73				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).
(ii) Figures in parenthesis are per cent reduction of monocot weeds m^{-2} over UWC.

From Table 16, it could be ascertained that at 60 DAT during 2001-02, treatment T_9, T_7 and T_4 were at par and recorded least number of monocot weeds m^{-2}, which recorded 56.35, 53.89 and 51.43 per cent reduction of monocot weeds respectively over UWC and proved significantly superior over all other treatments. They were followed by treatments T_5, T_6, T_1, T_2, T_3 and T_8 and the percentage reduction of monocot weeds was to the extent of 43.05, 37.14, 33.79, 21.67 and 18.52 over UWC respectively. Treatments T_5 and T_6 were at par. Similarly, treatments T_6 and T_1 were showed no significant differences. T_2 and T_3 were also equal in effect. Treatment unweeded control (T_8) noticed the highest population of monocot weeds.

Similar trend was noticed at 90 and 120 DAT during 2001-02. The weed population m^{-2} was lowest under the cultural treatment T_9, which reduced 74.65 and 67.60 per cent weeds over UWC at 90 and 120 DAT respectively.

Table 17: Per cent reduction in number of monocot weeds m^{-2} as influenced by different treatments during 2001-02 at 90 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 7.54 (28.67)	**T_2** 8.84 (16.37)	**T_3** 8.59 (18.73)	**T_7** 6.71 (36.52)	**T_9** 2.68 (74.65)	**T_8** 10.57 (-)
T_4 3.84 (63.67)	**T_5** 4.28 (59.51)	**T_6** 4.14 (60.83)	-	-	-
S.E.(m)±	0.32				
C.D. at 5%	0.94				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction of monocot weeds m^{-2} over UWC.

Treatment T_9 proved significantly superior over to all other treatments. Treatment T_9 followed by treatments T_4, T_6, T_5, T_7, T_1, T_3, T_2 and T_8, which recorded 63.67, 60.83, 59.51, 36.52, 28.67, 18.73 and 16.37 per cent at 90 DAT and at 120 DAT 45.62, 38.73, 41.62, 30.63, 19.18, 10.52 and 11.45 per cent reduction of weeds over UWC respectively. Treatments T_4, T_6 and T_5 were at par. Treatments T_7 and T_1 were at par.Similarly treatments T_2 and T_3 were also equal in effect but superior than unweeded control (T_8) treatment (Table 17&18).

Table 18: Per cent reduction in number of monocot weeds m^{-2} as influenced by different treatments during 2001-02 at 120 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 8.68 (19.18)	T_2 9.51 (11.45)	T_3 9.61 (10.52)	T_7 7.45 (30.63)	T_9 3.48 (67.60)	T_8 10.74 (-)
T_4 5.84 (45.62)	T_5 6.27 (41.62)	T_6 6.58 (38.73)	-	-	-
S.E.(m)±	0.27				
C.D. at 5%	0.79				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction of monocot weeds m^{-2} over UWC.

4.1.2.2 Effect of different treatments on dicot weeds

Data pertaining to number of dicot weeds m^{-2} as influenced by different treatments are presented in Table 19.

From the Table 19 it is revealed that the maximum number of dicot weeds was recorded at 30 DAT and there was a reduction in weed population at subsequent growth stages during both the seasons of experimentation. However, in general unweeded control (T_8) recorded significantly the highest population of dicot weeds at all the stages of crop growth. The population of dicot weeds m^{-2} was affected significantly at all the growth stages due to different treatments.

Table 19: Mean number of dicot weeds m^{-2} as influenced by different treatments during 2000-01 and 2001-02

Treat-ments	Mean number of dicot weed m^{-2}							
	2000-01				2001-02			
	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT
T_1	3.83 (14.75)	4.58 (21.25)	5.95 (35.75)	5.61 (31.75)	2.82 (8.00)	4.22 (18.00)	5.20 (27.25)	4.55 (20.75)
T_2	4.85 (24.00)	5.79 (33.75)	6.74 (45.75)	6.09 (37.25)	3.44 (12.00)	5.22 (27.25)	6.11 (37.75)	5.25 (27.75)
T_3	5.06 (25.75)	5.86 (34.50)	6.98 (49.00)	6.35 (40.75)	3.50 (12.25)	5.54 (30.75)	6.48 (42.25)	5.51 (30.50)
T_4	4.05 (16.50)	3.37 (11.50)	2.53 (6.50)	2.82 (8.00)	2.95 (8.75)	3.43 (12.00)	2.11 (4.50)	2.77 (7.75)
T_5	5.43 (29.75)	4.88 (24.00)	2.68 (7.25)	3.34 (11.25)	4.09 (16.75)	4.49 (20.25)	2.43 (6.00)	3.07 (9.50)
T_6	5.25 (27.25)	4.83 (23.50)	2.94 (8.75)	3.56 (12.75)	3.86 (15.00)	4.43 (19.75)	2.49 (6.25)	3.16 (10.00)
T_7	7.31 (53.50)	3.28 (10.75)	4.37 (17.25)	4.53 (20.75)	7.43 (55.25)	3.52 (12.50)	3.77 (14.25)	3.89 (15.25)
T_8	7.47 (56.00)	8.21 (67.50)	9.06 (82.50)	8.25 (68.25)	7.98 (63.75)	8.52 (72.75)	9.01 (81.25)	7.25 (52.75)
T_9	6.90 (47.75)	2.54 (6.50)	2.63 (7.00)	3.05 (9.50)	6.76 (45.75)	2.80 (8.00)	2.05 (4.25)	3.04 (9.25)
S.E(m) ±	0.25	0.23	0.24	0.25	0.15	0.18	0.22	0.20
C.D.at5%	0.74	0.67	0.70	0.74	0.45	0.55	0.65	0.59
Mean	5.56	4.81	4.88	4.85	4.76	4.69	4.40	4.28

N.B.: (i) Figures in parenthesis are original values.

(ii) Upper values are transformed values ($\sqrt{x}$).

During 2000-01, at 30 DAT, PPI of trifluralin @ 1 Kg ha^{-1} (T_1) recorded least number of dicot weeds m^{-2} and was at par with PPI of trifluralin @ 1 Kg ha^{-1} + one hoeing + one weeding at 45 and 60 DAT (T_4). These treatments were followed by PPI of fluchloralin @ 1 Kg ha^{-1} (T_2) treatment and which was at par with treatments T_3, T_6 and T_5. Treatment unweeded control (T_8) recorded the highest number of dicot weeds m^{-2} and was at par with T_7 and T_9.

Table 20: Per cent reduction in number of dicot weeds m^{-2} as influenced by different treatments during 2000-01 at 30 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 3.83 (48.73)	**T_2** 4.85 (35.07)	**T_3** 5.06 (32.26)	**T_7** 7.31 (2.14)	**T_9** 6.90 (7.63)	**T_8** 7.47 (-)
T_4 4.05 (45.78)	**T_5** 5.43 (27.31)	**T_6** 5.25 (29.72)	-	-	-
S.E.(m)± C.D. at 5%	0.25 0.74				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction of dicot weeds m^{-2} over UWC.

From this table it could be ascertained that PPI application of trifluralin @ 1.0 Kg ha^{-1} played a vital role and reduced 48.73 and 45.78 per cent dicot weeds m^{-2} over UWC by T_1 and T_4 treatments. The reduction of dicot weeds m^{-2} over control was to the tune of 2.14, 7.63, 27.31, 29.72, 32.26, 35.07, 45.78 and 48.73 per cent due to T_7, T_9, T_5, T_6, T_3, T_2, T_4 and T_1 treatments respectively.

At 60 DAT during 2000-01 (Table 21), among the different weed control treatments, cultural treatment two hoeings + two weedings at 30 and 60 DAT (T_9) recorded lowest number of dicot weeds m^{-2} which reduced 69.06 per cent over UWC and proved significantly superior over all other treatments. Treatment T_9 followed by one hoeing + one weeding at 30 and 45 DAT (T_7)

Table 21: Per cent reduction in number of dicot weeds m^{-2} as influenced by different treatments during 2000-01 at 60 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 4.58 (44.21)	**T_2** 5.79 (29.48)	**T_3** 5.86 (28.62)	**T_7** 3.28 (60.05)	**T_9** 2.54 (69.06)	**T_8** 8.21 (-)
T_4 3.37 (58.95)	**T_5** 4.88 (40.56)	**T_6** 4.83 (41.17)	-	-	-
S.E.(m)± C.D. at 5%	0.23 0.67				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction of dicot weeds m^{-2} over UWC.

treatment and was at par with PPI of trifluralin @ 1Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) treatment which were recorded 60.05 and 58.95 per cent reduction of weed over UWC. It was also found that next to T_4, treatments T_1, T_6, T_5, T_2 and T_3 recorded the lowest weed population than unweeded control (T_8) treatment. Treatments T_1, T_6 and T_5 were at par. T_2 and T_3 were also at par with each other. The order of reduction of dicot weeds m^{-2} over control was in the sequence of 28.62, 29.48, 40.56, 41.17, 44.21, 58.95, 60.05 and 69.06 percent due to T_3, T_2, T_5, T_6, T_1, T_4, T_7 and T_9 treatments respectively.

Table 22: Per cent reduction in number of dicot weeds m^{-2} as influenced by different treatments during 2000-01 at 90 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1HW	2H + 2HW	UWC
T_1 5.95 (34.33)	**T_2** 6.74 (25.61)	**T_3** 6.98 (22.96)	**T_7** 4.37 (51.77)	**T_9** 2.63 (70.97)	**T_8** 9.06 (-)
T_4 2.53 (72.08)	**T_5** 2.68 (70.42)	**T_6** 2.94 (67.55)	-	-	-
S.E.(m)± C.D. at 5%	0.24 0.70				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction of dicot weeds m^{-2} over UWC.

From the Table 22 and 23, it could be seen that, at 90 DAT and at 120 DAT more or less similar trend were recorded in population of dicot weeds m^{-2}. PPI of trifluralin @ 1 Kg ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) treatment noticed the least number of dicot weeds m^{-2} and was at par with treatments T_9, T_5 and T_6 which were recorded 72.08, 70.97, 70.42 and 67.55 per cent at 90 DAT and at 120 DAT, 65.82, 63.03, 59.52 and 56.85 per cent reduction of dicot weeds over UWC respectively. Treatment T_6 followed by treatments T_7, T_1, T_2, T_3 and T_8 these treatments reduced 51.77, 34.33, 25.61 and 22.96 per cent at 90 DAT and at 120 DAT 45.09, 32.00, 26.18 and 23.03 per cent of dicot weeds over unweeded control respectively.

Table 23: Per cent reduction in number of dicot weeds m^{-2} as influenced by different treatments during 2000-01 at 120 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 5.61 (32.00)	**T_2** 6.09 (26.18)	**T_3** 6.35 (23.03)	**T_7** 4.53 (45.09)	**T_9** 3.05 (63.03)	**T_8** 8.25 (-)
T_4 2.82 (65.82)	**T_5** 3.34 (59.52)	**T_6** 3.56 (56.85)	-	-	-
S.E.(m)±	0.25				
C.D. at 5%	0.74				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction of dicot weeds m^{-2} over UWC.

The data on effect of various treatments on population of dicot weeds m^{-2} are presented in Table 24. At 30 DAT during 2001-02, among the weed control treatments, PPI of trifluralin @ 1 Kg ha^{-1} (T_1) treatment recorded, the significantly superior in reduction of weed population m^{-2}, 64.79 per cent over UWC and recorded least number of weeds but was at par with PPI of trifluralin @

Table 24: Per cent reduction in number of dicot weeds m^{-2} as influenced by different treatments during 2001-02 at 30 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 2.81 (64.79)	T_2 3.44 (56.89)	T_3 3.50 (56.14)	T_7 7.43 (6.89)	T_9 6.76 (15.29)	T_8 7.98 (-)
T_4 2.95 (63.03)	T_5 4.09 (48.75)	T_6 3.86 (51.63)	-	-	-
S.E.(m)±	0.15				
C.D. at 5%	0.45				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction of dicot weeds m^{-2} over UWC.

1 Kg a.i. ha^{-1} + one hoeing + one weeding at 45 and 60 DAT (T_4) treatment that reduced 63.03 per cent of dicot weeds over UWC. Next to T_4, treatments T_2, T_3, T_6 and T_5 were better than the rest of treatments and were at par with each other. Unweeded control (T_8) treatment recorded the highest number of dicot weeds m^{-2}.

From the Table 24, it is seen that the per cent reduction of dicot weeds m^{-2} over unweeded control was 6.89, 15.29, 48.75, 51.63, 56.14, 56.89, 63.03 and 64.79 in case of T_7, T_9, T_5, T_6, T_3, T_2, T_4 and T_1.

Table 25: Per cent reduction in number of dicot weeds m^{-2} as influenced by different treatments during 2001-02 at 60 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1HW	2H + 2HW	UWC
T_1 4.22 (50.47)	T_2 5.22 (38.73)	T_3 5.54 (34.98)	T_7 3.52 (58.69)	T_9 2.80 (67.14)	T_8 8.52 (-)
T_4 3.43 (59.74)	T_5 4.49 (47.30)	T_6 4.43 (48.00)	-	-	-
S.E.(m)±	0.18				
C.D. at 5%	0.55				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction of dicot weeds m^{-2} over UWC.

At 60 DAT during 2001-02, Table 25 indicated that, two hoeings + two weedings at 30 and 60 DAT (T_9) treatment recorded the significantly superior in reduction of dicot weeds m^{-2}, 67.14 per cent over UWC. This was followed by treatments T_4, T_7, T_1, T_6, T_5, T_2, T_3 and T_8. Which were recorded 59.74, 58.69, 50.47, 48.00, 47.30, 38.73 and 34.98 per cent reduction of dicot weeds m^{-2} over unweeded control (T_8) treatment. Unweeded control (T_8) treatment recorded significantly inferior in reduction of dicot weeds.

Table 26: Per cent reduction in number of dicot weeds m^{-2} as influenced by different treatments during 2001-02 at 90 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 5.20 (42.29)	**T_2** 6.11 (32.19)	**T_3** 6.48 (28.08)	**T_7** 3.77 (58.16)	**T_9** 2.05 (77.25)	**T_8** 9.01 (-)
T_4 2.11 (76.58)	**T_5** 2.43 (73.03)	**T_6** 2.49 (72.36)	-	-	-
S.E.(m)±	0.22				
C.D. at 5%	0.65				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).
(ii) Figures in parenthesis are per cent reduction of dicot weeds m^{-2} over UWC.

From this Table, at 90 DAT during 2001-02, it is clear that cultural treatment, two hoeings + two weedings at 30 and 60 DAT (T_9) recorded the least number of dicot weeds m^{-2} and were at par with integrated treatments T_4, T_5 and T_6, which were reduced 77.25, 76.58, 73.03 and 72.36 per cent of dicot weeds over UWC respectively. These treatments were followed by treatments T_7, T_1, T_2, T_3 and T_8. Treatments T_2 and T_3 were equal in effect and superior over unweeded treatment (T_8) which recorded the highest number of weeds than all other treatments.

Table 27: Per cent reduction in number of dicot weeds m^{-2} as influenced by different treatments during 2001-02 at 120 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 4.55 (37.24)	**T_2** 5.25 (27.59)	**T_3** 5.51 (24.00)	**T_7** 3.89 (46.34)	**T_9** 3.04 (58.07)	**T_8** 7.25 (-)
T_4 2.77 (61.79)	**T_5** 3.07 (57.66)	**T_6** 3.16 (56.41)	-	-	-
S.E.(m)±	0.20				
C.D. at 5%	0.59				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction of dicot weeds m^{-2} over UWC.

At 120 DAT during 2001-02, from the above Table, it could be ascertained that the lowest population of dicot weeds m^{-2} was recorded by integrated treatment PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) but this treatment was at par with treatments T_9, T_5 and T_6. Treatment T_6 followed by treatments T_7, T_1, T_2, T_3 and T_8. Treatments T_2 and T_3 were equal in effect and superior over T_8 treatment. Treatments T_3, T_2, T_1, T_7, T_6, T_5, T_9 and T_4 reduced 24.00, 27.59, 37.24, 46.34, 56.41, 57.66, 58.07 and 61.79 per cent of dicot weeds m^{-2} over UWC respectively.

4.1.2.3 Effect of different treatments on total weed population

The data regarding total weed population m^{-2} recorded at 30, 60, 90 and 120 DAT are presented in Table 28 and depicted in Figure 4 and 5.

From the Table 28, it is revealed that the various treatments significantly affected total weed population m^{-2} at all stages of crop growth. Except at 30 DAT, unweeded control (T_8) treatment recorded significantly the

Table 28: Total number of weeds m^{-2} as influenced by different treatments during 2000-01 and 2001-02

Treat-ments	Total number of weeds m^{-2}							
	2000-01				2001-02			
	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT
T_1	6.86 (47.25)	7.85 (62.00)	9.40 (89.00)	9.10 (83.25)	7.42 (55.25)	7.95 (63.50)	9.17 (84.50)	9.80 (96.25)
T_2	8.03 (65.00)	9.11 (83.25)	10.57 (112.25)	10.33 (107.00)	8.71 (76.25)	9.50 (90.50)	10.77 (116.25)	10.88 (118.50)
T_3	8.12 (66.50)	9.21 (85.25)	10.85 (118.25)	10.62 (113.00)	9.06 (82.25)	9.95 (99.25)	10.79 (116.50)	11.09 (123.00)
T_4	6.72 (45.75)	5.69 (32.75)	5.57 (31.25)	6.03 (36.50)	7.31 (53.75)	5.99 (36.50)	4.39 (19.50)	6.48 (42.00)
T_5	8.36 (70.25)	7.74 (60.25)	5.82 (34.25)	6.40 (41.25)	9.21 (85.00)	7.29 (53.25)	4.95 (24.75)	6.99 (49.00)
T_6	8.53 (73.00)	7.85 (62.00)	6.10 (37.50)	6.63 (44.25)	9.22 (85.50)	7.77 (60.50)	4.84 (23.50)	7.31 (53.50)
T_7	10.55 (111.75)	5.22 (27.50)	7.28 (53.50)	7.92 (63.00)	11.97 (143.50)	5.88 (34.75)	7.70 (59.50)	8.45 (71.50)
T_8	10.48 (110.25)	12.09 (146.75)	13.29 (177.00)	12.58 (158.75)	12.18 (148.50)	13.25 (175.75)	13.90 (193.25)	12.97 (168.25)
T_9	10.43 (109.50)	4.48 (20.25)	4.00 (16.25)	5.04 (25.75)	11.82 (140.00)	5.25 (27.75)	3.38 (11.50)	4.63 (21.50)
S.E(m)± C.D.at5%	0.39 1.15	0.37 1.11	0.39 1.14	0.33 0.97	0.32 0.92	0.31 0.90	0.26 0.76	0.21 0.62
Mean	8.67	7.69	8.10	8.32	9.65	8.09	7.76	8.73

N.B.: (i) Figures in parenthesis are original values.

(ii) Upper values are transformed values ($\sqrt{x}$).

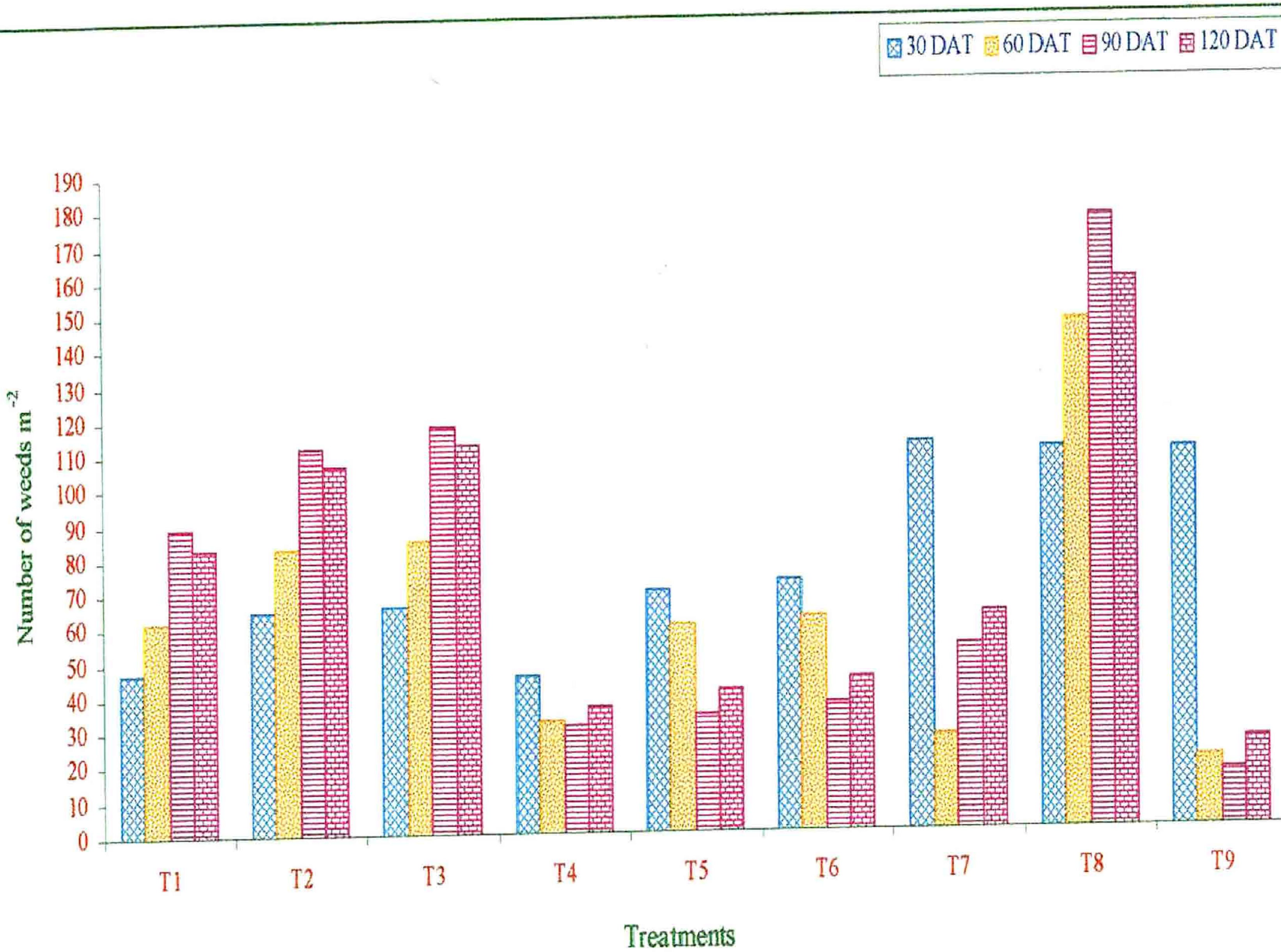

Figure 4: Total number of weeds m^{-2} as influenced by different treatments during 2000-01

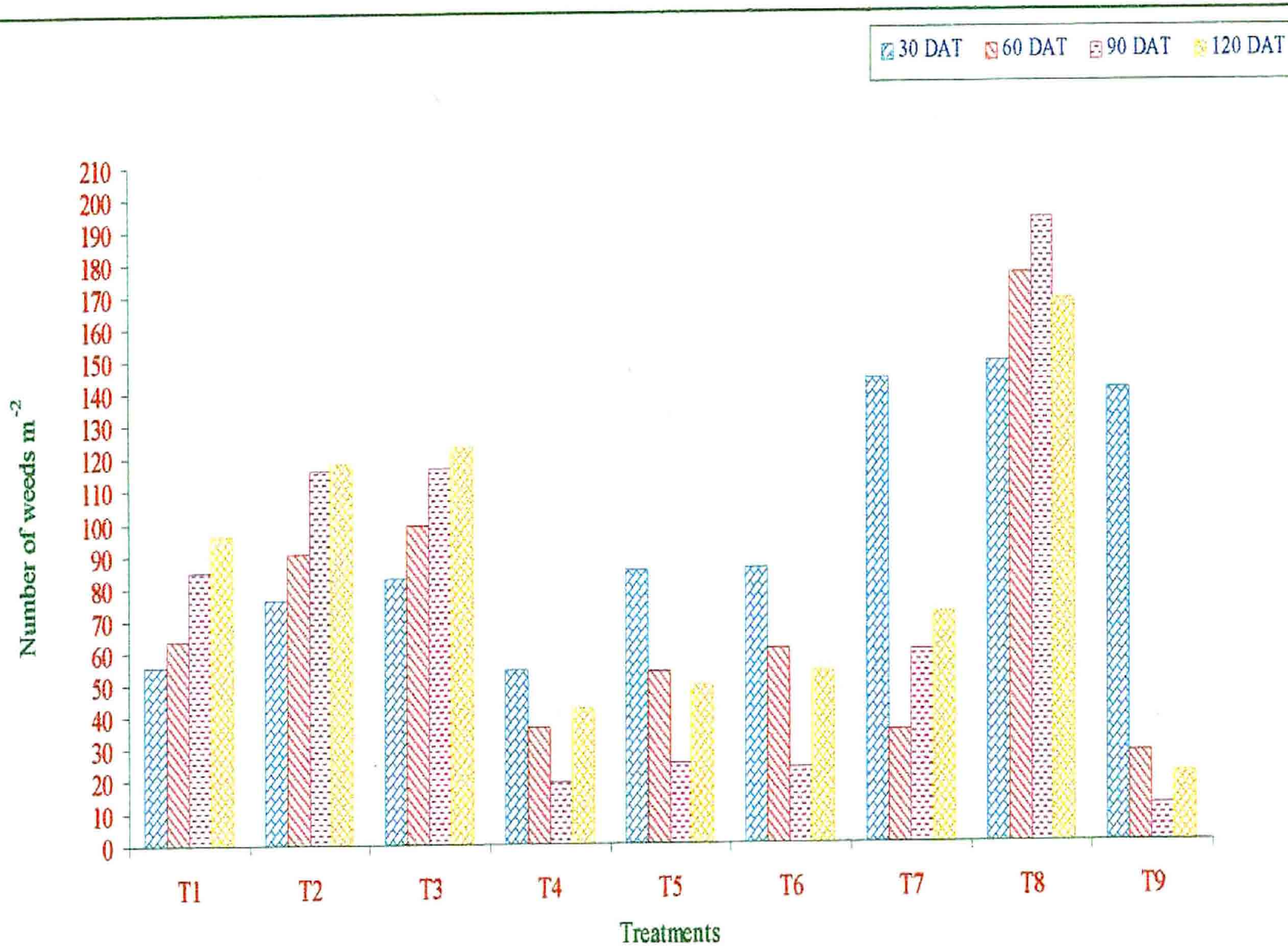

Figure 5: Total number of weeds m^{-2} as influenced by different treatments during 2001-02

highest total weed population at all stages of crop growth. In general, maximum weed population was observed at 30 DAT and thereafter there was a gradual decrease in mean total weed population but slightly increase at 120 DAT. Highest total weed population (177.00 and 193.25) m^{-2} was recorded at 90 DAT under unweeded (T_8) treatment during both the year respectively, however, it was decreased at 120 DAT.

Table 29: Per cent reduction in total number of weeds m^{-2} as influenced by different treatments during 2000-01 at 30 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 6.86 (34.54)	**T_2** 8.03 (23.38)	**T_3** 8.12 (22.52)	**T_7** 10.55 (-0.67)	**T_9** 10.43 (0.48)	**T_8** 10.48 (-)
T_4 6.72 (35.88)	**T_5** 8.36 (20.23)	**T_6** 8.53 (18.61)	-	-	-
S.E (m)±	0.39				
C.D. at 5%	1.15				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).
(ii) Figures in parenthesis are per cent reduction in total number of weeds m^{-2} over control.

From the above Table, it is observed that, during 2000-01 at 30 DAT, PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing + one weeding at 45 and 60 DAT (T_4) treatment and PPI of trifluralin @ 1 Kg a.i. ha^{-1} (T_1) were significantly superior over all other treatments and reduced maximum number of weeds m^{-2}, 35.88 and 34.54 respectively. Treatments T_2, T_3, T_5 and T_6 were at par and the next best treatments which were superior over remaining treatments and recorded 23.38, 22.52, 20.23 and 18.61 per cent of weed population over UWC. However, one hoeing + one weeding at 30 and 45 DAT (T_7) recorded the highest weed population m^{-2} but it was at par with T_8 and T_9 treatments.

Table 30: Per cent reduction in total number of weeds m^{-2} as influenced by different treatments during 2000-01 at 60 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 7.85 (35.07)	T_2 9.11 (24.65)	T_3 9.21 (23.82)	T_7 5.22 (56.82)	T_9 4.48 (62.94)	T_8 12.09 (-)
T_4 5.69 (52.94)	T_5 7.74 (35.98)	T_6 7.85 (35.07)	-	-	-
S.E.(m)±	0.37				
C.D. at 5%	1.11				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction in total number of weeds m^{-2} over control.

During 2000-01, at 60 DAT from the Table 30, it is seen that, cultural treatment two hoeings + two weeding at 30 and 60 DAT (T_9) recorded least number of weeds m^{-2} and was at par with T_7. However, T_7 and T_4 were equal in effect and significantly superior over rest of the treatments and which recorded 62.94, 56.82 and 52.94 per cent reduction of weeds over UWC (T_8) respectively. Treatments T_5, T_1 and T_6 were the next best treatments and superior over T_2 and T_3, these treatments were at par among themselves. Treatment unweeded control (T_8) noticed the highest weed population than all other treatments. The percentages of reduction in total weeds m^{-2} over control were 23.82, 24.65, 35.07, 35.07, 35.98, 52.94, 56.82 and 62.94 under T_3, T_2, T_6, T_1, T_5, T_4, T_7 and T_9 treatments respectively.

The data pertaining to effect of various treatments on total weed population are presented in Table 31 and 32. During 2000-01, at both 90 and 120 DAT, significantly superior and lowest weed population m^{-2} was under

Table 31: Per cent reduction in total number of weeds m^{-2} as influenced by different treatments during 2000-01 at 90 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 9.40 (29.27)	T_2 10.57 (20.47)	T_3 10.85 (18.36)	T_7 7.28 (45.22)	T_9 4.00 (69.90)	T_8 13.29 (-)
T_4 5.57 (58.09)	T_5 5.82 (56.21)	T_6 6.10 (54.10)	-	-	-
S.E.(m)±	0.39				
C.D. at 5%	1.14				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction in total number of weeds m^{-2} over UWC.

the two hoeings + two weedings at 30 and 60 DAT (T_9) treatment, it was followed by treatments T_4, T_5, T_6, T_7, T_1, T_2, T_3 and T_8 which were reduced 69.90, 58.09, 56.21, 54.10, 45.22, 29.27, 20.47 and 18.36 per cent at 90 DAT and at 120 DAT 59.94, 52.07, 49.13, 47.30, 37.04, 27.66, 17.89 and 15.58 per cent over UWC respectively. Treatments T_4, T_5 and T_6 were at par, similarly, treatments T_2 and T_3 were also equal in effect with each other. Highest weed population was recorded under unweeded control (T_8) treatment.

Table 32: Per cent reduction in total number of weeds m^{-2} as influenced by different treatments during 2000-01 at 120 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 9.10 (27.66)	T_2 10.33 (17.89)	T_3 10.62 (15.58)	T_7 7.92 (37.04)	T_9 5.04 (59.94)	T_8 12.58 (-)
T_4 6.03 (52.07)	T_5 6.40 (49.13)	T_6 6.63 (47.30)	-	-	-
S.E.(m)±	0.33				
C.D. at 5%	0.97				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction in total number of weeds m^{-2} over UWC.

Table 33: Per cent reduction in total number of weeds m^{-2} as influenced by different treatments during 2001-02 at 30 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 7.42 (39.08)	**T_2** 8.71 (28.49)	**T_3** 9.06 (25.62)	**T_7** 11.97 (1.72)	**T_9** 11.82 (2.96)	**T_8** 12.18 (-)
T_4 7.31 (39.98)	**T_5** 9.21 (24.38)	**T_6** 9.22 (24.30)	-	-	-
S.E.(m)±	0.32				
C.D. at 5%	0.92				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction in total number of weeds m^{-2} over UWC.

From the Table 33 at 30 DAT during 2001-02, it is seen that, PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) and PPI of trifluralin @ 1Kg a.i. ha^{-1} (T_1) treatments were at par and recorded 39.98 and 39.08 per cent reduction of weeds over UWC respectively and proved significantly superior in lowest population of weeds m^{-2} over all other treatments. Treatments T_2, T_3, T_5 and T_6 were at par and the next best treatments, which reduced 28.49, 25.62, 24.38 and 24.30 per cent weed population over UWC respectively. The highest total weed population was observed in unweeded control (T_8) treatment and was at par with T_7 and T_9 treatments.

The effects of various treatments on total number of weeds m^{-2} are presented in Table 34.

From the above Table, at 60 DAT during 2001-02, it is evident that the cultural treatment two hoeings + two weedings at 30 and 60 DAT (T_9) noticed the least number of weeds m^{-2} and recorded 60.38 per cent reduced of weeds over UWC and proved significantly superior over all other treatments except treatments

Table 34: Per cent reduction in total number of weeds m^{-2} as influenced by different treatments during 2001-02 at 60 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 7.95 (40.00)	T_2 9.50 (28.30)	T_3 9.95 (24.91)	T_7 5.88 (55.62)	T_9 5.25 (60.38)	T_8 13.25 (-)
T_4 5.99 (54.79)	T_5 7.29 (44.98)	T_6 7.77 (41.35)	-	-	-
S.E.(m)±	0.31				
C.D. at 5%	0.90				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction in total number of weeds m^{-2} over UWC.

T_7 and T_4, which reduced 55.62 and 54.79 per cent weeds over UWC respectively. They were followed by treatments T_5, T_6, T_1, T_2, T_3 and T_8. Treatment T_5, T_6 and T_1 were at par and superior than T_2 and T_3 which were also equal in effect. Unweeded control (T_8) recorded the highest weed population compared to all other treatments.

The data regarding per cent reduction in total number of weeds m^{-2} as influenced by different treatments during 2001-2002 at 90 DAT are presented in Table 35.

Table 35: Per cent reduction in total number of weeds m^{-2} as influenced by different treatments during 2001-02 at 90 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 9.17 (34.03)	T_2 10.77 (22.52)	T_3 10.79 (22.37)	T_7 7.70 (44.60)	T_9 3.38 (75.68)	T_8 13.90 (-)
T_4 4.39 (68.42)	T_5 4.95 (64.39)	T_6 4.84 (65.18)	-	-	-
S.E.(m)±	0.26				
C.D. at 5%	0.76				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction in total number of weeds m^{-2} over UWC.

During 2001-02, at 90 DAT, least number of weeds m^{-2} was recorded under cultural treatment, two hoeings + two weedings at 30 and 60 DAT (T_9) treatment that was significantly superior over all other treatments and recorded 75.68 per cent reduction of weeds over UWC. Treatments T_4, T_6 and T_5 were at par and the next best treatments which were reduced 68.42, 65.18 and 64.39 per cent of weeds over UWC, these treatments were significantly superior over rest of the treatments. Treatments T_2 and T_3 were also equal in effect and superior over UWC (T_8), which recorded highest weed population.

Table 36: Per cent reduction in total number of weeds m^{-2} as influenced by different treatments during 2001-02 at 120 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 9.80 (24.44)	T_2 10.88 (16.11)	T_3 11.09 (14.49)	T_7 8.45 (34.85)	T_9 4.63 (64.30)	T_8 12.97 (-)
T_4 6.48 (50.04)	T_5 6.99 (46.11)	T_6 7.31 (43.64)	-	-	-
S.E.(m)±	0.21				
C.D. at 5%	0.62				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction in total number of weeds m^{-2} over UWC.

From the above Table, it is observed that, during 2001-02 at 120 DAT, cultural treatment two hoeings + two weedings at 30 and 60 DAT (T_9) noticed the significantly lowest number of weeds m^{-2} and recorded 64.30 per cent reduction of weeds over UWC, followed by treatments T_4, T_5 and T_6 which were at par and reduced 50.04, 46.11 and 43.64 per cent of weeds over UWC. These treatments were significantly superior over rest of the treatments. Treatment T_6 followed by T_7, T_1, T_2, T_3 and T_8 treatments. However, treatments T_2 and T_3 were at par and superior over treatment unweeded control (T_8).

4.1.3 Effect of different treatments on dry weed biomass production of weeds

The dry weight of weeds indicates the magnitude of competition, which the weeds offer to the crop plants. The data in respect of dry weight of weeds at 30, 60, 90 and 120 DAT are presented in Table 37 and depicted in figure 6 and 7.

Table 37: Dry weed biomass (g m^{-2}) at different growth stages of chilli as influenced by various treatments during 2000-01 and 2001-02

Treat-ments	Dry weed biomass (g m^{-2})							
	2000-01				2001-02			
	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT
T_1	2.56 (6.70)	5.82 (34.15)	8.07 (65.85)	8.68 (75.70)	2.88 (8.35)	5.71 (32.95)	8.01 (64.40)	8.91 (79.55)
T_2	3.21 (10.40)	6.80 (46.55)	9.20 (84.90)	9.91 (98.45)	3.71 (13.85)	7.04 (49.75)	9.28 (86.25)	10.16 (103.35)
T_3	3.34 (11.30)	6.89 (47.75)	9.40 (88.65)	10.24 (105.10)	4.03 (16.35)	7.40 (54.85)	9.51 (90.50)	10.61 (112.80)
T_4	2.51 (6.35)	4.12 (17.25)	4.44 (20.00)	5.61 (31.75)	2.69 (7.35)	4.32 (18.90)	3.84 (14.75)	5.83 (34.00)
T_5	3.43 (11.95)	5.67 (32.50)	4.71 (22.60)	6.01 (36.30)	4.03 (16.25)	5.34 (28.70)	4.50 (20.70)	6.55 (42.90)
T_6	3.40 (11.70)	5.76 (33.45)	4.94 (24.75)	6.22 (38.90)	4.14 (17.30)	5.62 (31.65)	4.20 (17.75)	7.05 (49.80)
T_7	4.47 (20.10)	3. 76 (14.30)	6.16 (38.20)	7.78 (60.75)	5.07 (25.75)	4.15 (17.25)	6.53 (42.65)	8.06 (65.40)
T_8	4.30 (18.75)	9.04 (82.15)	11.64 (136.30)	12.46 (155.60)	5.28 (27.95)	10.01 (100.40)	12.28 (150.90)	12.72 (161.90)
T_9	4.29 (18.60)	3.21 (10.50)	3.20 (10.40)	4.71 (22.40)	4.87 (23.75)	3.87 (15.25)	3.07 (9.55)	4.32 (18.75)
S.E(m)±	0.21	0.30	0.37	0.29	0.18	0.26	0.25	0.25
C.D.at5%	0.61	0.89	1.09	0.85	0.54	0.75	0.75	0.74
Mean	3.50	5.68	6.86	7.96	4.08	5.94	6.80	8.24

N.B.: (i) Figures in parenthesis are original values.

(ii) Upper values are transformed values ($\sqrt{x}$).

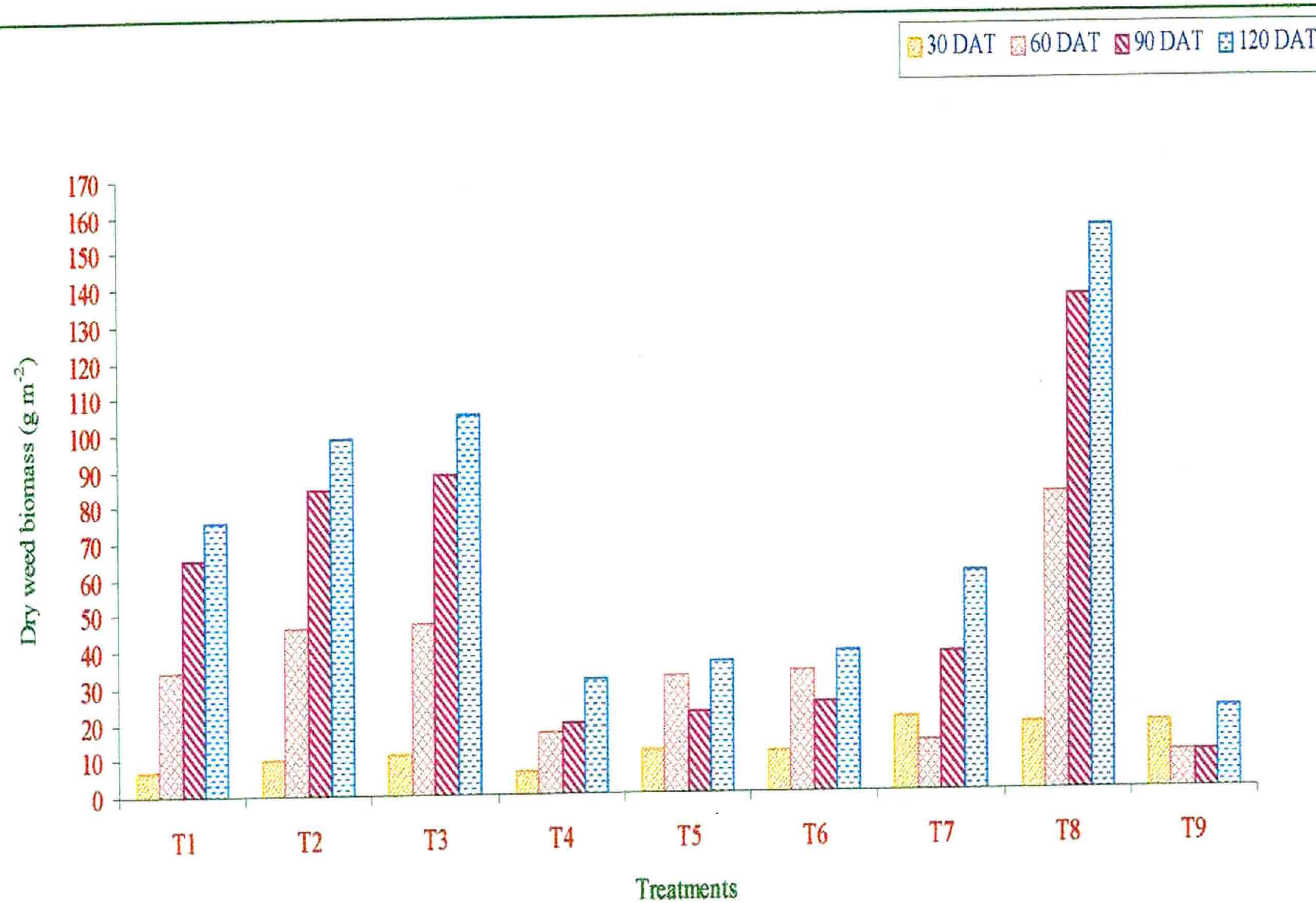

Figure 6: Dry weed biomass (g m^{-2}) at different growth stages of chilli as influenced by various treatments during 2000-01

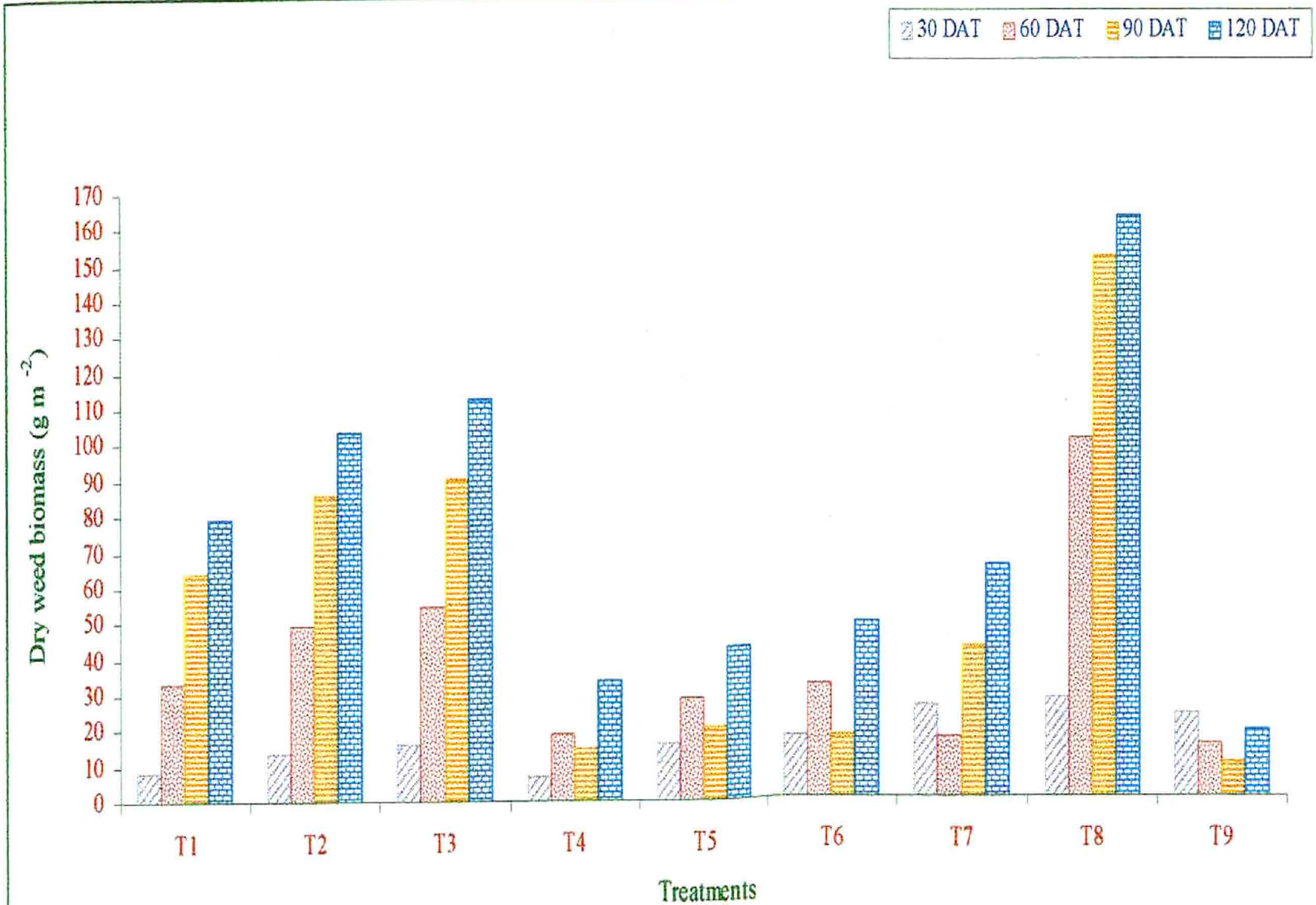

Figure 7: Dry weed biomass (g m^{-2}) at different growth stages of chilli as influenced by various treatments during 2001-02

From the Table 37, it is revealed that the data on dry weight of weeds as influenced by different methods of weed control were significant at all the growth stages of chilli crop. All the weed control treatments recorded significantly lower dry weight of weeds than unweeded control (T_8) treatment at all the growth stages except at 30 DAT. In general, during both the years the dry matter production by weeds was minimum at 30 DAT and maximum at 120 DAT.

Table 38: Per cent reduction in dry weed biomass (g m^{-2}) as influenced by different treatments during 2000-01 at 30 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 2.56 (40.47)	**T_2** 3.21 (25.35)	**T_3** 3.34 (22.33)	**T_7** 4.47 (-3.95)	**T_9** 4.29 (0.23)	**T_8** 4.30 (-)
T_4 2.51 (41.63)	**T_5** 3.43 (20.23)	**T_6** 3.40 (20.93)	-	-	-
S.E.(m)±	0.21				
C.D. at 5%	0.61				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction of the dry weed biomass over UWC.

From the above Table, it is evident that during 2000-01 at 30 DAT, lowest weed dry matter production was recorded in PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) treatment and was significantly superior over rest of the treatments except T_1 treatment, which was at par with T_4 treatment and recorded 41.63 and 40.47 per cent reduction of dry weight of weeds over UWC respectively. Treatments T_2, T_3, T_6 and T_5 were next best treatments but were equal in effect which were reduced 25.35, 22.33, 20.93 and 20.23 per cent dry weight of weeds over UWC respectively. Highest dry matter production by weeds was recorded in one hoeing + one weeding at 30 and 45 DAT (T_7) treatment and was at par with T_8 and T_9 treatments.

Table 39: Per cent reduction in dry weed biomass (g m^{-2}) as influenced by different treatments during 2000-01 at 60 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 5.82 (35.62)	**T_2** 6.80 (24.78)	**T_3** 6.89 (23.78)	**T_7** 3.76 (58.41)	**T_9** 3.21 (64.49)	**T_8** 9.04 (-)
T_4 4.12 (54.42)	**T_5** 5.67 (37.28)	**T_6** 5.76 (36.28)	-	-	-
S.E.(m)±	0.30				
C.D. at 5%	0.89				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction of the dry weed biomass over UWC.

During 2000-01 at 60 DAT, from the Table 39, it is seen that treatments T_9 and T_7 were at par while, T_7 was at par with T_4 treatment and recorded least dry weight of weeds which reduced 64.49, 58.41 and 54.42 per cent dry weight of weeds over UWC respectively. They were significantly superior over all other treatments. Treatments T_5, T_6 and T_1 were next best treatments but were equal in effect that recorded 37.28, 36.28 and 35.62 per cent reduction of dry weight of weeds respectively over UWC. Treatment T_1 followed by T_2 and T_3 treatments, which were at par and recorded 24.78 and 23.78 per cent reduction of dry weight respectively over UWC (T_8) treatment.

Table 40: Per cent reduction in dry weed biomass (g m^{-2}) as influenced by different treatments during 2000-01 at 90 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 8.07 (30.67)	**T_2** 9.20 (20.96)	**T_3** 9.40 (19.24)	**T_7** 6.16 (47.08)	**T_9** 3.20 (72.51)	**T_8** 11.64 (-)
T_4 4.44 (61.86)	**T_5** 4.71 (59.54)	**T_6** 4.94 (57.56)	-	-	-
S.E.(m)±	0.37				
C.D. at 5%	1.09				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).

(ii) Figures in parenthesis are per cent reduction of the dry weed biomass over UWC.

The effect of various treatments on dry weight of weeds during 2000-01 at 90 and 120 DAT are presented in Table 40 and 41. From the data, it is evident that the effect of different treatments on dry weight of weeds at 90 and 120 DAT was noticed similar trend. The cultural treatment T_9 produced less dry weight of weeds and reduced 72.51 and 62.20 per cent at 90 and 120 DAT over UWC, it was significantly superior over all other treatments. Treatments T_4, T_5 and T_6 were the next best treatments and were equal in effect. However, these treatments were significantly superior over T_7, T_1, T_2, T_3 and T_8 treatments. Treatments T_2 and T_3 were equal in effect and superior over unweeded control (T_8) treatment. The reduction of dry weight of weeds over unweeded control ranged in between 19.24 to 72.51 per cent at 90 DAT and 17.82 to 62.20 per cent at 120 DAT.

Table 41: Per cent reduction in dry weed biomass (g m^{-2}) as influenced by different treatments during 2000-01 at 120 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 8.68 (30.34)	T_2 9.91 (20.47)	T_3 10.24 (17.82)	T_7 7.78 (37.56)	T_9 4.71 (62.20)	T_8 12.46 (-)
T_4 5.61 (54.98)	T_5 6.01 (51.77)	T_6 6.22 (50.09)	-	-	-
S.E.(m)±	0.29				
C.D. at 5%	0.85				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).
(ii) Figures in parenthesis are per cent reduction of the dry weed biomass over UWC.

The effect of various treatments at 30 DAT during 2001-02 are presented in Table 42.

Table 42: Per cent reduction in dry weed biomass (g m^{-2}) as influenced by different treatments during 2001-02 at 30 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 2.88 (45.45)	T_2 3.71 (29.73)	T_3 4.03 (23.67)	T_7 5.07 (3.98)	T_9 4.87 (7.77)	T_8 5.28 (-)
T_4 2.69 (49.05)	T_5 4.03 (23.67)	T_6 4.14 (21.59)	-	-	-
S.E.(m)±	0.18				
C.D. at 5%	0.54				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).
(ii) Figures in parenthesis are per cent reduction of the dry weed biomass over UWC.

From the Table 42, it is revealed that the PPI of trifluralin @ 1Kg. a.i.ha^{-1} + one hoeing + one weeding at 45 and 60 DAT (T_4) treatment proved significantly superior over all other treatments except T_1 treatment. These treatments (T_4 and T_1) reduced 49.05 and 45.45 per cent of dry weight of weeds respectively over control. Treatment T_2 was next in order for reducing dry weight of weeds and it was at par with treatments T_3, T_5 and T_6 that recorded 29.73, 23.67, 23.67 and 21.59 per cent reduction of dry weight of weeds respectively over unweeded control (T_8) treatment. These treatments were significantly superior over treatments T_9, T_7 and T_8, which recorded the highest dry weight of weeds.

Table 43: Per cent reduction in dry weed biomass (g m^{-2}) as influenced by different treatments during 2001-02 at 60 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 5.71 (42.96)	**T_2** 7.04 (29.67)	**T_3** 7.40 (26.07)	**T_7** 4.15 (58.54)	**T_9** 3.87 (61.34)	**T_8** 10.01 (-)
T_4 4.32 (56.84)	**T_5** 5.34 (46.65)	**T_6** 5.62 (43.86)	-	-	-
S.E.(m)±	0.26				
C.D. at 5%	0.75				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).
(ii) Figures in parenthesis are per cent reduction of the dry weed biomass over UWC.

During 2001-02 at 60 DAT, significant effect on reduction of dry weight of weeds over control are presented in Table 43.

Cultural treatment, two hoeings + two weedings at 30 and 60 DAT (T_9) had recorded least dry weight of weeds and was at par with T_7 and T_4 treatments and significantly superior over treatments T_5, T_6, T_1, T_2, T_3 and T_8 respectively.

Treatment T_5, T_6 and T_1 were at par with each other. Treatments T_2 and T_3 were also equal in effect. Per cent reduction of dry weight of weeds m^{-2} over control ranged in between 26.07 to 61.34 under T_3 and T_9 treatments respectively.

Table 44: Per cent reduction in dry weed biomass (g m^{-2}) as influenced by different treatments during 2001-02 at 90 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 8.01 (34.77)	**T_2** 9.28 (24.43)	**T_3** 9.51 (22.56)	**T_7** 6.53 (46.82)	**T_9** 3.07 (75.00)	**T_8** 12.28 (-)
T_4 3.84 (68.73)	**T_5** 4.50 (63.36)	**T_6** 4.20 (65.80)	-	-	-
S.E.(m) ±	0.25				
C.D. at 5%	0.75				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).
(ii) Figures in parenthesis are per cent reduction of the dry weed biomass over UWC.

At 90 DAT, during 2001-02, two hoeings + two weedings at 30 and 60 DAT (T_9) treatment proved significantly superior over all other treatments. This treatment (T_9) reduced dry weight of weeds m^{-2} over control to the extent of 75.00 per cent. Per cent reduction in dry weight of weeds m^{-2} over control ranged in between 22.56 to 75.00 under T_3 and T_9 treatments respectively. Treatments T_4, T_6 and T_5 were at par and significantly superior over treatments T_7, T_1, T_2, T_3 and T_8. Treatments T_2 and T_3 were also equal in effect. Treatment unweeded control (T_8) noticed the highest dry weight of weeds than all other treatments (Table 44).

Table 45: Per cent reduction in dry weed biomass (g m^{-2}) as influenced by different treatments during 2001-02 at 120 DAT

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 8.91 (29.95)	**T_2** 10.16 (20.13)	**T_3** 10.61 (16.59)	**T_7** 8.06 (36.64)	**T_9** 4.32 (66.04)	**T_8** 12.72 (-)
T_4 5.83 (54.17)	**T_5** 6.55 (48.51)	**T_6** 7.05 (44.58)	-	-	-
S.E.(m) ±	0.25				
C.D. at 5%	0.74				

N.B.: (i) Upper values are transformed values ($\sqrt{x}$).
(ii) Figures in parenthesis are per cent reduction of the dry weed biomass over UWC.

From the Table 45 at 120 DAT during 2001-02, revealed that more or less similar trend was found as that of 90 DAT. The per cent reduction of dry weight of weeds m^{-2} over control ranged in between 16.59 to 66.04 under T_3 and T_9 treatments respectively.

4.1.3.1 Dry weight of weeds at harvest of chilli as influenced by different treatments

To reveal the real effect of treatments, cumulative dry weight of weeds removed at each cultural operation (T_7 and T_9) and integrated treatments (T_4, T_5 and T_6) were taken into account and the data was statistically analysed.

The data in respect of dry weed biomass removed during cultural operation and at harvest are presented in Table 46 and depicted in Figure 8.

Table 46: Dry weight of weeds (q/ha) at harvest during 2000-01 and 2001-02

Treatments	Dry weight of weeds (q/ha)	
	2000-01	2001-02
T_1	8.14	9.21
T_2	10.27	11.09
T_3	10.93	11.33
T_4	4.21	3.92
T_5	5.32	5.56
T_6	5.81	6.04
T_7	7.02	7.97
T_8	15.88	16.65
T_9	2.98	3.24
S.E (m) ±	0.36	0.18
C.D. at 5 %	1.04	0.52
Mean	7.84	8.33

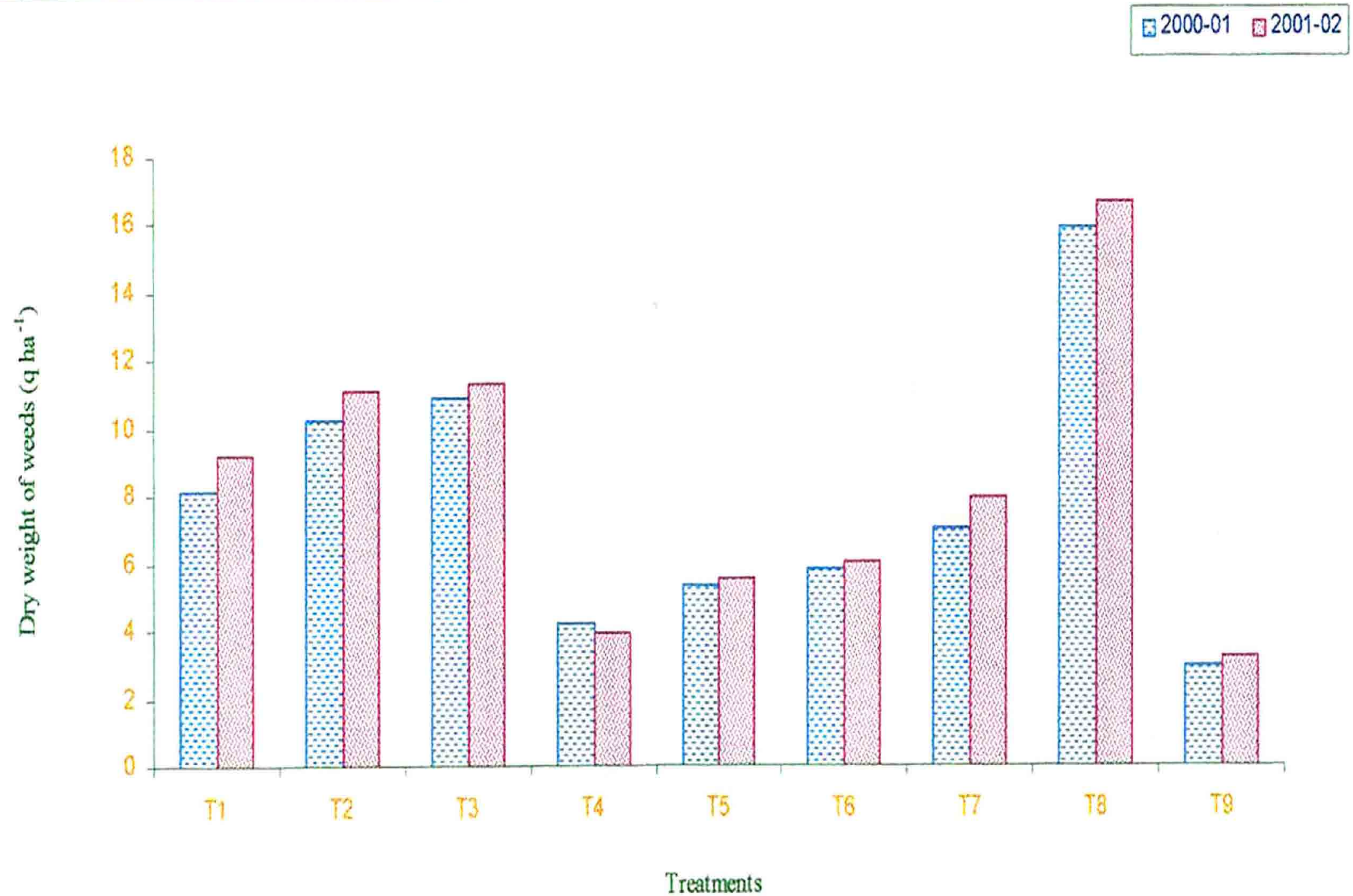

Figure 8: Dry weight of weeds (q ha^{-1}) at harvest during 2000-01 and 2001-02

During both the years, the differences among various treatments in respect of total weed biomass were significant. Dry weight of weeds recorded in unweeded control (T_8) was 15.88 and 16.65 q ha^{-1} during 2000-01 and 2001-02 respectively which was significantly higher as compared to all other treatments. Cultural treatment, two hoeings + two weedings at 30 and 60 DAT (T_9) recorded 2.98 and 3.24 q ha^{-1} dry weight of weeds during first and second season respectively. None of the other treatments was superior to the treatment T_9 in reducing the dry weight of weeds. Integrated treatment T_4 was the next best treatment and followed by T_5, T_6, T_7, T_1, T_2, T_3 and T_8 treatments. However, treatments T_5 and T_6 were at par, treatments T_2 and T_3 were also showed no significant differences but superior than unweeded control (T_8) treatment in reducing the dry weed biomass.

4.1.4 Weed control efficiency (%)

The data on the effect of weed control treatments on weed control efficiency are presented in Table 47 and illustrated in Figure 9. It was worked out on the basis of dry weight of weeds in unweeded control and other treatments.

Table 47: Weed control efficiency (%) as influenced by different treatments during 2000-01 and 2001-02

Treatments	Weed control efficiency (%)	
	2000-01	2001-02
T_1	48.74	44.68
T_2	35.33	33.39
T_3	31.17	31.95
T_4	73.49	76.46
T_5	66.50	66.61
T_6	63.41	63.72
T_7	55.79	52.13
T_8	-	-
T_9	81.23	80.54

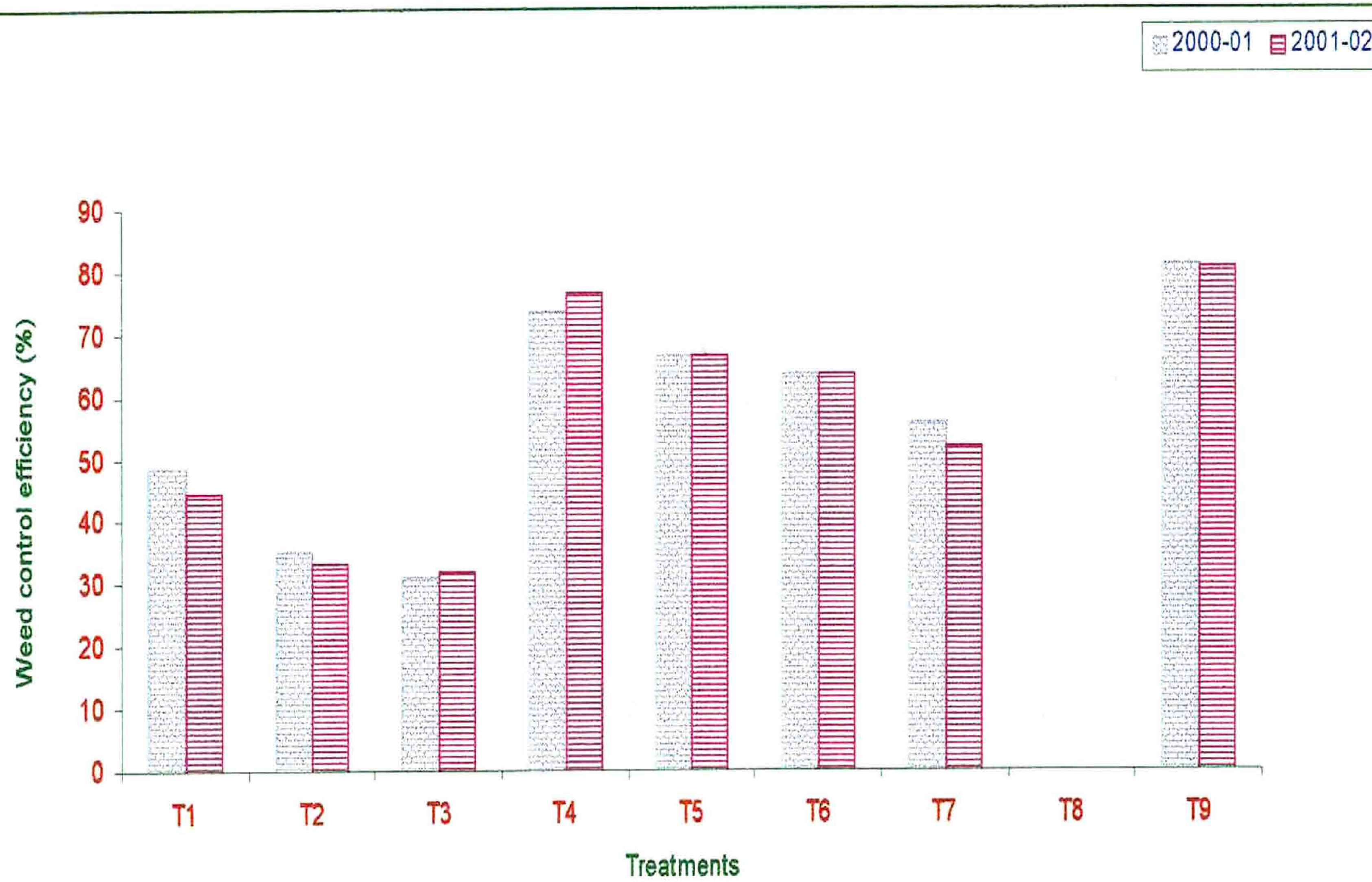

Figure 9: Weed control efficiency (%) as influenced by different treatments during 2000-01 and 2001-2002

Regarding the best treatment, two hoeings with two weedings at 30 and 60 DAT (T_9) was best than all other treatments during both the years of investigation.

During 2000-01, the cultural treatment, two hoeings with two weedings at 30 and 60 DAT (T_9) indicated highest weed control efficiency (81.23%) and was superior over all other treatments. Among the integrated methods, PPI of trifluralin @ 1 Kg a.i. ha^{-1} with one hoeing at 45 DAT and one weeding at 60 DAT (T_4) treatment recorded 73.49 per cent and it was superior than the PPI of fluchloralin @ 1 Kg a.i. ha^{-1} with one hoeing and weeding at 45 and 60 DAT (T_5) and pre-plant application of alachlor @ 2 Kg a.i. ha^{-1} with one hoeing and weeding at 45 and 60 DAT (T_6) treatments which recorded, 66.50 and 63.41 per cent weed control efficiency respectively. However, among the herbicidal treatments, PPI of trifluralin @ 1 Kg a.i. ha^{-1} (T_1) treatment recorded the maximum weed control efficiency (48.74 %) and better than T_2 (35.33 %) and T_3 (31.17 %) treatments.

During 2001-02, treatment two hoeings with two weedings at 30 and 60 DAT (T_9) recorded the maximum weed control efficiency (80.54 %) than rest of the treatments. Treatments T_4, T_5 and T_6 were the next best treatments that recorded 76.46, 66.61 and 63.72 per cent weed control efficiency respectively. Whereas, it was (T_6) followed by T_7, T_1, T_2 and T_3 treatments that recorded 52.13, 44.68, 33.39 and 31.95 per cent weed control efficiency.

4.2 Crop studies

4.2.1 Effect on plant population

Data regarding plant population as affected by different treatments are presented in Table 48.

Table 48: Plant population of chilli as influenced by different treatments during 2000-01 and 2001-02

Treatments	Number of plants $plot^{-1}$			
	2000-01		2001-02	
	Initial	At harvest	Initial	At harvest
T_1	60.00	57.25	59.50	58.00
T_2	59.75	56.25	59.75	57.50
T_3	59.75	57.75	60.00	58.75
T_4	59.50	58.00	59.75	58.25
T_5	59.75	57.00	59.50	57.00
T_6	59.75	58.00	59.75	58.75
T_7	60.00	57.25	59.75	56.50
T_8	59.75	57.75	59.75	57.25
T_9	59.75	56.50	59.75	58.75
S.E. (m) ±	0.23	0.56	0.25	0.54
C.D. at 5%	N.S.	N.S.	N.S.	N.S.
Mean	59.78	57.31	59.72	57.86

Data from the Table 48 indicated that, at initial population count the mean number of plants per gross plot was 59.78 in the first season and 59.72 in the second season of the experimentation.However, at harvest the mean number of plant per gross plot was 57.31 and 57.86 during 2000-01 and 2001-02 respectively.

Plant population at initial and harvest stage of chilli was not influenced by various weed control treatments during both the years of experimentation.

4.2.2 Effect on plant height

The data pertaining to effect of different weed control treatments on plant height were recorded at 30, 60, 90 and 120 days after transplanting (DAT) of the chilli. The relevant data are presented in Table 49 and illustrated in Figure 10 and 11.

There was significant difference among the different weed control treatments for plant height at all the stages of crop growth. The plant height progressively increased during both the seasons of experimentation. The mean maximum height 54.62 cm and 49.93 cm was recorded at 120 DAT during first and second season respectively.

During 2000-01 at 30 DAT, all the treatments showed significant differences in plant height. Pre-plant soil incorporation (PPI)of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing at 45 DAT and one weeding at 60 DAT (T_4) and PPI of trifluralin @ 1 Kg a.i. ha^{-1} (T_1) were at par and significantly superior over all other treatments. Treatments T_2, T_5, T_6 and T_3 were at par and significantly superior over T_9, T_7 and T_8. Treatment unweeded control (T_8) recorded the lowest height and was at par with T_7 and T_9 treatments.

Table 49: Mean height of chilli plant (cm) as influenced by different treatments

Treat-ments	Mean height of chilli plant (cm)							
	2000-01				2001-02			
	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT
T_1	29.85	38.81	47.96	50.92	30.46	38.22	43.04	45.98
T_2	26.88	34.76	43.18	45.60	25.36	32.90	38.62	40.90
T_3	25.74	33.28	39.33	45.06	27.52	32.68	39.32	40.22
T_4	30.15	41.96	60.60	65.32	32.06	42.64	55.28	60.52
T_5	26.46	35.04	51.69	60.86	27.10	33.86	46.16	55.74
T_6	25.80	34.82	49.14	59.26	26.00	33.40	45.72	54.56
T_7	22.04	34.78	48.86	55.00	21.78	33.04	45.36	50.30
T_8	21.36	26.40	34.34	39.80	22.14	25.72	32.14	34.66
T_9	22.14	37.86	58.64	69.74	22.58	38.10	53.80	66.50
S.E(m)±	0.87	0.95	1.48	1.37	0.86	1.39	1.26	1.34
C.D.at 5%	2.53	2.78	4.31	4.00	2.52	4.06	3.69	3.92
Mean	25.60	35.30	48.19	54.62	26.11	34.51	44.38	49.93

At 60 DAT during 2000-01 season, the PPI of trifluralin @ 1 Kg a.i.ha^{-1} with one hoeing at 45 DAT and one weeding at 60 DAT (T_4) recorded maximum plant height and was significantly superior over all other treatments.

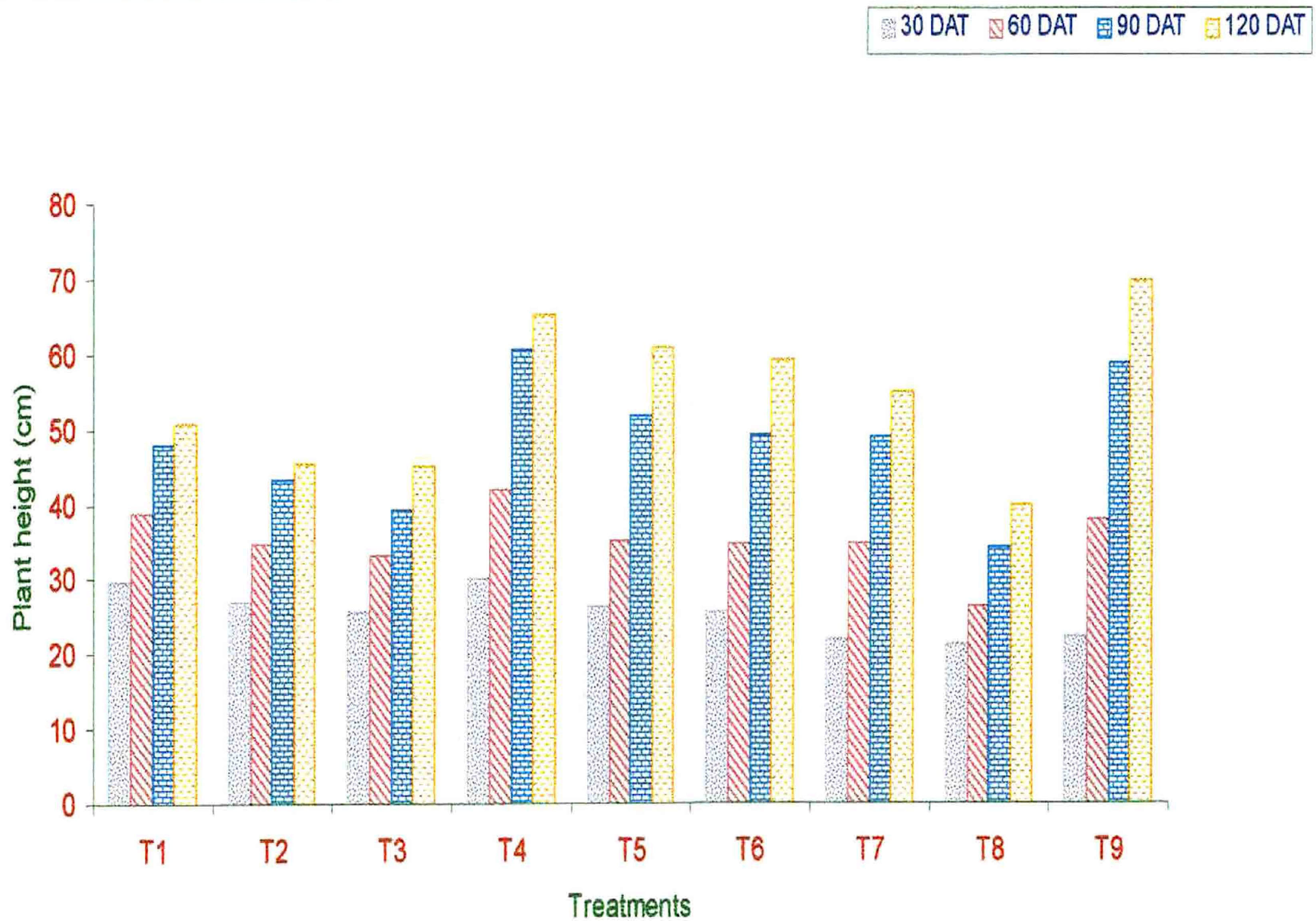

Figure 10: Mean height (cm) plant^{-1} during 2000-01

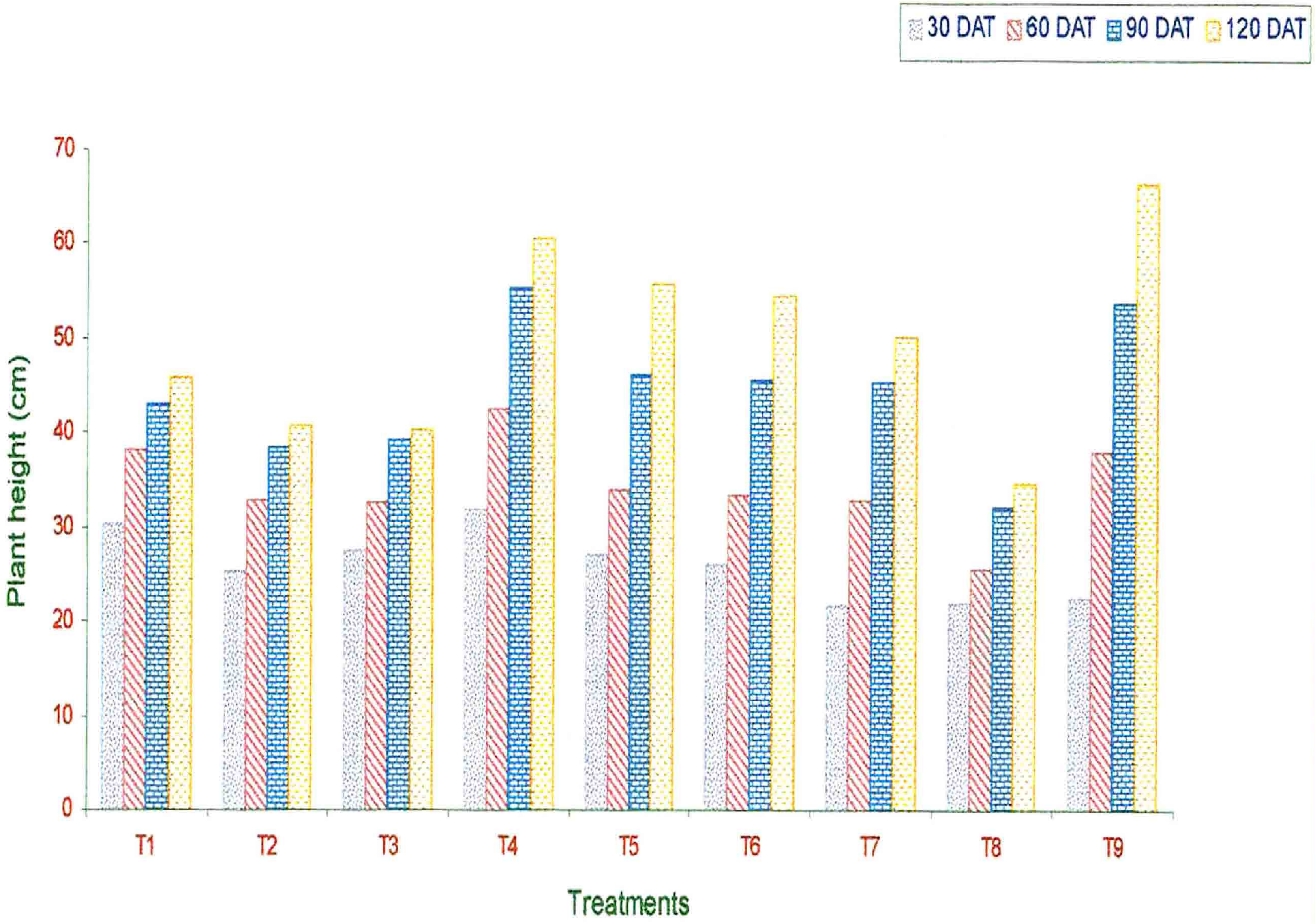

Figure 11: Mean height (cm) $plant^{-1}$ during 2001-02

Treatment T_4 was followed by T_1. Whereas, treatment T_1 and T_9 were at par and the next best treatments in increasing height of plant. Treatment T_5, T_6, T_7, T_2 and T_3 were equal in effect and superior over unweeded control (T_8) treatment that was recorded least height of plant.

At 90 DAT during 2000-01, PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing at 45 DAT and one weeding at 60 DAT (T_4) and two hoeings + two weedings at 30 and 60 DAT (T_9) treatments recorded significantly more hight than all other treatments and was followed by T_5, T_6, T_7, T_1, T_2, T_3 and T_8 treatments. Treatments T_5, T_6, T_7, T_1 were at par but significantly superior over T_2 and T_3. Treatments T_2 and T_3 were also at par with each other. Treatment T_8 recorded the least height than all other treatments.

At 120 DAT during 2000-01 cultural treatment, T_9 noticed significantly maximum hight than all other treatments and was followed by integrated treatment T_4. Treatments T_5 and T_6 were similar in effect and significantly superior over T_7, T_1, T_2, T_3 and T_8 treatments. However, treatments T_2 and T_3 were at par.

During 2001-02 at 30 DAT, treatment T_4 and T_1 were at par and recorded significantly more height than all other treatments. They were followed by treatments T_3, T_5, T_6, T_2, T_9, T_8 and T_7. Treatment T_7 recorded the least height and was at par with T_8 and T_9. However, treatments T_3, T_5, T_6 and T_2 were showed no significant differences but superior in height over T_9, T_8 and T_7 treatments.

At 60 DAT in second season, PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing at 45 DAT + one weeding at 60 DAT (T_4) treatment noticed the maximum height and significantly superior over all other treatments. Treatment T_4 followed by PPI of trifluralin @ 1 Kg a.i. ha^{-1} (T_1) and it was at par with T_9 treatment. They were (T_1 and T_9) superior over T_5, T_6, T_7, T_2, T_3 and T_8 treatments. However, treatments T_5, T_6, T_7, T_2 and T_3 were equal in effect and recorded more plant height than unweeded control (T_8) treatment.

During 2001-02 at 90 DAT, PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing at 45 DAT and one weeding at 60 DAT (T_4) treatment showed the highest plant height and proved significantly superior over all other treatments but was at par with T_9 treatment. Treatment T_5 was the next best treatment and was at par with T_6, T_7 and T_1 treatments. Similarly, treatments T_3 and T_2 were also equal in effect. Treatment T_8 noticed the lowest plant height over all other treatments.

During 2001-02 at 120 DAT, the cultural treatment, two hoeings + two weedings at 30 and 60 DAT (T_9) was significantly superior over all other treatments and recorded highest plant height. Treatment T_4 was the next best treatment and which was followed by T_5, T_6, T_7, T_1, T_2, T_3 and T_8 treatments. Whereas, treatments T_5 and T_6 were at par and superior over T_7, T_1,T_2, T_3 and T_8 treatments. Treatments, T_2 and T_3 were also showed no significantly differences, but recorded better plant height than the unweeded control (T_8) treatment.

4.2.3. Effect on dry matter production $plant^{-1}$ at harvest

The accumulation of dry matter per plant is the best index of growth put forth by the crop. The data pertaining to mean dry matter accumulation per plant at harvest as influenced by various treatments are presented in Table 50 and represented graphically in Figure 12.

Table 50: Dry matter accumulation per plant (g) of chilli at harvest as influenced by different treatments during 2000-01 and 2001-02

Treatments	Dry matter accumulation plant^{-1} (g) at harvest	
	2000-01	2001-02
T_1	26.93	24.11
T_2	22.61	19.79
T_3	20.49	18.93
T_4	42.22	38.45
T_5	38.81	32.88
T_6	35.98	33.04
T_7	31.73	28.00
T_8	15.16	14.25
T_9	47.26	45.53
S.E. (m) ±	1.26	1.20
C.D. at 5%	3.68	3.51
Mean	31.24	28.33

The general mean from the table, showed that the dry matter accumulation per plant were 31.24 and 28.33 g during first and second season of experimentation respectively.

During 2000-01, data showed that the dry matter production due to various treatments were influenced significantly. Cultural treatments, two hoeings + two weedings at 30 and 60 DAT (T_9) recorded significantly higher dry matter, per plant (47.26 g). It was followed by integrated treatment PPI of

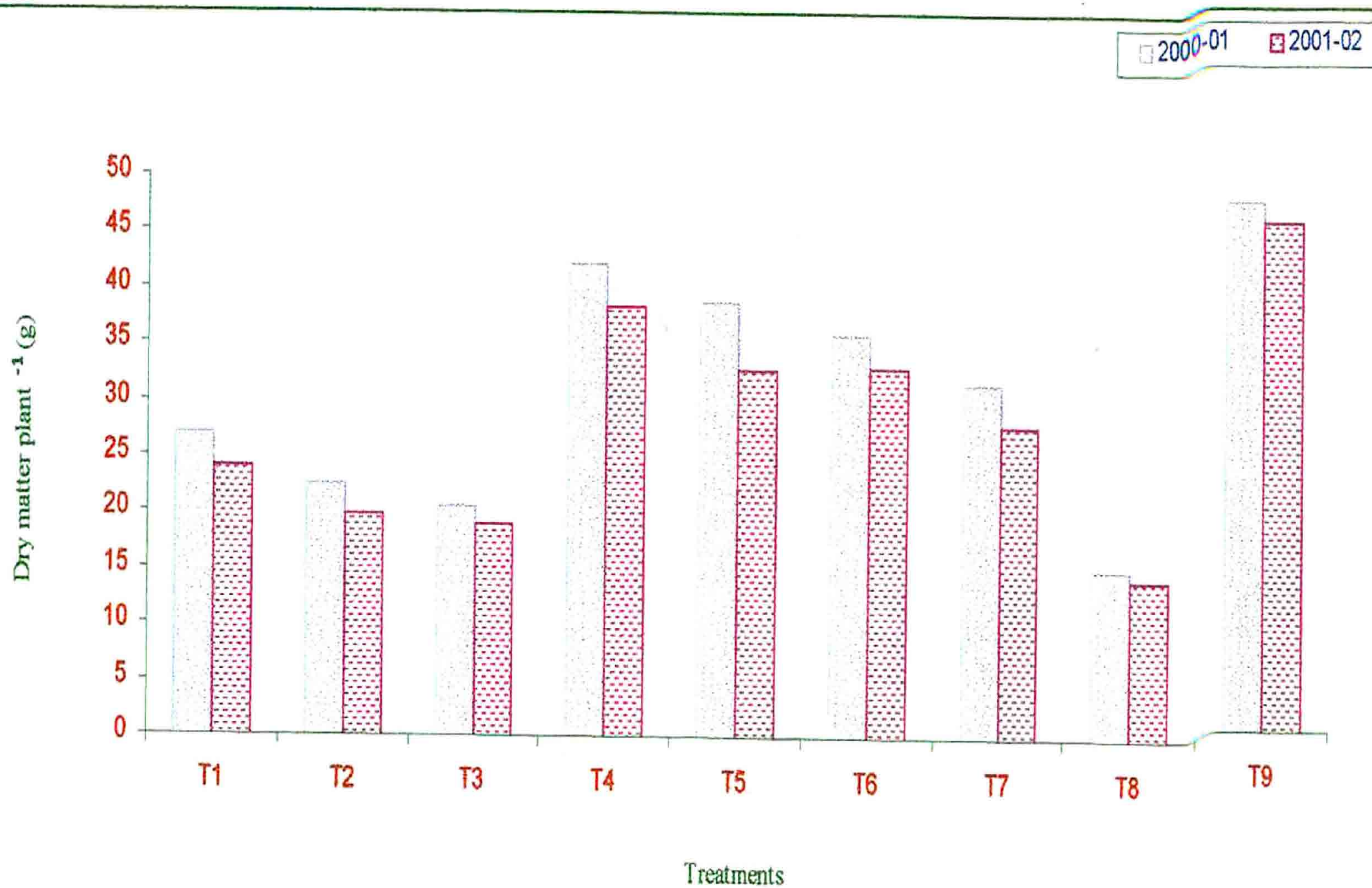

Figure 12: Dry matter accumulation plant^{-1} (g) during 2000-01 and 2001-02

trifluralin @ 1 Kg. ha^{-1} + one hoeing at 45 DAT + one weeding at 60 DAT (T_4) treatment which was at par with PPI of fluchloralin @ 1 Kg ha^{-1} + one hoeing at 45 DAT + one weedings at 60 DAT (T_5). However, treatments T_5 and T_6 could not show any significant differences in dry matter accumulation per plant. Similarly, treatments T_2 and T_3 were at par and significantly superior to unweeded control (T_8) treatment.

During the second season, cultural treatment two hoeings + two weedings at 30 and 60 DAT (T_9) recorded significantly maximum dry matter per plant over all other treatments. Treatment PPI of trifluralin @ 1Kg ha $^{-1}$ + one hoeing at 45 DAT and one weeding at 60 DAT (T_4) was significantly superior over rest of the treatments. Treatments T_6 and T_5 were at par, treatments T_2 and T_3 were showed no significant differences in dry matter production per plant, while lowest dry matter production plant^{-1} was recorded by unweeded control (T_8) treatment.

4.3 Yield contributory characters

The yield of a crop is the net result of interactions of various factors influencing the crop under field conditions which is a major criterion for evaluation the efficiency of different methods of weed control. The observation on yield components viz., total number of fruits per plant, fruit weight per plant, fruit weight per plot, wet red and dry red chilli yield (q ha^{-1}) were recorded. The relevant data on yield contributory characters during both the seasons are presented in Table 51 and depicted in Figure 13.

Table 51: Number of fruits obtained plant^{-1} at each picking as influenced by different treatments during 2000-01 and 2001-02

Treatments	Number of fruits plant^{-1} at each picking													
	2000-01							2001-02						
	1st	2nd	3rd	4th	5th	6th	Total	1st	2nd	3rd	4th	5th	6th	Total
T_1	13.75	11.55	7.85	6.95	6.45	3.85	50.40	10.95	8.45	8.05	7.00	4.95	3.75	43.15
T_2	11.90	9.20	6.00	5.20	4.65	3.30	40.25	8.05	7.35	5.80	4.85	4.00	3.00	33.05
T_3	11.75	9.15	5.95	5.00	4.85	3.25	39.95	7.70	6.75	5.65	4.55	3.95	2.90	31.50
T_4	20.00	17.35	13.70	12.10	9.90	7.60	80.65	17.90	14.60	11.75	9.90	8.50	8.45	71.10
T_5	8.20	15.65	12.00	10.45	8.35	7.25	71.90	13.60	11.85	11.70	10.05	7.80	6.80	61.80
T_6	17.95	15.55	11.90	10.30	8.25	7.20	71.15	13.35	11.85	11.45	9.85	8.40	6.40	61.30
T_7	15.20	12.90	9.80	8.65	6.70	5.50	58.75	13.00	10.05	9.45	8.35	6.40	4.85	52.10
T_8	7.85	7.10	3.35	2.40	2.00	1.40	24.10	5.70	4.95	3.75	3.00	1.85	1.45	20.70
T_9	19.65	17.20	14.75	13.95	11.70	9.00	86.25	18.00	14.70	13.20	11.45	9.90	10.00	77.25
S.E(m) ±	0.53	0.68	0.53	0.47	0.43	0.47	1.33	0.62	0.38	0.34	0.41	0.32	0.26	1.97
C.D.at 5%	1.54	1.99	1.57	1.40	1.28	1.37	3.91	1.82	1.14	1.02	1.20	0.95	0.77	5.77
Mean	15.14	12.85	9.48	8.33	6.98	5.37	58.16	12.03	10.06	8.98	7.67	6.19	5.29	50.22

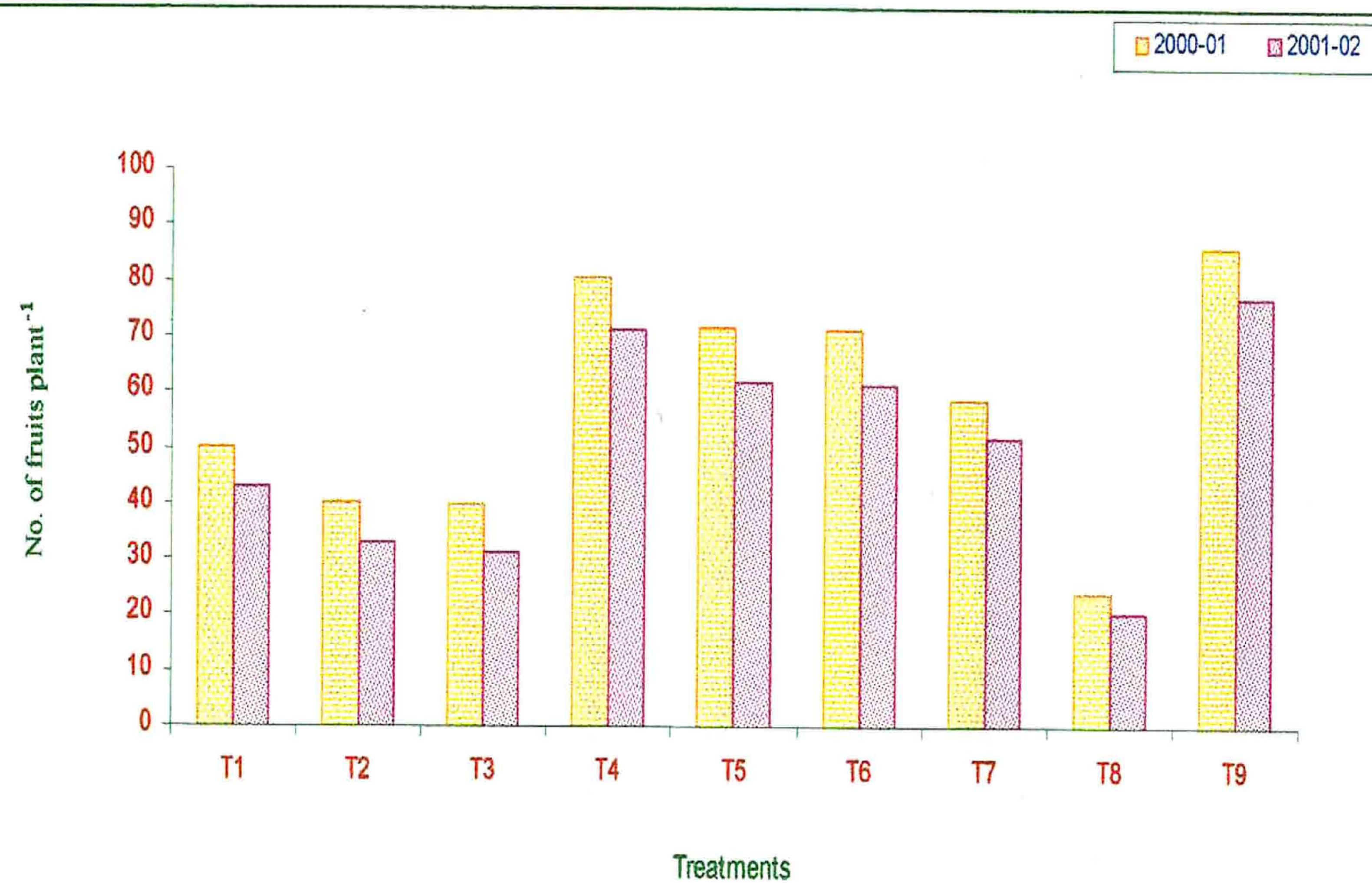

Figure 13: Number of fruits obtained plant^{-1} during 2000-01 and 2001-02

4.3.1 Effect on number of fruits plant^{-1} at each picking

Data in respect of number of fruits plant^{-1} at each picking are presented in Table 51 and graphically represented in Figure 13.

The general mean from the table showed that the highest number of fruits plant^{-1} was recorded at the time of first picking and thereafter, there was decreasing in number of fruits per plant up to last picking during both the seasons of experimentation. During 2000-01 at the time of first picking, the highest number of fruits per plant was recorded by integrated treatment, PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing at 45 DAT + one weeding at 60 DAT (T_4) and it was at par with cultural treatment, two hoeings + two weedings at 30 and 60 DAT (T_9). However, treatment T_9 was equal in effect with T_5 treatment. Treatments T_5 and T_6 showed no significant differences but superior over rest of the treatments. Treatments T_7 and T_1 were at par. Similarly, chemical treatments T_2 and T_3 were also at par with each other and recorded more number of fruits than unweeded control (T_8) treatment.

At second picking during 2000-01, the integrated treatment, PPI of trifluralin @ 1 Kg a.i. suplimented with one hoeing and one weeding at 45 and 60 DAT respectively recorded the highest number of fruits plant^{-1} but it was at par with T_9, T_5 and T_6 treatments. These treatments were significantly superior over rest of the treatments. Whereas, treatments T_7 and T_1 were at par. Treatment T_2 and T_3 treatments showed equal in effect and superior over unweeded control (T_8) treatment.

At third picking during 2000-01, treatments T_9 and T_4 were at par and significantly superior over all other treatments. Treatment T_5 was the next best treatment but at par with T_6 that recorded more number of fruits plant^{-1} than T_7, T_1, T_2, T_3 and T_8 treatments. Treatment unweeded control (T_8) was recorded lowest number of fruits plant^{-1}.

At fourth, fifth and sixth time of picking during 2000-01, more or less similar trend was noticed in respect of number of fruits plant^{-1}. The cultural treatment, two hoeings + two weedings at 30 and 60 DAT (T_9) recorded highest number of fruits plant^{-1} and was significantly superior to all other treatments. Integrated treatment, PPI of trifluralin @ 1 Kg ha^{-1} + one hoeing at 45 DAT + one weeding at 60 DAT (T_4) treatment was found next best treatment, while treatment unweeded control (T_8) recorded least number of fruits plant^{-1}.

During 2001-02 at first picking, treatment two hoeings + two weedings at 30 and 60 DAT recorded significantly higher number of fruits plant^{-1} but was at par with T_4 treatment. Treatment T_4 followed by T_5. However, treatments T_5, T_6 and T_7 were at par and superior over treatments T_1, T_2, T_3 and T_8. Least number of fruits plant^{-1} was found in unweeded control (T_8) treatment.

At second picking during second season, treatment T_9 and T_4 were at par and significantly superior over all other treatments. Similarly, treatments T_5 and T_6 were also equal in effect and recorded more number of fruits plant^{-1} than treatments T_7, T_1, T_2, T_3 and T_8. Treatment T_8 showed the least number of fruits than all other treatments.

At third, fourth, fifth and sixth picking during 2001-02, more or less similar trend was recorded in respect of number of fruits plant^{-1}. Treatment T_9 recorded significantly highest number of fruits plant^{-1} than all other treatments, followed by T_4, T_5, T_6, T_7, T_1, T_2, T_3 and T_8 respectively.

The data related to per cent increase in number of fruits plant^{-1} as influenced by different treatments during 2000-01 and 2001-02 are presented in Table 52 and 53.

Table 52: Per cent increase in number of fruits plant^{-1} as influenced by different treatments during 2000-01

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 50.40 (109.13)	T_2 40.25 (67.01)	T_3 39.95 (65.77)	T_7 58.75 (143.78)	T_9 86.25 (257.88)	T_8 24.10 (-)
T_4 80.65 (234.65)	T_5 71.90 (198.34)	T_6 71.15 (195.23)	-	-	-
S.E.(m) ±	1.33				
C.D. at 5%	3.91				

N.B.: (i) Upper values are original values

(ii) Figures in parenthesis are per cent increase in number of fruits plant^{-1} over UWC.

The data indicated that the trend was similar in respect of number of fruits plant^{-1} during both the seasons of experimentation. Cultural treatment, two hoeings + two weedings (T_9) at 30 and 60 DAT recorded the highest number of fruits plant^{-1} and it was significantly superior over all other treatments. This treatment (T_9) was increased 257.88 and 273.19 per cent number of fruits plant^{-1} over UWC (T_8) treatment during both the seasons respectively. PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing at 45 DAT + one weeding at 60 DAT (T_4) was the next best treatment that recorded 234.65 and 243.48 per cent increased in number of fruits plant^{-1} during both the seasons respectively over UWC. T_4 was followed by treatments T_5, T_6, T_7, T_1, T_2, T_3 and T_8 as decreasing in order.

Table 53: Per cent increase in number of fruits plant^{-1} as influenced by different treatments during 2001-02

Tri. 1.0	Flu. 1.0	Ala. 2.0	1H+ 1W	2H + 2W	UWC
T_1 43.15 (108.45)	**T_2** 33.05 (59.66)	**T_3** 31.50 (52.17)	**T_7** 52.10 (151.69)	**T_9** 77.25 (273.19)	**T_8** 20.70 (-)
T_4 71.10 (243.48)	**T_5** 61.80 (198.55)	**T_6** 61.30 (196.14)	-	-	-
S.E.(m) ±	1.97				
C.D. at 5%	5.77				

N.B.: (i) Upper values are original values

(ii) Figures in parenthesis are per cent increase in number of fruits plant^{-1} over UWC.

4.3.2. Effect on yield of wet red chilli fruits obtained plant^{-1}

The yield of wet red chilli fruits obtained plant^{-1} was significantly influenced due to various treatments. The data are presented in Table 54 and represented graphically in figure 14 and 15.

From the general mean during both the seasons, it is observed that mean yield of wet red fruits plant^{-1} were decreased gradually upto last picking from 34.10 g to 12.09 g and 27.08 to 11.91 g during 2000-01 and 2001-02 respectively.

During 2000-01 at first and second picking near about similar trend was recorded in respect weight of fruits plant^{-1}. The highest yield of wet red chilli obtained plant^{-1} was in integrated treatment, pre-plant soil incorporation (PPI) of trifluralin @ 1 Kg a.i. ha^{-1} combined with one hoeing and one weeding at 45 and 60 DAT (T_4) and it was significantly superior over all other treatments but was

Tabl[redacted] 54 : Yield of wet red fruits (g) obtained plant^{-1} at each picking as influenced by different treatments during 2000-01 and 2001-02

Treat[redacted]nents	Mean weight of wet red fruits of chilli plant^{-1} (g) at each picking													
	2000-01							2001-02						
	1st	2nd	3rd	4th	5th	6th	Total	1st	2nd	3rd	4th	5th	6th	Total
[redacted]1	30.92	25.49	17.74	15.65	14.50	8.69	112.99	24.64	19.04	18.14	15.78	11.20	8.28	97.08
[redacted]2	26.82	20.78	13.54	11.75	10.55	7.44	90.88	18.14	16.58	13.06	10.88	9.02	6.70	74.38
[redacted]3	26.54	20.62	13.46	11.30	10.95	7.27	90.14	17.36	15.30	12.75	10.32	8.96	6.55	71.24
[redacted]4	45.07	38.99	30.84	27.26	22.32	17.04	181.52	40.26	32.79	26.45	22.24	19.12	19.08	159.94
[redacted]5	40.98	35.20	27.10	23.54	18.76	16.29	161.87	30.66	26.65	26.26	22.60	17.52	15.39	139.08
[redacted]6	40.42	35.04	26.84	23.20	18.55	16.25	160.30	30.06	26.62	25.74	22.15	18.86	14.56	137.99
[redacted]7	34.25	29.06	22.00	19.54	15.06	12.45	132.36	29.24	22.54	21.28	18.80	14.35	11.08	117.29
[redacted]8	17.57	15.92	7.54	5.36	4.55	3.12	54.06	12.80	11.18	8.46	6.75	4.12	3.05	46.36
[redacted]9	44.35	38.66	33.24	31.35	26.26	20.25	194.11	40.56	33.02	29.70	25.76	22.30	22.48	173.82
S.E([redacted]) ±	1.18	1.28	1.15	1.08	1.00	1.05	2.97	1.41	0.86	0.79	0.92	0.72	0.58	4.47
C.D. [redacted]t 5%	3.44	3.75	3.35	3.15	2.93	3.07	8.67	4.12	2.53	2.32	2.71	2.11	1.70	13.07
Mea[redacted]	34.10	28.86	21.37	18.77	15.72	12.09	130.91	27.08	22.64	20.20	17.25	13.94	11.91	113.02

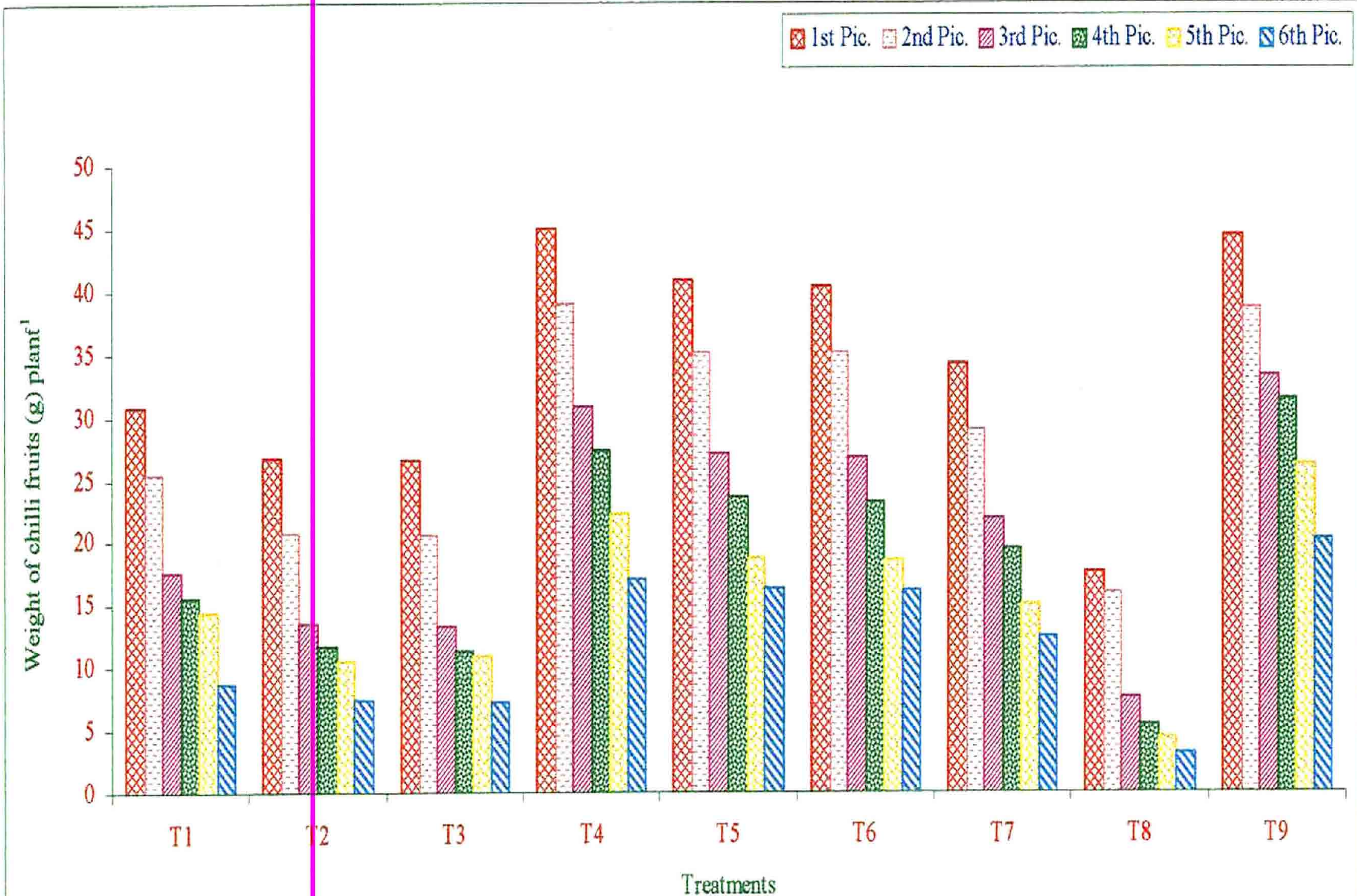

Figure 14: Yield of wet red fruits (g) obtained plant^{-1} at each picking as influenced by different treatments during 2000-01

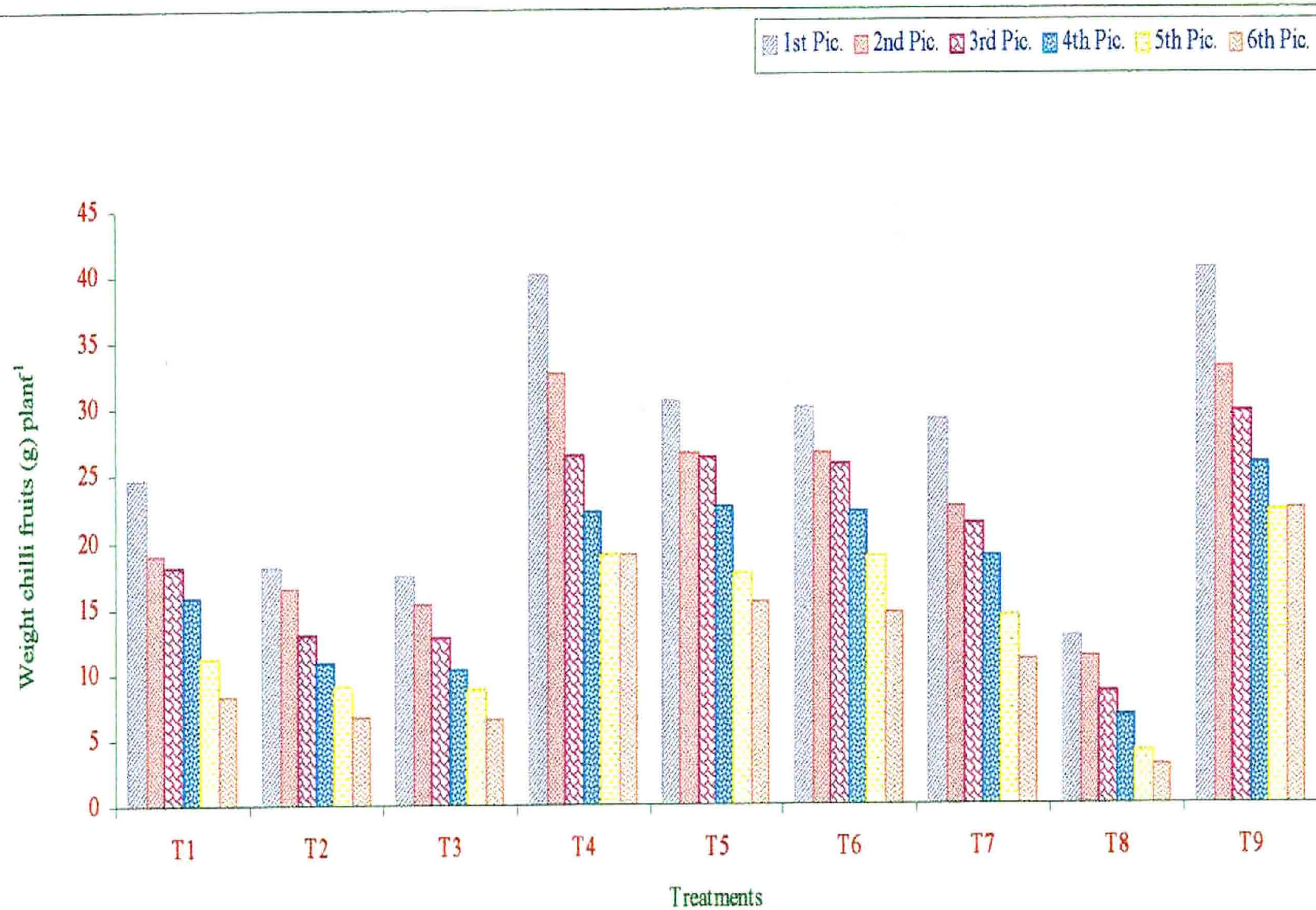

Figure 15: Yield of wet red fruits (g) obtained plant^{-1} at each picking as influenced by different treatments during 2001-02

at par with cultural treatment, two hoeings plus two weedings at 30 and 60 DAT (T_9). Whereas, T_9 was equal in effect with T_5 treatment and T_5 was at par with T_6 during first picking while at second picking treatments T_9, T_5 and T_6 were recorded no significant differences among themselves. However, these treatments were significantly superior over T_7, T_1, T_2, T_3 and T_8 treatments.

At third picking during 2000-01, treatments T_9 and T_4 were at par and significantly superior over all other treatments. T_5 and T_6 treatments were equal in effect and superior over T_7, T_1, T_2, T_3 and T_8 treatments. The lowest yield of wet red fruits obtained plant^{-1} was in treatment unweeded control (T_8).

At fourth, fifth and sixth picking during 2000-01, more or less similar trend were noticed in respect of yield of fruits plant^{-1}. The cultural treatment two hoeings + two weedings at 30 and 60 DAT (T_9) recorded the significantly highest yield of wet red chilli fruits obtained plant^{-1}. While among the integrated treatments, PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing at 45 DAT + one weeding at 60 DAT (T_4) treatment was recorded the highest yield plant^{-1}, followed by treatments T_5, T_6, T_7, T_1, T_2, T_3 and T_8. Treatment unweeded control (T_8) found to be significantly inferior and recorded lowest yield of wet red chilli plant^{-1} than all other treatments.

During 2001-02 at first and second picking, cultural treatment two hoeings + two weedings at 30 and 60 DAT (T_9) recorded the highest yield of wet red chilli plant^{-1} but it was at par with integrated treatment T_4 and recorded significantly superior over all other treatments. Treatment T_5 was the next best treatment and it was followed by treatments T_6, T_7, T_1, T_2, T_3 and T_8 as decreasing in order. Treatment unweeded control (T_8) recorded the lowest yield of wet red chilli plant^{-1} over all other treatments.

At third, fourth, fifth and sixth picking during second season, the cultural treatment two hoeings + two weedings at 30 and 60 DAT (T_9) was recorded significantly highest yield of wet red fruits plant^{-1} over all other treatments. However, treatment unweeded control (T_8) recorded the least yield of wet red fruits plant^{-1}. The order of decreasing the yield was due to T_9, T_4, T_5, T_6, T_7, T_1, T_2, T_3 and T_8 treatments.

The data pertaining to yield of wet red fruits per plant as influenced by various treatments are presented in Table 55 and graphically represented in Figure 16.

The mean yield of fruits plant^{-1} was 130.91 and 113.02 g during 2000-01 and 2001-02 respectively. During both the seasons of investigation, cultural treatment, two hoeings + two weedings (T_9) at 30 and 60 DAT recorded maximum yield of fruits plant^{-1} and was significantly superior over all other treatments, PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) was the next best treatment that gave significantly highest yield plant^{-1} followed by T_5, T_6, T_7, T_1, T_2, T_3 and T_8 treatments. PPI of fluchloralin @ 1 Kg a.i. ha^{-1} + one hoeing at 45 DAT + one weeding at 60 DAT (T_5) and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} + one hoeing at 45 DAT + one weeding at 60 DAT (T_6) were at par and showed greater weight of fruits per plant than remaining treatments. Treatments T_2 and T_3 were also equal in effect and recorded more yield per plant over unweeded control (T_8).

Table 55: Yield of wet red fruits (g) obtained plant^{-1} as influenced by different treatments during 2000-01 and 2001-02

Treatments	Yield of wet red fruits (g plant^{-1})		
	2000-01	2001-02	Pooled mean
T_1	112.99	97.08	105.04
T_2	90.88	74.38	82.63
T_3	90.14	71.24	80.69
T_4	181.52	159.94	170.73
T_5	161.87	139.08	150.48
T_6	160.30	137.99	149.15
T_7	132.36	117.29	124.83
T_8	54.06	46.36	50.21
T_9	194.11	173.82	183.97
S.E. (m) ±	2.97	4.47	2.85
C.D. at 5%	8.67	13.07	8.37
Mean	130.91	113.02	121.97

Pooled mean indicated that, cultural treatment T_9 recorded maximum yield of wet red chilli fruits plant^{-1} and significantly superior over all other treatments. Integrated treatment T_4 found to be next best treatment that recorded significantly more yield plant^{-1} over rest of the treatments. Treatments T_5 and T_6 were at par and superior over T_7, T_1, T_2, T_3 and T_8. Treatments T_2 and T_3 were similar in effect that recorded more yield plant^{-1} than unweeded control (T_8) treatment.

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Figure 16: Yield of wet red fruits (g) obtained plant^{-1} during 2000-01 and 2001-02

4.3.3 Effect on yield of wet red chilli fruits ha^{-1}

The data on chilli fruits yield per hectare are given in Table 56 and graphically represented in figure 17.

Table 56: Yield ha^{-1} of wet red fruits of chilli as influenced by different treatments during 2000-01 and 2001-02

Treatments	Yield (q ha^{-1})			Percentage increase over control
	2000-01	2001-02	Pooled mean	
T_1	31.72	27.52	29.62	112.63
T_2	27.96	22.92	25.44	82.63
T_3	27.71	22.05	24.88	78.61
T_4	49.54	43.49	46.52	233.96
T_5	45.13	39.15	42.14	202.51
T_6	45.09	38.98	42.03	201.72
T_7	36.94	32.99	34.96	150.97
T_8	14.67	13.19	13.93	-
T_9	53.20	47.66	50.43	262.02
S.E. (m) ±	1.11	1.38	1.00	-
C.D. at 5%	3.25	4.05	2.93	-
Mean	36.88	31.99	34.44	-

Wet red chilli fruits yield per hectare was significantly influenced by various method of weed control. The mean yield ha^{-1} was more in first year (36.88 q ha^{-1}) than second year (31.99 q ha^{-1}) of experimentation.

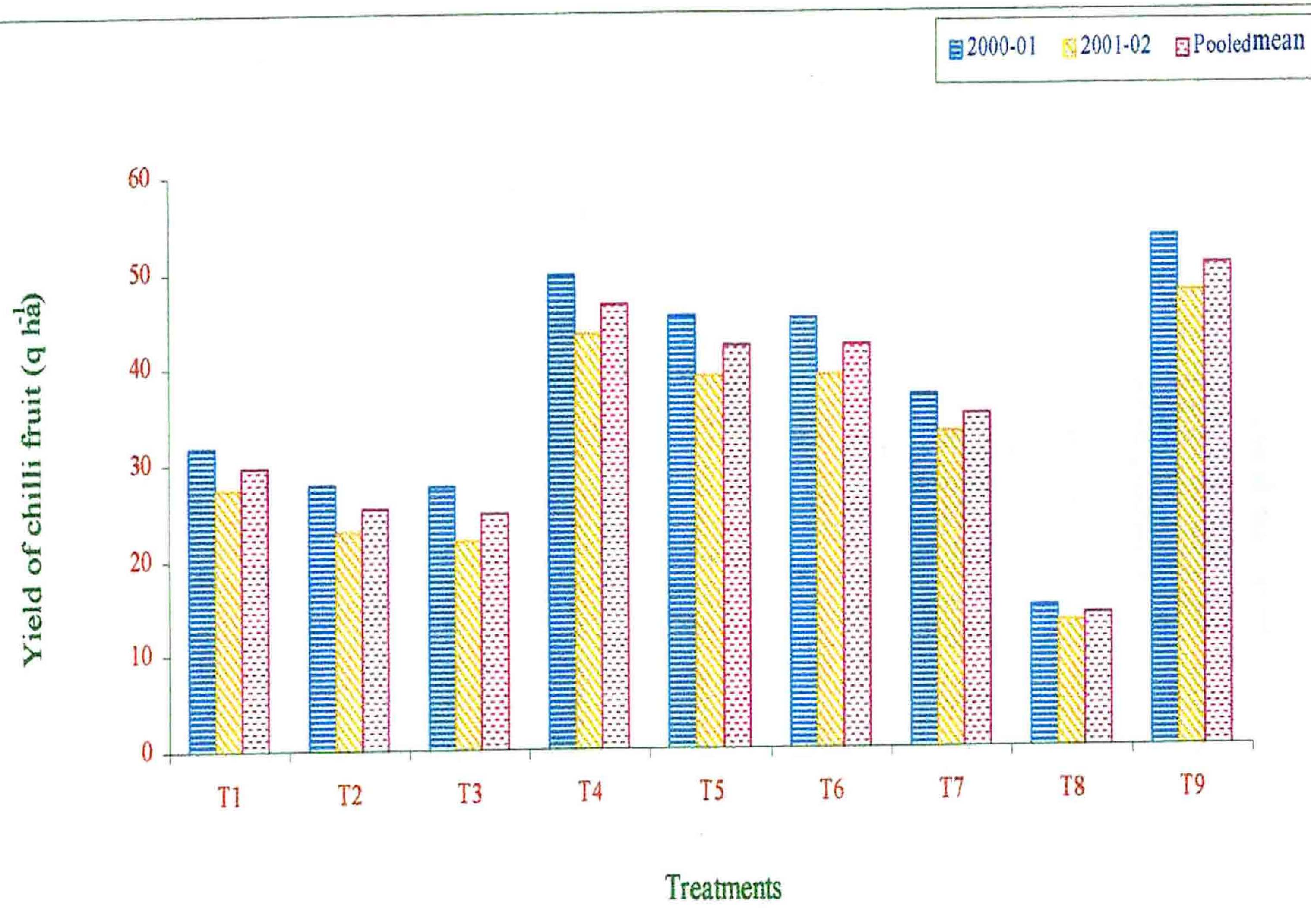

Figure 17: Yield per hectare of wet red fruits of chilli during 2000-01 and 2001-02

From the pooled data it was found that the treatment effect were highly significant over unweeded control. The Chilli fruits yield ha^{-1} was found significantly higher under cultural treatment, two hoeings + two weedings at 30 and 60 DAT (T_9) as compared to all other treatments that increased 262.02 per cent more yield over unweeded control (T_8). Latter on, integrated treatment, PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 DAT and 60 DAT (T_4) recorded significantly more yield of chilli fruits ha^{-1} than treatments T_5 and T_6 which were observed 233.96, 202.51 and 201.72 per cent increased in yield respectively over unweeded control (T_8) treatment. However, treatments T_5 and T_6 showed no significant differences and produced more yield than treatments T_7, T_1, T_2, T_3 and T_8. Percentage increase in yield ha^{-1} due to treatments T_7, T_1, T_2 and T_3 over T_8 was 150.97, 112.63, 82.63 and 78.61 per cent respectively.

4.3.4 Dry chilli fruit yield (q ha^{-1})

The data on dry chilli fruit yield are presented in Table 57 and depicted in Figure 18.

During both the years, total dry chilli fruit yield per hectare was significantly influenced by various methods of weed control. The highest dry chilli fruit yield was obtained in cultural treatment two hoeings + two weedings at 30 and 60 DAT (T_9), 19.53 and 17.49 q ha^{-1} during 2000-01 and 2001-02 respectively. Whereas, the lowest 5.49 and 5.19 q ha^{-1} was recorded under unweeded control (T_8) treatment.

Among the various methods of weed control, integrated treatment, PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) was the next best treatment after T_9 treatment, which recorded significantly the highest

Table 57: Dry chilli fruit yield (q ha^{-1}) as influenced by various treatments during 2000-01 and 2001-02

Treatments	Dry chilli fruit yield (q ha^{-1})		
	2000-01	2001-02	Pooled mean
T_1	11.54	10.02	10.78
T_2	10.15	08.33	09.24
T_3	10.03	07.99	09.01
T_4	18.03	15.86	16.95
T_5	16.20	14.08	15.14
T_6	16.18	14.01	15.10
T_7	13.08	11.70	12.39
T_8	05.49	05.19	05.34
T_9	19.53	17.49	18.51
S.E.(m) ±	0.40	0.53	0.38
C.D. at 5%	1.18	1.55	1.10
Mean	13.36	11.63	12.50

dry chilli fruit yield followed by PPI of fluchloralin @ 1 Kg a.i. ha^{-1} supplimented with one hoeing and one weeding at 45 and 60 DAT (T_5) and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_6). However, treatments T_5 and T_6 were at par and significantly superior over treatments T_7, T_1, T_2, T_3 and T_8. Treatments T_2 and T_3 were found significantly superior over unweeded control (T_8) and showed equal in effect.

Pooled mean indicated that the cultural treatment T_9 recorded significantly the highest yield of dry chilli fruit and proved superior over all other treatments. Treatment T_4 was the next best treatment and significantly superior over T_5, T_6, T_7, T_1, T_2, T_3 and T_8 treatments. However, unweeded control (T_8) treatment recorded the lowest dry chilli fruit yield.

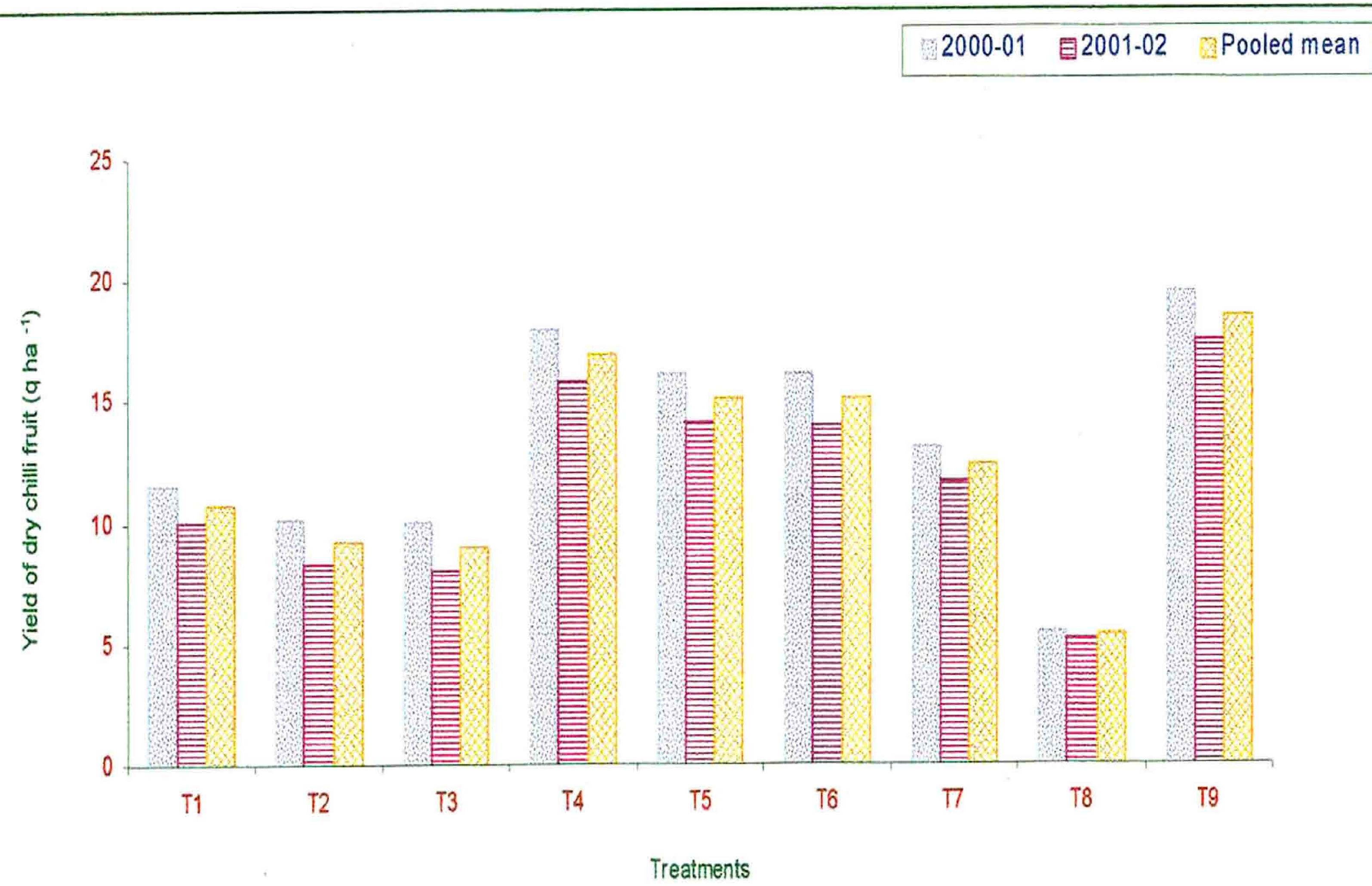

Figure 18: Dry chilli fruit yield (q ha^{-1}) as influenced by variaous treatments during 2000-01 and 2001-02

4.4 Weed index (%)

The data on the effect of different weed control treatments on weed index (%) are presented in Table 58 and illustrated in Figure 19.

From the Table 58 it could be ascertained that, the cultural treatment of two hoeings + two weedings at 30 and 60 DAT (T_9) recorded the lowest weed index while the highest was with unweeded control, 71.89 and 70.33 per cent during 2000-01 and 2001-02 respectively.

Table 58 : Weed index (%) as influenced by different treatments during 2000-01 and 2001-02

Treatments	Weed index (%)		
	2000-01	2001-02	Mean
T_1	40.91	42.71	41.81
T_2	48.03	52.37	50.20
T_3	48.64	54.32	51.48
T_4	7.68	9.32	8.50
T_5	17.05	19.50	18.28
T_6	17.15	19.90	18.53
T_7	33.03	33.10	33.07
T_8	71.89	70.33	71.11
T_9	-	-	-

Among all the treatments during both the years, the integrated treatment, PPI of trifluralin @ 1 Kg a.i. ha^{-1} supplimented with one hoeing and one weeding at 45 and 60 DAT (T_4) recorded the lowest weed index than all other treatments. Treatment T_5 was the next best treatment and was followed by T_6. T_6, T_7, T_1, T_2, T_3 and T_8 treatments. The chemical treatments (T_1, T_2 and T_3) were

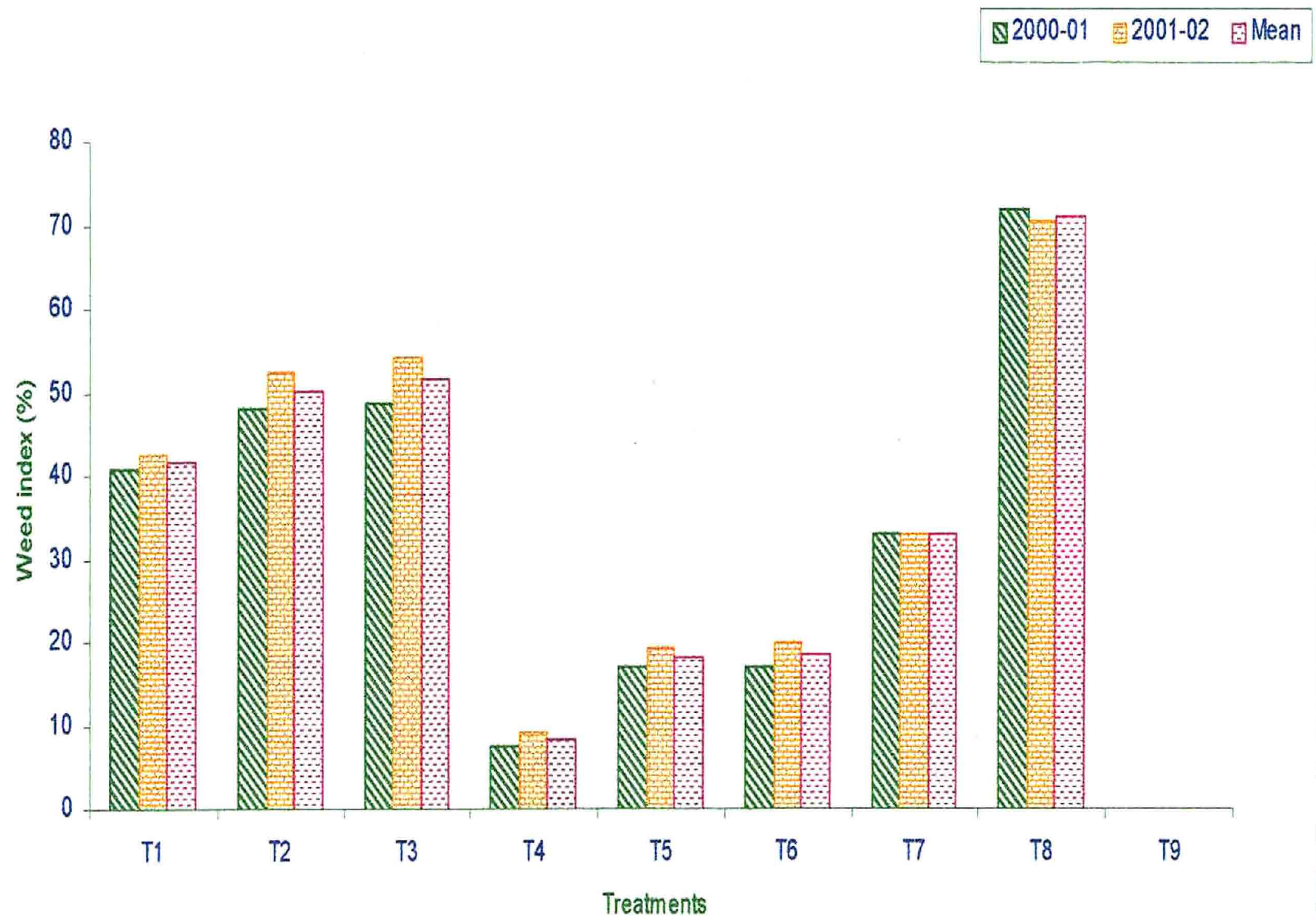

Figure 19: Weed index (%) as influenced by different treatments during 2000-01 and 2001-02

recorded lowest weed index over unweeded control (T_8) during both the years of experimentation.

In general mean, the order of increasing per cent values of weed index over treatment T_9 was in the sequence of 8.50, 18.28, 18.53, 33.07, 41.81, 50.20, 51.48 and 71.11 per cent due to T_4, T_5, T_6, T_7, T_1, T_2, T_3 and T_8 treatments respectively.

4.5 Chemical Studies

4.5.1 Mean uptake of nutrients (NPK) by weeds (Kg ha^{-1})

The uptake of nitrogen, phosphorus and potassium by weeds was calculated on dry matter weight basis of weeds and the data have been furnished in Table 59 and depicted in Figures 20 and 21.

Table 59: Uptake of nitrogen, phosphorus and potassium by weeds (Kg ha^{-1}) during 2000-01 and 2001-02 as influenced by different treatments

Treatments	Uptake of nitrogen (Kg ha^{-1})		Uptake of phosphorus (Kg ha^{-1})		Uptake of potassium (Kg ha^{-1})	
	2000-01	2001-02	2000-01	2001-02	2000-01	2001-02
T_1	10.82	10.73	2.56	2.72	15.16	10.96
T_2	15.96	14.78	3.35	3.30	20.70	15.81
T_3	16.63	15.66	3.67	3.50	22.93	16.46
T_4	4.65	4.02	1.09	1.03	6.32	4.99
T_5	6.85	5.91	1.49	1.55	8.76	6.72
T_6	7.29	6.64	1.57	1.62	9.21	7.37
T_7	9.24	9.23	1.98	2.18	12.16	9.61
T_8	25.17	23.11	5.91	5.44	34.41	24.45
T_9	2.96	3.16	0.69	0.52	3.86	4.03
S.E.(m) ±	0.53	0.33	0.12	0.16	0.77	0.25
C.D. at 5%	1.55	0.97	0.36	0.48	2.24	0.73
Mean	11.06	10.36	2.48	2.43	14.83	11.15

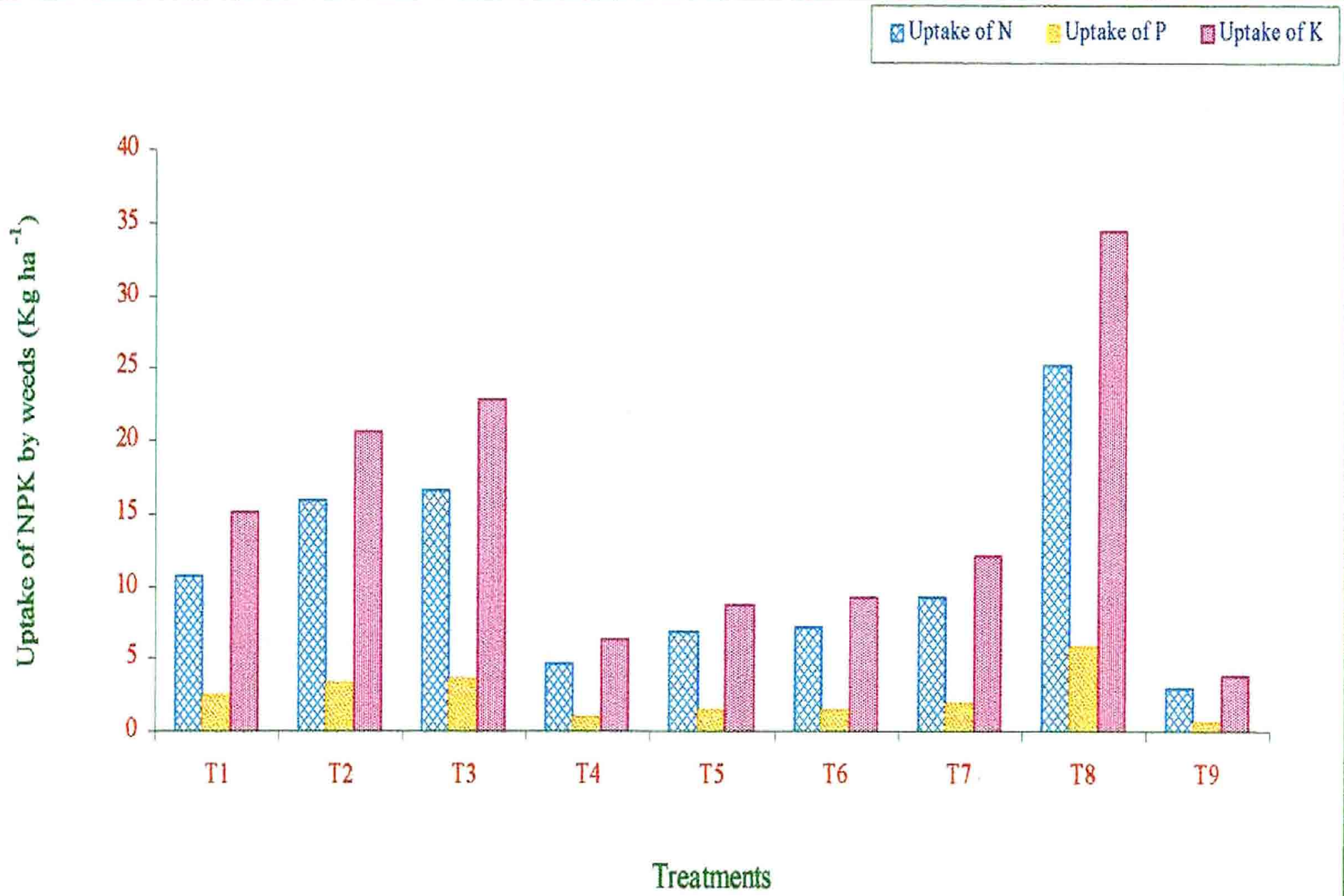

Figure 20: Uptake of NPK by weeds (Kg ha^{-1}) during 2000-01

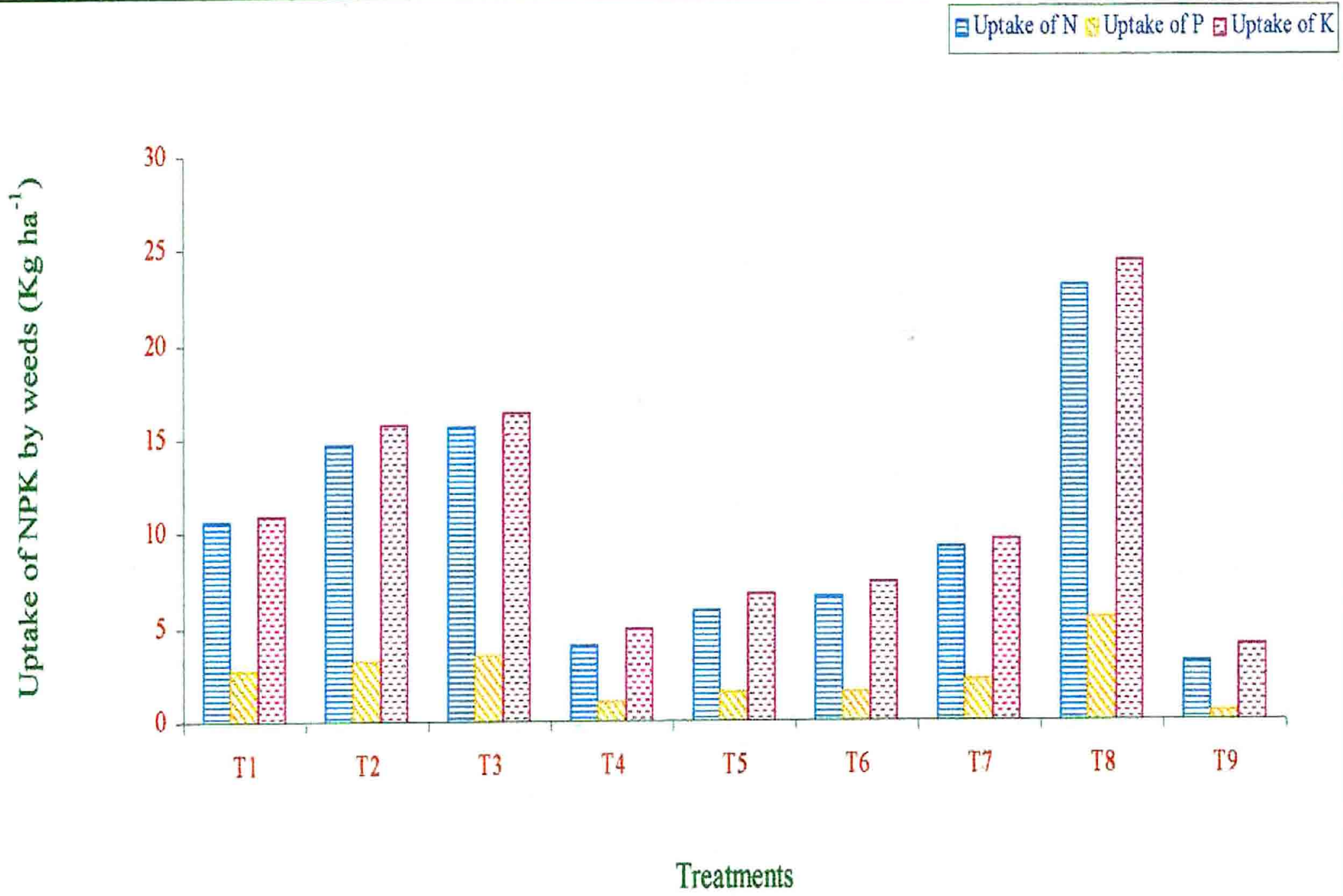

Figure 21: Uptake of NPK by weeds (Kg ha^{-1}) during 2001-02

4.5.1.1 Uptake of nitrogen by weeds

The data presented in Table 59 would reveal that there were significant differences among the treatments during both the seasons in respect of uptake of nitrogen by weeds. An average uptake of nitrogen by weeds was 11.06 and 10.36 Kg ha^{-1} in 2000-01 and 2001-02 respectively. The uptake of nitrogen through weeds was maximum in unweeded control (T_8) treatment during both the seasons of experimentation as compared to all other treatments.

Removal of nitrogen by weeds in unweeded control (T_8) treatment was 25.17 and 23.11 Kg ha^{-1} as against 2.96 and 3.16 Kg ha^{-1} under cultural treatment, two hoeings + two weedings at 30 and 60 DAT (T_9) during first and second season respectively. During both the years treatment T_9 was most effective in reducing nitrogen removal by weeds and proved significantly superior to the remaining treatments. Whereas, it was (T_9) at par with integrated treatment T_4 during 2001-02. PPI of trifluralin @ 1 Kg a.i. ha^{-1} with one hoeing and one weeding at 45 and 60 DAT (T_4) treatment which ranked second in reducing nitrogen removal by weeds, it was followed by T_5, T_6, T_7, T_1, T_2, T_3 and T_8 treatments. However, treatments T_5 and T_6 were at par and significantly superior over T_7, T_1, T_2, T_3 and T_8 treatments. Treatments T_2 and T_3 showed equal in effect and superior over unweeded control (T_8).

4.5.1.2 Uptake of phosphorus by weeds

Data pertaining to uptake of phosphorus by weeds presented in Table 59 and graphically represented in Figures 20 and 21. An average uptake of phosphorus by weeds was 2.48 and 2.43 Kg ha^{-1} in the first and second season respectively.

The uptake of phosphorus by weeds was significantly influenced by various treatments in both the seasons of experimentation. The removal of phosphorus through weeds in unweeded control (T_8) treatment was highest in both the years as compared to remaining treatments.

During both the years, treatment two hoeings + two weedings at 30 and 60 DAT (T_9) was found significantly better in reducing the uptake of phosphorus by weeds as compared to treatments T_4, T_5, T_6, T_7, T_1, T_2, T_3 and T_8. However, among the integrated treatments, T_4 was the best treatment and ranked second and superior over remaining treatments, followed by T_5 and T_6 treatments which were equal in effect. Similarly, treatments T_2 and T_3 were also at par with each other and better than unweeded control (T_8) treatment.

4.5.1.3 Uptake of potassium by weeds

The data on the potassium uptake by weeds at harvest as influenced by different method of weed control are furnished in Table 59 and depicted in Figure 20 and 21. An average uptake of potassium by weeds was 14.83 and 11.15 Kg ha^{-1} in the first and second season of the experimentation respectively.

The data further showed, the potassium losses through weeds were significantly influenced due to various treatments in both the years. The removal of potassium by weeds was higher in unweeded control (T_8) treatment than the all other treatments.

During both the years, treatment two hoeings + two weedings at 30 and 60 DAT (T_9) proved significantly superior in reducing the uptake of potassium by weeds over all other treatments. Pre-plant soil incorporation of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) treatment was the next best treatment and followed by T_5 and T_6 treatments, which were observed to be at par and significantly superior over T_7, T_1, T_2, T_3 and T_8 treatments. However, T_2

and T_3 were at par with each other and superior over unweeded control (T_8) treatment.

4.5.2 Mean uptake (Kg ha^{-1}) of nutrients (NPK) by chilli plant

The uptake of nutrients (NPK) by chilli plant at harvest under different treatments was studied on the basis of dry matter produced by the crop. From the nutrient content (per cent) in chilli fruit the uptake of nutrient in chilli fruit was computed on the basis of their yield. Summation of these gave the total uptake. The relevant data for two seasons are tabulated in Table 60 and graphically presented in Figures 22 and 23.

The nutrient (N, P and K) uptake was significantly influenced by various methods of weed control. The highest nutrient uptake by chilli plant was recorded in two hoeings + two weedings at 30 and 60 DAT (T_9) treatment while, lowest by unweeded control (T_8).

4.5.2.1 Uptake of nitrogen by chilli plant (Straw)

From Table 60, it would be seen that the mean uptake of nitrogen by plant was 19.31 and 17.46 Kg ha^{-1} during 2000-01 and 2001-02 respectively.

During both the years, among various methods of weed control, maximum nitrogen uptake per hectare was noticed under the treatment, two hoeings + two weedings (T_9) at 30 and 60 DAT which was at par with pre-plant soil in corporation (PPI) of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) treatment. Treatments pre-plant soil incorporation of fluchloralin @ 1 Kg a.i. ha^{-1} (T_5) and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} (T_6) each supplemented with one hoeing + one weeding at 45 and 60 DAT were at par and the next best treatments. These (T_5 and T_6) treatments were significantly superior

Table 60: Uptake of Nitrogen, Phosphorus and Potassium (Kg ha^{-1}) by chilli plant (Straw) and chilli fruits during 2000-01 and 2001- 02 as influenced by different treatments

Treatments	Uptake of Nitrogen (Kg ha^{-1})						Uptake of Phosphorus (Kg ha^{-1})						Uptake of Potassium (Kg ha^{-1})					
	2000-01			2001-02			2000-01			2001-02			2000-01			2001-02		
	Chilli plant	Chilli fruit	Total	Chilli plant	Chilli fruit	Total	Chilli plant	Chilli fruit	Total	Chilli plant	Chilli fruit	Total	Chilli plant	Chilli fruit	Total	Chilli plant	Chilli fruit	Total
T_1	16.47	55.17	71.64	14.06	47.71	61.77	3.71	7.62	11.33	3.69	6.22	9.91	31.42	43.17	74.59	30.99	36.89	67.88
T_2	13.43	48.53	61.96	11.22	39.63	50.85	3.01	6.70	9.71	2.36	5.08	7.44	25.78	37.97	63.75	23.77	30.63	54.40
T_3	12.21	47.93	60.14	11.43	38.03	49.46	2.60	6.62	9.22	2.49	4.88	7.37	24.56	37.50	62.06	24.69	29.41	54.10
T_4	27.61	87.09	114.70	25.64	76.14	101.78	7.03	12.26	19.29	6.73	10.15	16.88	50.97	68.35	119.32	51.78	59.01	110.79
T_5	23.24	77.77	101.01	20.90	67.28	88.18	6.05	10.86	16.91	5.39	8.87	14.26	45.14	60.76	105.90	43.44	52.08	95.52
T_6	22.17	77.68	99.85	20.99	66.95	87.94	6.26	10.85	17.11	5.31	8.83	14.14	42.73	60.69	103.42	42.97	51.82	94.79
T_7	19.21	62.64	81.85	16.92	55.93	72.85	4.68	8.76	13.44	4.42	7.27	11.68	36.70	49.04	85.74	36.47	43.18	79.65
T_8	9.20	26.18	35.38	8.16	24.64	32.80	1.75	3.57	5.32	1.72	3.17	4.89	16.86	20.47	37.33	16.89	19.09	35.98
T_9	30.27	94.31	124.58	27.82	83.95	111.77	8.00	13.28	21.28	7.71	11.20	18.91	59.71	73.42	133.13	61.52	65.06	126.58
S.E(m) ±	0.92	1.93	2.04	0.86	2.53	2.80	0.24	0.27	0.36	0.16	0.33	0.39	1.51	1.51	2.08	1.61	1.96	2.72
C.D.at 5%	2.71	5.64	5.95	2.52	7.39	8.18	0.69	0.78	1.06	0.46	0.96	1.14	4.40	4.41	6.08	4.71	5.72	7.93
Mean	19.31	64.14	83.46	17.46	55.58	73.04	4.79	8.95	13.73	4.42	7.29	11.72	37.10	50.15	87.25	36.94	43.02	79.96

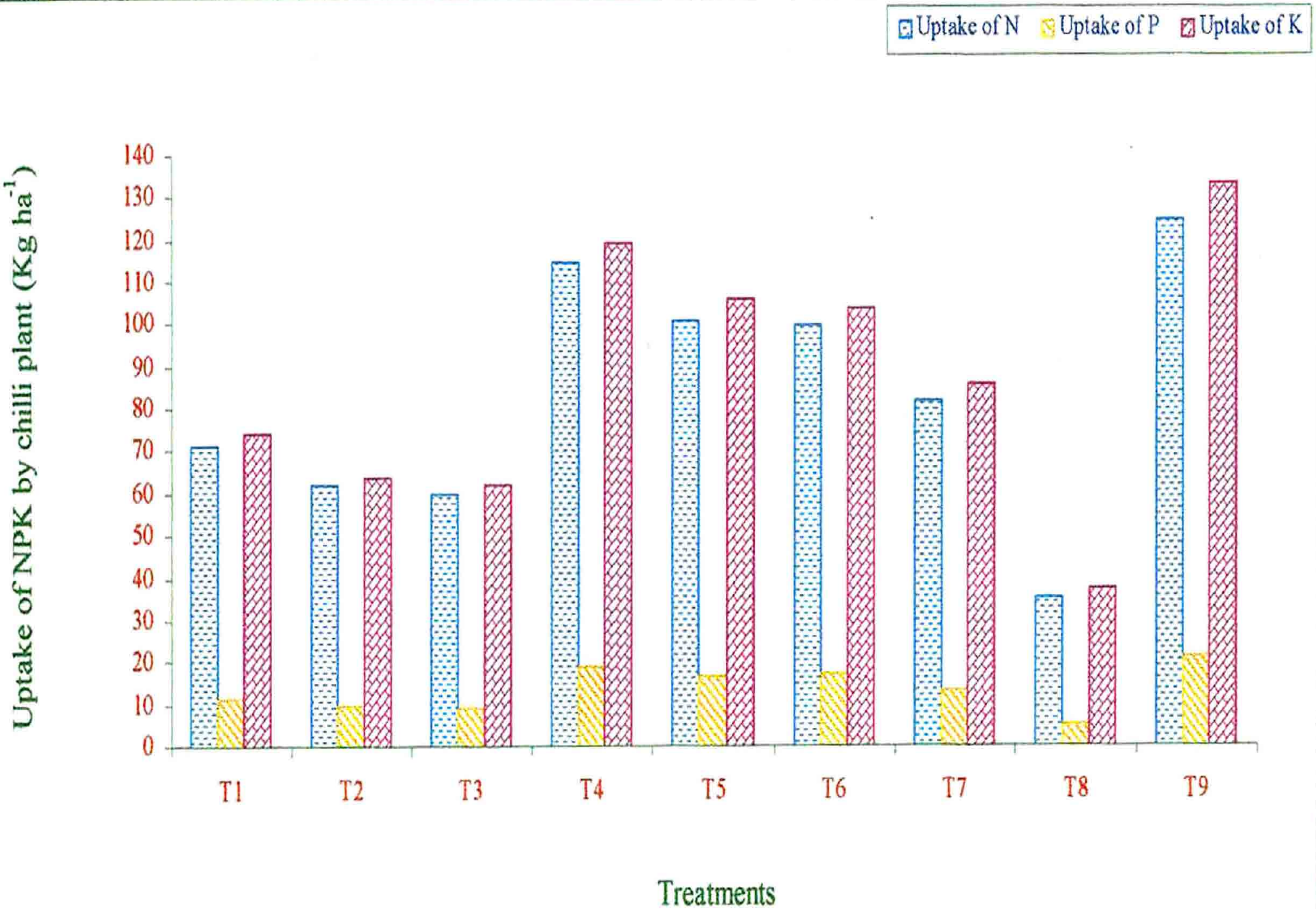

Figure 22: Uptake of NPK (Kg ha^{-1}) by chilli plant during 2000-01

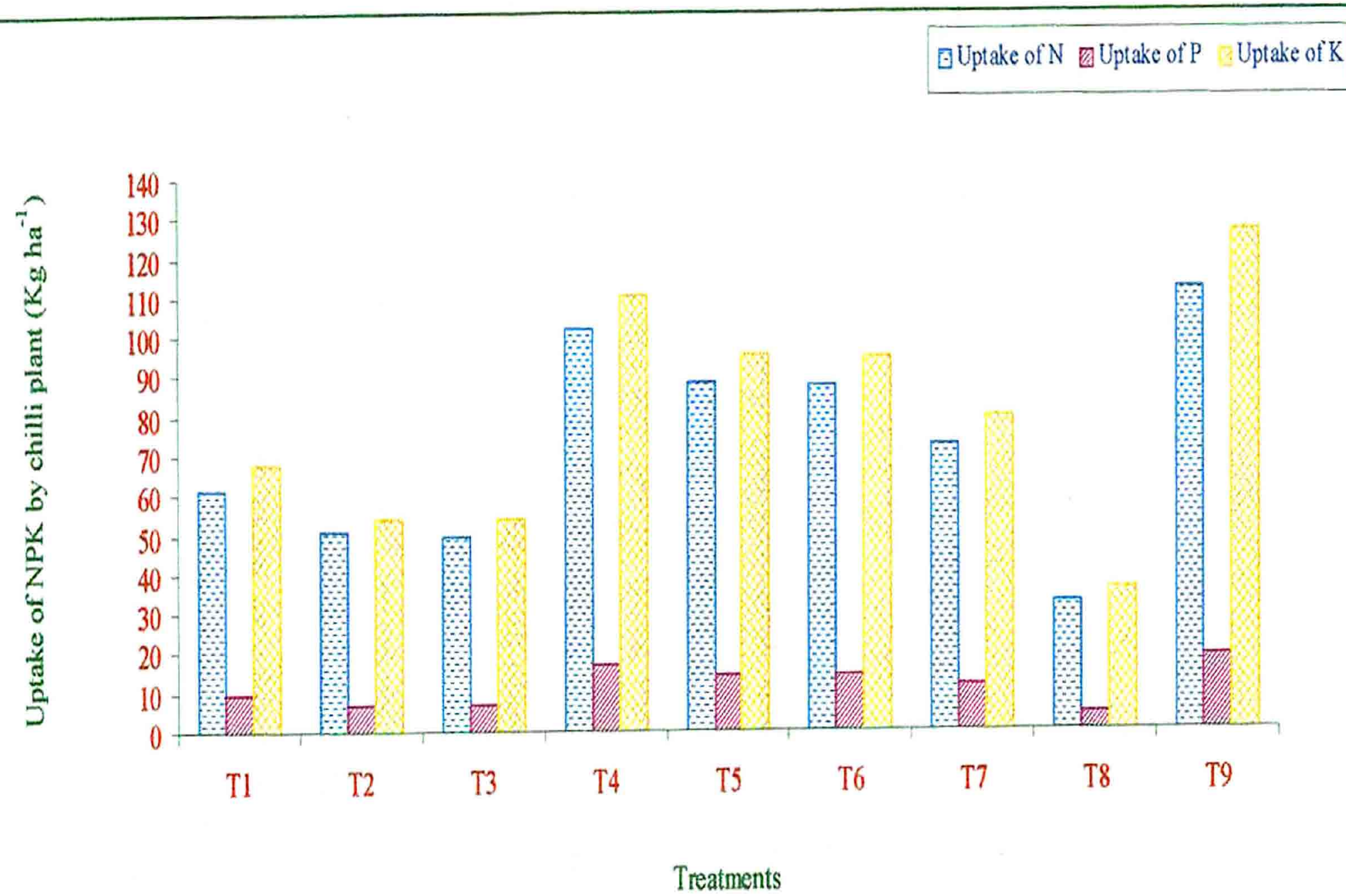

Figure 23: Uptake of NPK (Kg ha^{-1}) by chilli plant during 2001-02

over treatments T_7, T_1, T_2, T_3 and T_8. However, treatments T_2 and T_3 were showed equal in effect but superior over unweeded control (T_8) treatment.

4.5.2.2 Uptake of nitrogen by chilli fruit

Mean uptake of nitrogen by chilli fruit was 64.14 and 55.58 Kg ha^{-1} during first and second year of experimentation respectively. Uptake of nitrogen by fruits was higher in first year due to their higher yield. During both the years, uptake of nitrogen by fruits was significantly influenced by various treatments. The cultural treatment two hoeings + two weedings at 30 and 60 DAT (T_9) registered maximum uptake of nitrogen by chilli fruit and was significantly superior over all other treatments. The lowest uptake of nitrogen by chilli fruit was noted by unweeded control (T_8) treatment. Integrated treatment, PPI of trifluralin @ 1 Kg ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) was the next best treatment to uptake nitrogen by fruits, followed by T_5, T_6, T_7, T_1, T_2, T_3 and T_8 treatments.

4.5.2.3 Total uptake of nitrogen by chilli plant (Kg ha^{-1})

It is seen from the Table 60, the total uptake of nitrogen by chilli plant was 83.46 and 73.04 Kg ha^{-1} during 2000-01 and 2001-02 respectively. In the first year more uptake of nitrogen was recorded than the second year.

During both the years, two hoeings + two weedings at 30 and 60 DAT (T_9) recorded the highest uptake of nitrogen. On the contrary, lowest uptake of nitrogen by chilli plant was noted by the unweeded control (T_8) treatment.

During 2000-01, total uptake of nitrogen by chilli plant was 124.58, 114.70, 101.01 99.85, 81.85, 71.64, 61.96, 60.14 and 35.38 Kg ha^{-1} due to T_9, T_4, T_5, T_6, T_7, T_1, T_2, T_3 and T_8 treatments respectively.

During 2001-02, total uptake of nitrogen by chilli plant was 111.77, 101.78, 88.18, 87.94, 72.85, 61.77, 50.85, 49.46 and 32.80 Kg.ha^{-1} due to T_9, T_4, T_5, T_6, T_7, T_1, T_2, T_3 and T_8 treatments respectively.

4.5.2.4 Uptake of phosphorus by chilli plant (Straw)

During both the years, uptake of phosphorus by chilli plant was *significantly influenced by various treatments. The mean uptake of phosphorus by* chilli plant (Straw) was 4.79 and 4.42 Kg ha^{-1} during first and second year of experimentation.

Two hoeings + two weedings at 30 and 60 DAT (T_9) treatment registered maximum uptake of phosphorus by chilli plant (straw) and was significantly superior over all other treatments. PPI of trifluralin supplemented with one hoeing + one weeding at 45 and 60 DAT (T_4) treatment ranked second position and was followed by T_6, T_5, T_7, T_1, T_2, T_3 and T_8 treatments. Treatments T_6 and T_5 were at par and superior over remaining treatments. Treatments T_2 and T_3 were also equal in effect and showed more uptake than unweeded control (T_8) treatment.

4.5.2.5 Uptake of phosphorus by chilli fruit (Kg ha^{-1})

From the Table 60, it is evident that, mean removal of phosphorus by chilli fruit was 8.95 and 7.29 Kg ha^{-1} during 2000-01 and 2001-02. Uptake of phosphorus by chilli fruit was more in first year than in second year due to more yield.

During both the years, uptake of phosphorus by chilli fruit was significantly influenced by various treatments. Treatment two hoeings + two weedings at 30 and 60 DAT (T_9) registered highest uptake of phosphorus by fruit and was significantly superior over all other treatments, followed by T_4, T_5, T_6, T_7, T_1, T_2, T_3 and T_8. However, the lowest uptake of phosphorus was recorded by the unweeded control (T_8) treatment.

4.5.2.6 Total uptake of phosphorus by chilli plant (Kg ha^{-1})

It is seen from the Table 60, the average quantity of total phosphorus removed by chilli plant was 13.73 and 11.72 Kg ha^{-1} during 2000-01 and 2001-02 respectively. Thus in first year more uptake of total phosphorus by chilli plant was recorded because more yield of fruits and chilli plant (straw) than that of second year.

During 2000-01, the total uptake of phosphorus by chilli plant varied from 5.32 to 21.28 Kg ha^{-1} by T_8 and T_9 treatments respectively. During 2001-02, the removal of phosphorus by chilli plant was 18.91, 16.88, 14.26, 14.14, 11.68, 9.91, 7.44, 7.37 and 4.89 Kg ha^{-1} under T_9, T_4, T_5, T_6, T_7, T_1, T_2, T_3 and T_8 treatments respectively.

During both the years, the highest total uptake of phosphorus by chilli plant was recorded under two hoeings + two weedings at 30 and 60 DAT (T_9) treatment and proved better over all other treatments. The lowest total uptake of phosphorus by chilli plant was noticed under unweeded control (T_8) treatment. Treatment T_9 was followed by PPI of trifluralin @ 1 Kg a.i. ha^{-1} combined with one hoeing and one weeding at 45 and 60 DAT (T_4), which was significantly superior over T_5, T_6, T_7, T_1, T_2, T_3 and T_8. However, treatments T_5 and T_6 were at par with each other. T_2 and T_3 treatments also showed equal in effect.

4.5.2.7 Uptake of potassium by chilli plant (Straw)

From the Table 60 it is observed, the mean uptake of potassium by chilli plant was 37.10 and 36.94 Kg ha^{-1} during 2000-01 and 2001-02 respectively. During both the years, more or less similar results were obtained in respect of potassium uptake by chilli plant (straw). The highest uptake of potassium by chilli plant (straw) was recorded by treatment, two hoeings + two weedings at 30 and 60 DAT (T_9) followed by PPI of trifluralin @ 1 Kg a.i. ha^{-1} with one hoeing + one weeding at 45 and 60 DAT (T_4). Treatments T_5 and T_6 were at par and significantly superior over treatments T_7, T_1, T_2, T_3 and T_8. Treatments T_2 and T_3 were also equal in effect and superior over unweeded control (T_8) treatment.

4.5.2.8 Uptake of potassium by chilli fruits

From the Table 60 it is observed, the mean uptake of potassium by chilli fruit was 50.15 and 43.02 Kg ha^{-1} during 2000-01 and 2001-02, respectively.

During 2000-01, the potassium uptake by chilli fruit varied from 20.47 to 73.42 Kg ha^{-1} by T_8 and T_9 treatments. However, during 2001-02 it was varied from 19.09 to 65.06 by the same , T_8 and T_9 treatments.

Treatment, two hoeings + two weedings at 30 and 60 DAT (T_9) recorded the significantly highest uptake of potassium by chilli fruits, followed by T_4, T_5, T_6, T_7, T_1, T_2, T_3 and T_8 treatments respectively. Treatments T_5 and T_6 were equal in effect. T_2 and T_3 also recorded the equally uptake of potassium by chilli fruits and superior than unweeded control (T_8) treatment.

4.5.2.9 Total uptake of potassium by chilli plant (Kg ha^{-1})

The mean total uptake of potassium by chilli plant was 87.25 and 79.96 Kg ha^{-1} during 2000-01 and 2001-02 respectively.

During both the years, the highest uptake of potassium by chilli plant was recorded under treatment, two hoeings + two weedings at 30 and 60 DAT (T_9), followed by T_4, T_5, T_6, T_7, T_1, T_2, T_3 and T_8. Among the integrated treatments, PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) recorded the highest uptake of potassium as compared to remaining T_5, T_6 and chemical (T_1, T_2 and T_3) treatments. Treatments T_5 and T_6 similarly, T_2 and T_3 were equal in effect between themselves.

4.6 Correlation and regression analysis

4.6.1 Simple correlation analysis

Correlation studies were undertaken between uptake of nutrients (NPK) by chilli plant and uptake of nutrients (NPK) by weeds (as per treatments) at harvest during both the seasons. The values of correlation coefficient (r) are presented in Table 61.

From the Table 61 it was observed that the correlation coefficient (r) values of uptake of nutrients (NPK) by chilli plants and by weeds showed negative correlation. It indicated, higher nutrient uptake by the weeds resulted in decrease in the uptake of nutrient by chilli plant.

Table 61: Correlation coefficient (r) between nutrients (NPK) uptake in chilli plant and in weed

Sr. No.	Relation between	Correlation Coefficient (r)	
		2000-01	2001-02
1.	Total nitrogen in chilli plants and total nitrogen in weeds (Kg ha^{-1})	-0.96227	-0.96034
2.	Total phosphorus in chilli plants and total phosphorus in weeds (Kg ha^{-1})	-0.94395	-0.94932
3.	Total potassium in chilli plants and total potassium in weeds (Kg ha^{-1})	-0.95952	-0.94343

4.6.2 Phenotypic correlation coefficient

To study the inter-relation between the yield and yield contributing characters and also to establish relationship in the form of multiple linear regression equation between the yield contributing characters (independent variables) and yield (dependant). Phenotyipic correlation and regression analysis was carried with the help of Seven yield contributing characters and yield. During analysis three characters plant height at 30, 60 and 90 days after transplanting were deleted as these parameters could not establish the relationship with yield, ultimately four yield contributing characters, plant height (X_1), dry weight per plant (X_2), number of fruits per plant (X_3) and weight of fruits per plant (X_4) were selected to explain the contribution of each variable with yield.

The phenotypic correlations were calculated and presented in Table 62.

Table 62: Phenotypic correlation coefficient (r)

Characters	Plant height (cm)	Dry weight plant^{-1} (g)	Number of fruits plant^{-1}	Weight of fruits plant^{-1} (g)	Yield of wet red chilli fruits (q ha^{-1})
Plant height (cm)	1	0.996	0.986	0.985	0.983
Dry weight plant^{-1} (g)		1	0.986	0.985	0.983
Number of fruits plant^{-1}			1	0.998	0.993
Weight of fruits plant^{-1} (g)				1	0.992
Yield of wet red chilli fruits (q ha^{-1})					1

All the values of correlation coefficients (r) were significant both at 5 and 1 per cent levels.

It is revealed from the above table that all phenotypic correlation coefficients were found to be positive and significant, indicating these variables are strongly related with each other and yield.

It can be concluded from the study that these variables are appropriate to explain the yield as yield attributes.

4.6.3 Path analysis

The direct and total indirect effect of yield contributing characters in yield was worked and presented in Table 63.

Table 63:Direct and total indirect effect

Sr.No.	Characters	Direct effect	Total indirect effect
1.	Plant height (cm)	0.131	0.853
2.	Dry weight plant^{-1} (g)	0.018	0.965
3.	Number of fruits plant^{-1}	0.441	0.551
4.	Weight of fruits plant^{-1} (g)	0.406	0.586

Residual effect = 0.0134

It is revealed from the Table 63 that the direct effect of number of fruits per plant followed by weight of fruits per plant is substantially higher, plant height contributed 0.131 and least direct effect is exhibited by dry weight per plant. The total indirect effects through dry weight per plant is substantially higher than other yield contributing characters. The total indirect effect through plant height is 0.853 and through number of fruits per plant is 0.586. It is revealed from the table that the three yield contributing characters, number of fruits per plant, weight of fruits per plant and plant height are the major contributers to the indirect effect also.

4.6.4 Regression analysis

To study the relation among the yield and selected yield contributing characters, multiple linear regression between plant height (X_1), dry weight per plant (X_2), number of fruits per plant (X_3), weight of fruits per plant (X_4) and yield was fitted and results obtained are presented in Table 64.

Table 64: Regression analysis

Sr.No.	Characters	Regression coefficient (b) values	SE (b)
1.	Plant height (cm)	$-0.067^{N.S.}$	0.0532
2.	Dry weight plant^{-1} (g)	$0.062^{N.S.}$	0.0561
3.	Number of fruits plant^{-1}	0.399**	0.0378
4.	Weight of fruits plant^{-1} (g)	0.088**	0.0156

'a' (Intercept) = 3.799 R^2 = 0.982**

It is revealed from that the total contribution explained by all the four variables is 98.20 per cent. The two variables, number of fruits per plant and weight of fruits per plant significantly contributed to the yield. Remaining two variables plant height and dry weight per plant could not exhibit significant contribution in yield. It can be concluded from the correlation and regression studies that the two major yield contributing characters are, number of fruits per plant and weight of fruits per plant to the yield per plant.

4.7 Economics of weed control treatments

The comparative cost of various weed control treatments under study was worked out by taking into consideration market prices of produce, chemicals, hire charges of bullock and wages of labourers. Economics of various weed control treatments were worked out and data are presented in Table 65.

Table 65: Economics of different weed control treatments

Treat-ments	Fruit yield ($q\ ha^{-1}$)		Gross return ($Rs.\ ha^{-1}$)		Cost of cultivation ($Rs.\ ha^{-1}$)		Net return or loss (-) ($Rs.\ ha^{-1}$)			Net return or loss (-) $rupee^{-1}$		Cost : benefit ratio	
	2000-01	2001-02	2000-01	2001-02	2000-01	2001-02	2000-01	2001-02	Mean	2000-01	2001-02	2000-01	2001-02
T_1	31.72	27.52	31720	27520	30563	29395	1157	(-) 1875	(-) 359	0.04	(-) 0.06	1:1.04	1:0.94
T_2	27.96	22.92	27960	22920	30426	29210	(-) 2466	(-) 6290	(-) 4378	(-) 0.08	(-) 0.22	1:0.92	1:0.78
T_3	27.71	22.05	27710	22050	30394	29142	(-) 2684	(-) 7092	(-) 4888	(-) 0.09	(-) 0.24	1:0.91	1:0.76
T_4	49.54	43.49	49540	43490	32579	31305	16961	12185	14573	0.52	0.39	1:1.52	1:1.39
T_5	45.13	39.15	45130	39150	32405	31135	12725	8015	10370	0.39	0.26	1:1.39	1:1.26
T_6	45.09	38.98	45090	38980	32384	31107	12706	7873	10290	0.39	0.25	1:1.39	1:1.25
T_7	36.94	32.99	36940	32990	30343	29189	6597	3801	5199	0.22	0.13	1:1.22	1:1.13
T_8	14.67	13.19	14620	13190	28074	27061	(-)13404	(-)13871	(-) 13638	(-) 0.48	(-) 0.51	1:0.52	1:0.49
T_9	53.20	47.66	53200	47660	32017	30772	21183	16888	19036	0.66	0.55	1:1.66	1:1.55

(i) Cost of wet red chilli fruits @ Rs. 1000 q^{-1} during 2000-01& 2001-02
(ii) Labour charges Rs. 37 day^{-1} during 2000-01 & 2001-02
(iii) Bullock pair charges Rs. 100 day^{-1} during both the years.

(iv) Cost of chemicals :--
a) Price of Trifluralin (Treflan 48 EC) @ Rs. 587 L^{-1}(Rs. 1220 ha^{-1})
b) Price of Fluchloralin (Basalin 45EC) @Rs. 580 L^{-1} (Rs. 1288 ha^{-1})
c) Price of Alachlor (Lasso 50EC) @ Rs. 318 L^{-1}(Rs. 1272 ha^{-1})

During 2000-01 and 2001-02 the data in respect of cost of cultivation, the integrated treatments, pre-plant soil incorporation (PPI) of trifluralin @ 1 Kg a.i. ha^{-1} (T_4), PPI of fluchloralin @ 1 Kg a.i. ha^{-1} (T_5) and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} (T_6) each combined with one hoeing at 45 DAT and one weeding at 60 DAT were required highest cost of cultivation than the cultural treatment T_9 and chemical treatments T_1, T_2 and T_3. Whereas, least cost of cultivation was require by the unweeded control (T_8) treatment.

The data pertaining to economics of various treatments showed, during both the years the highest gross return (rupees ha^{-1}) was noticed under the cultural treatment, two hoeings + two weedings at 30 and 60 DAT (T_9) followed by integrated treatments, pre-plant soil incorporation (PPI) of trifluralin @ 1 Kg a.i. ha^{-1} (T_4), PPI of fluchloralin @ 1 Kg a.i. ha^{-1} (T_5) and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} (T_6) each supplimented with one hoeing at 45 DAT and one weeding at 60 DAT. Thereafter, the cultural treatment one hoeing at 30 DAT + one weeding at 45 DAT (T_7) gave the more gross return than the chemical treatments T_1, T_2 and T_3. However, these chemical treatments gave more gross return than the unweeded control (T_8) treatment. Same trend were observed in respect of net returns and cost benefit ratio during both the years. The losses in net returns and cost benefit ratio were noticed by the treatments T_2, T_3 and T_8 during first season and T_1, T_2, T_3 and T_8 during second season of experiment while, maximum loss was recorded under T_8 treatment, Rs. 13404 and 13871 ha^{-1} during 2000-01 and 2001-02 respectively.From the mean of net returned the losses were noticed under the T_1, T_2, T_3 and T_8 treatment.

CHAPTER V

DISCUSSION

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CHAPTER V

DISCUSSION

The present investigation entitiled "Studies on integrated weed management in chilli (*Capsicum annum* L.)", was conducted at farm of Chilli and Vegetable Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during 2000-01 and 2001-02 Kharif Seasons.

The experimental findings reported in the preceding chapter are discussed in this chapter and an attempt is made to provide appropriate reasonings for the results obtained during the course of investigation.

5.1 Soil

The soil of the experimental plot was clayey in texture, it was low in total nitrogen and available phosphorus whereas, high in potassium and medium in organic carbon. The soil reaction was slightly alkaline.

5.2 Season and weed infestation

Weekly weather data for the year 2000-01 and 2001-02 are presented in Table 3 and 4 respectively.

A perusal of the data revealed that, the total precipitation received during the first season of 2000-01, from June to December was about 534.3 mm (in 32 rainy days) which seemed to be less than normal. The season was characterised by a relatively high rainfall in the month of July (226.3 mm) followed by August (150.7 mm), June (102.3 mm) and September (55.0 mm). There were no post monsoon rains as against normal.

During the crop season, there was three long dry spell during 24^{th} to 25^{th}, 30^{th} to 31^{st} and 36^{th} to 38^{th} M.W. There was not much deviation in maximum and minimum temperatures and bright sunshine hours from the normal values.

The season of 2000-01 was favourable for weeds as compared to the season of 2001-02. Among the dicot weeds, *Psorulea corylifolia*, *Ipomea reniformis, Chenopodium album* , *Lagasca mollis* and *Parthenium hysterophorus* were dominant whereas, among the monocot weeds *Cyperus rotundus* and *Cynodon dactylon* were dominant.

During 2001-02, the total rainfall received was 731.2 mm as against the normal rainfall 818.6 mm. During this season a long dry spell of 21 days occurred during the 35^{th} to 37^{th} M.W. which affected the flowering of chilli adversely and caused partial shedding of flowers with the result that crop yield was low. Highest rainfall of 110.5 mm was recorded during 24^{th} M.W., rainfall values during June, July, August and September were 204.5, 89.2, 112.4 and 76.4 mm respectively as against normal rainfall values 150.5, 212.2, 215.7 and 111.1 mm.

In general, during 2001-02 monocot, weeds like *Cyperus rotundus*, *Cynodon dactylon* and *Echinochloa crusgalli* and dicot weeds Viz., *Psorulea corylifolia, Corchorus acutangulas, Lagasca mollis, Euphorbia hirta* and *Parthenium hysterophorus* were dominant in the experimental plot.

During both the years, the proportion of monocot weeds was more than that of dicot weeds. The influence of weather condition and weed competition was probably responsible for low yield.

5.3 General crop growth and plant population

An extract of relevant information on mean plant height is given in Table 67. The data revealed that plant height showed gradual increase from 30 DAT to 120 DAT and more plant height was attained from a period 60 DAT to 90 DAT of chilli plant during both the years of experimentation. The plant population at initial and at harvest stage did not show significant variation due to treatments during both the years.

During the growth period of crop, the incidence of Thrips (*Scritothrips dosalis*) and mites (*Hemitorsonemus latus*) was negligible but the incidence of aphids and leaf curl disease of chilli were noticed during both the years of experimentation. Pesticides were sprayed to overcome the pest problem.

5.4 Effect of cultural, herbicidal and integrated treatments on weed control in chilli (Var. Jayanti)

With a view to evaluate the effect of cultural, herbicidal and integrated methods on number of monocot weeds, number of dicot weeds, total weed population, dry weight of weeds, weed control efficiency, uptake of nitrogen, phosphorus and potassium by weeds, an extract of relevant information has been presented in Table 66.

5.4.1 Effect on monocot weeds

In both the years weed population m^{-2} at all the stages of crop growth (Viz. 30, 60, 90 and 120 DAT) differed significantly among the various weed control treatments (Table 66).

Table 66: An extract of relevant information on number of monocot weeds, dicot weeds, total weed population, dry weight of weeds, weed control efficiency (WCE), Uptake of Nitrogen, Phosphorus and Potassium by weeds as influenced by various weed control treatments during 2000-01 and 2001-02

Sr. No.	Particulars	Days after transplanting	Year	Treatments									C.D. at 5%	Mean
				T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9		
1	* Number of monocot weeds m^{-2}	30	2000-01	5.68	6.39	6.37	5.40	6.36	6.72	7.62	7.36	7.85	0.58	6.64
			2001-02	6.87	8.01	8.35	6.69	8.26	8.39	9.40	9.19	9.70	0.67	8.32
		60	2000-01	6.37	7.03	7.12	4.60	6.01	6.19	4.08	8.89	3.68	0.61	6.00
			2001-02	6.72	7.95	8.27	4.93	5.78	6.38	4.68	10.15	4.43	0.73	6.59
		90	2000-01	7.29	8.15	8.31	4.96	5.18	5.35	6.02	9.71	3.03	0.65	6.43
			2001-02	7.54	8.84	8.59	3.84	4.28	4.14	6.71	10.57	2.68	0.94	6.35
		120	2000-01	7.15	8.33	8.48	5.32	5.45	5.60	6.49	9.50	4.02	0.79	6.71
			2001-02	8.68	9.51	9.61	5.84	6.27	6.58	7.45	10.74	3.48	0.79	7.57
2	* Number of dicot weeds m^{-2}	30	2000-01	3.83	4.85	5.06	4.05	5.43	5.25	7.31	7.47	6.90	0.74	5.56
			2001-02	2.82	3.44	3.50	2.95	4.09	3.86	7.43	7.98	6.76	0.45	4.76
		60	2000-01	4.58	5.79	5.86	3.37	4.88	4.83	3.28	8.21	2.54	0.67	4.81
			2001-02	4.22	5.22	5.54	3.43	4.49	4.43	3.52	8.52	2.80	0.55	4.69
		90	2000-01	5.95	6.74	6.98	2.53	2.68	2.94	4.37	9.06	2.63	0.70	4.88
			2001-02	5.20	6.11	6.48	2.11	2.43	2.49	3.77	9.01	2.05	0.65	4.40
		120	2000-01	5.61	6.09	6.35	2.82	3.34	3.56	4.53	8.25	3.05	0.74	4.85
			2001-02	4.55	5.25	5.51	2.77	3.07	3.16	3.89	7.25	3.04	0.59	4.28
3	* Total number of weeds m^{-2}	30	2000-01	6.86	8.03	8.12	6.72	8.36	8.53	10.55	10.48	10.43	1.15	8.67
			2001-02	7.42	8.71	9.06	7.31	9.21	9.22	11.97	12.18	11.82	0.92	9.65
		60	2000-01	7.85	9.11	9.21	5.69	7.74	7.85	5.22	12.09	4.48	1.11	7.69
			2001-02	7.95	9.50	9.95	5.99	7.29	7.77	5.88	13.25	5.25	0.90	8.09
		90	2000-01	9.40	10.57	10.85	5.57	5.82	6.10	7.28	13.29	4.00	1.14	8.10
			2001-02	9.17	10.77	10.79	4.39	4.95	4.84	7.70	13.90	3.38	0.76	7.76
		120	2000-01	9.10	10.33	10.62	6.03	6.40	6.63	7.92	12.58	5.04	0.97	8.32
			2001-02	9.80	10.88	11.09	6.48	6.99	7.31	8.45	12.97	4.63	0.62	8.73

Table 66 contd.

4	* Dry weed biomass (g m^{-2})	30	2000-01	2.56	3.21	3.34	2.51	3.43	3.40	4.47	4.30	4.29	0.61	3.50
			2001-02	2.88	3.71	4.03	2.69	4.03	4.14	5.07	5.28	4.87	0.54	4.08
		60	2000-01	5.82	6.80	6.89	4.12	5.67	5.76	3.76	9.04	3.21	0.89	5.68
			2001-02	5.71	7.04	7.40	4.32	5.34	5.62	4.15	10.01	3.87	0.75	5.94
		90	2000-01	8.07	9.20	9.40	4.44	4.71	4.94	6.16	11.64	3.20	1.09	6.86
			2001-02	8.01	9.28	9.51	3.84	4.50	4.20	6.53	12.28	3.07	0.75	6.80
		120	2000-01	8.68	9.91	10.24	5.61	6.01	6.22	7.78	12.46	4.71	0.85	7.96
			2001-02	8.91	10.16	10.61	5.83	6.55	7.05	8.06	12.72	4.32	0.74	8.24
5	Dry weight of weeds (q ha^{-1})	At harvest	2000-01	8.14	10.27	10.93	4.21	5.32	5.81	7.02	15.88	2.98	1.04	7.84
			2001-02	9.21	11.09	11.33	3.92	5.56	6.04	7.97	16.65	3.24	0.52	8.33
6	Weed control efficiency (%)	At harvest	2000-01	48.74	35.33	31.17	73.49	66.50	63.41	55.79	-	81.23	-	-
			2001-02	44.68	33.39	31.95	76.46	66.61	63.72	52.13	-	80.54	-	-
7	Uptake of nitrogen by weeds (Kg ha^{-1})	At harvest	2000-01	10.82	15.96	16.63	4.65	6.85	7.29	9.24	25.17	2.96	1.55	11.06
			2001-02	10.73	14.78	15.66	4.02	5.91	6.64	9.23	23.11	3.16	0.97	10.36
8	Uptake of phosphorus by weeds (Kg ha^{-1})	At harvest	2000-01	2.56	3.35	3.67	1.09	1.49	1.57	1.98	5.91	0.69	0.36	2.48
			2001-02	2.72	3.30	3.50	1.03	1.55	1.62	2.18	5.44	0.52	0.48	2.43
9	Uptake of potassium by weeds (Kg ha^{-1})	At harvest	2000-01	15.16	20.70	22.93	6.32	8.76	9.21	12.16	34.41	3.86	2.24	14.83
			2001-02	10.96	15.81	16.46	4.99	6.72	7.37	9.61	24.45	4.03	0.73	11.15

* = The values are transformed values ($\sqrt{x}$)

Generally, all the weed control treatments recorded significantly lower weed population compared to unweeded control. During both the years at 30 DAT (Tables 10 to 18), pre-plant soil incorporation (PPI) of trifluralin @ 1 Kg a.i. ha^{-1} with or without integration of one hoeing + one weeding at 45 and 60 DAT (T_4 and T_1) were quite effective in controlling monocot weeds as compared to PPI of fluchloralin @ 1 Kg ha^{-1} and soil application of alachlor @ 2 Kg a.i. ha^{-1} both combined with or without one hoeing at 45 DAT and one weeding at 60 DAT (T_5, T_6, T_2 and T_3). This may be due to the efficacy of trifluralin in destroying the viability of weed seeds which helped to reduce the population of monocot weeds except the weeds like *Cynodon dactylon* and *Cyperus rotundus*. Similar results were reported by Ashley and Rahn (1966), Elal *et al.* (1970), Whiting *et al.* (1970), Metwally *et al.* (1979) and Varopai (1981).

However, further analysis of data revealed, the cultural treatment of twice hoeing plus twice weeding at 30 and 60 DAT (T_9) caused maximum reduction in the monocot weed population at all the remaining growth stages. This could be attributed to the removal of monocot weeds during cultural operations such effect being less where only single hoeing and weeding (T_7) was done. These results are in conformity with those of Labrada and Paredes (1983), Adigun *et al.* (1987), Narayan Rao (1988) and Narasalagi (1999).

Among the combinations of pre-plant soil applied herbicides and cultural treatments (integrated treatment), the maximum reduction in number of monocot weeds was under PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT(T_4) as compared to PPI of fluchloralin @ 1 Kg a.i. ha^{-1}

(T_5) and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} each with combination of one hoeing at 45 DAT and one weeding at 60 DAT. This was due to better control of monocot weeds at early stage of crop growth by trifluralin and thereafter there was removal of monocot weeds due to hoeing and weeding at 45 DAT and 60 DAT, the other herbicides caused less suppression of these weeds. Similar effect of trifluralin plus intercultural operation was reported by Bhalla (1980) and Anonymous (2001b). Among the herbicides, PPI of trifluralin @ 1 Kg a.i. ha^{-1} appeared to be better than the other herbicides at all the growth stages. This might be due to effectiveness of trifluralin against monocot weeds. Whiting *et al.* (1970), Beste (1985), Sutater *et al.* (1987) and Joshi *et al.* (1995) also stated that PPI of trifluralin recorded the maximum reduction in number of monocot weeds.

The herbicides could not control the monocot weeds like *Cynodon dactylon* and *Cyperus rotundus* due to their deep rhizome and root systems. Relatively lower population under treatments T_4 and T_1 (PPI trifluralin @ 1 Kg a.i. ha^{-1}) could be due to suppression of monocot weeds, other than *Cyperus rotundus* and *Cynodon dactylon*. Similar results were reported by Bhalla (1975), Randhawa and Bhalla (1976) and Bhalla and Nakhtore (1980).

5.4.2 Effect on dicot weeds

The population of dicot weeds m^{-2} was affected significantly at all the growth stages due to different weed control treatments (Tables 19 to 27), in general unweeded control recorded significantly, the highest number of dicot weeds. During both the years pre-plant soil incorporation (PPI) of trifluralin @ 1 Kg a.i. ha^{-1} with or without hoeing plus weeding at 45 and 60 DAT was found equally effective in reducing the population of dicot weeds significantaly at 30 days after transplanting (DAT) of chilli. It was due to better efficiency of trifluralin in controlling the dicot weeds. These findings coinsided with the findings of Orsenigo and Ozaki (1962), Ashley and Rahn (1966), Kostov (1975) and Metwally *et al.* (1979).

Further, it was observed that at 60 DAT during both the years, the cultural treatment, two hoeings followed by two weedings at 30 and 60 DAT (T_9) caused maximum reduction in population of dicot weeds. This might be due to the control of dicot weed population significantly by hoeing and weeding operation at 30 days after transplanting of chilli plant. Similar results were recorded by Labrada and Paredes (1983), Narayana Rao (1988) and Narasalagi (1999). Further analysis of data revealed that during both the years pre-plant soil incorporation (PPI) of trifluralin @ 1 Kg ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4), two hoeings + two weedings at 30 and 60 DAT (T_9), PPI of fluchloralin @ 1 Kg ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_5) and pre-plant soil application of alachlor @ 2 Kg ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_6) were found equally effective in reducing the dicot weeds, which could be attributed to the removal of weeds during weeding undertaken at 60 DAT. However, during 2001-02 at 90 DAT, cultural treatment two hoeings + two weedings (T_9) recorded slightly less number of dicot weeds than integrated treatment T_4 but both were at par. This might be due to some favourable effect of hoeing followed by weeding operation at 60 DAT. The results were in conformity with the findings of Labrada and Paredes (1983), Adigun et al.(1987),Irfan Raza (1998) and Anonymous (2001 b).

5.4.3 Effect on total weed population

In both the years, total weed population m^{-2} was affected significantly due to pre-plant herbicidal treatments at early stages of crop growth (30 DAT) only(Tables 28 to 36). There was highest reduction in total weed population in treatments of PPI of trifluralin @ 1 Kg a.i. ha^{-1} with or without hoeing + weeding at 45 and 60 DAT (T_4 and T_1), followed by PPI of fluchloralin @ 1 Kg a.i. ha^{-1} and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} each supplemented with or without one hoeing + one weeding at 45 and 60 DAT (T_5, T_6, T_2 and T_3). This may be due to better performance of these herbicides probably due to their ability to control both monocot and dicot weeds effectively, especially at the early stage of crop growth. Similar effect on weed population was reported earlier by Stoian *et al.* (1984), Singh *et al.* (1985) and Joshi *et al.* (1995).

Further, the cultural treatment of two hoeings + two weedings at 30 and 60 DAT (T_9) caused maximum reduction in the total weed population at all the growth stages which could be attributed to the removal of both monocot and dicot weeds. Similar results were observed by Labrada and Paredes (1983), Narayana Rao (1988) and Narasalagi (1999).The pre-plant soil incorporation of trifluralin @ 1 Kg a.i. ha^{-1}, PPI of fluchloralin @ 1 Kg a.i. ha^{-1} and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} each treatment supplemented with one hoeing and one weeding at 45 and 60 DAT (T_4, T_5 and T_6) were the next best treatments and recorded the maximum reduction in total weed population as compared to one hoeing + one weeding at 30 and 45 DAT (T_7) and the herbicides application (T_1, T_2 and T_3). This may be due to the fact that weed plants, which escaped the effect of pre-planting application were destroyed by hoeing and weeding that followed.

Similar results, have been also reported by Adigun *et al.* (1987), Bhalla (1980) and Lankroo *et al.* (1990).

5.4.4 Effect on dry weed biomass

In fact, the real effect of weed control treatments can be judged on the basis of dry weight of weeds rather than their count. The data given in Table 66 indicated that the dry weed biomass of total weeds in unweeded control increased with advancement in crop growth (Tables 37 to 45)

During both the years, dry weed biomass was significantly affected due to pre-plant herbicides at 30 DAT. In general, dry weed biomass under pre-plant soil incorporation (PPI) of trifluralin @ 1 Kg a.i. ha^{-1} with or without one hoeing + weeding at 45 and 60 DAT (T_1 and T_4) were significantly lowest than rest of the treatments at 30 DAT. This could be attributed to inhibition of growth of weeds during early crop growth period and more reduction in weed population under PPI of trifluralin as compared to other herbicidal treatments, application of fluchloralin @ 1 Kg a.i. ha^{-1} and alachlor @ 2 Kg a.i. ha^{-1}. It has also reported by Rajender Singh *et al.* (1993) and Joshi *et al.* (1995).

Further, the cultural method, two hoeings + two weedings at 30 and 60 DAT (T_9) brought about significant reduction in dry weed biomass and recorded the least dry weight of weeds after subsequent days, 60, 90, 120 DAT and at harvest. Treatment T_9 was followed by pre-plant soil incorporation (PPI) of trifluralin @ 1 Kg a.i. ha^{-1} (T_4), PPI of fluchloralin @ 1 Kg a.i. ha^{-1} (T_5) and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} (T_6) each treatment supplemented with one hoeing + one weeding at 45 and 60 DAT. Among the herbicidal treatments, PPI of trifluralin @ 1 Kg a.i. ha^{-1} (T_1) performed better to reduce dry weed biomass than the application of fluchloralin @ 1 Kg ha^{-1} (T_2) and alachlor @ 2 Kg ha^{-1}. This trend of reduction of dry weight of weeds coincided with the total weed population and hence, the weed control treatments were much effective in reducing the dry weight of weeds as compared to unweeded control. The findings are in agreement with those of Georgieva (1989), Irfan Raza (1998), Narasalagi (1999) and Anonymous (2001 a).

5.4.5 Effect on weed control efficiency (WCE)

The weed control efficiency with different weed control treatments had a direct negative relationship with the quantum of dry matter produced by weeds.

From the Table 66 revealed that during both the years, the cultural treatment two hoeings + two weedings at 30 and 60 DAT (T_9) recorded highest weed control efficiency. The next higher WCE was obtained in case of PPI of trifluralin @ 1 Kg ha^{-1} supplimented with one hoeing and one weeding at 45 and 60 DAT (T_4).

Among the herbicides, pre-plant soil incorporation of trifluralin @ 1 Kg ha^{-1} showed high value of WCE followed by PPI of fluchloraline @ 1 Kg ha^{-1} and pre-plant soil application of alachlor @ 2 Kg ha^{-1}. Chemical, cultural and chemical cum cultural (integrated) treatments indicated high values of WCE over unweeded control. This was due to all the weed control treatments which were helpful in reduced weed population and dry weight accumulation by weeds that lead to increase the value of WCE. Similar results were obtained by Irfan Raza (1998) and Anonymous (2001b).

5.4.6 Effect on uptake of nutrients (NPK) by weeds

The uptake of nitrogen, phosphorus and potassium by weeds at harvest differed significantly among the treatments (Table 66). There was inverse relationship between the crop and weed with respect to nutrient uptake. In unweeded control (T_8), weeds removed significantly higher quantity of nitrogen, phosphorus and potassium, during first season 25.17, 5.91 and 34.41 Kg N, P, K ha^{-1} and at second season 23.11, 5.44 and 24.45 Kg N, P, K ha^{-1} this might be due to more total weed population and dry weight of weeds in unweeded control. The results are in agreement with those of Yaroslaskaya *et al.* (1970), Rethinam (1978) and Maurya *et al.* (1990).

Under the different method of weed control, during 2000-01 weeds removed nutrients ranging from 2.96 to 25.17 Kg N, 0.69 to 5.91 Kg P and 3.86 to 34.41 Kg K ha^{-1} and during 2001-02 it was 3.16 to 23.11 Kg N, 0.52 to 5.44 Kg P and 4.03 to 24.45 Kg K ha^{-1}. It was mainly due to varying weed population, weed dry weight and weed species under different methods of weed control. During both the years among all treatments, two hoeings + two weedings at 30 and 60 DAT (T_9) recorded the lowest removal of nutrients by weeds. Which was closely followed by integrated treatment pre-plant soil incorporation (PPI) of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) it was followed by PPI of fluchloralin @ 1 Kg a.i. ha^{-1} (T_5) and alachlor @ 2 Kg a.i. ha^{-1} (T_6) both in combination with one hoeing + one weeding at 45 and 60 DAT. However, T_5 and T_6 were found equal in effect. These weed control treatments checked the weed population, weed growth and interfered in nutrient uptake, which resulted in lowest nutrient uptake at harvest by weeds. Treatments, which consisted both chemical and cultural methods (integrated method) reduced the uptake of nutrients significantly due to lower weed population and weed growth than the single use of either herbicides or cultural operation, except T_9. The results were in conformity with the findings of Ajay Kumar *et al.* (1995) and Biradar (1999).

5.5 Effect of cultural, herbicidal and integrated treatments on growth, yield and nutrients uptake of chilli plant (Var. Jayanti)

An extract of relevant information giving the influence of various weed control treatments on growth, yield, nutrient uptake and economics of weed control treatments are summarized in Table 67.

5.5.1 Effect on plant stand

During both the years, there were no significant variation in respect of initial and final plant population, indicating, there were no phytotoxic effect of these herbicides (Trifluralin, Fluchloralin and Alachlor) on seedling establishment and subsequent growth of the crop. These findings are in quite conformity with those of 'O'sullivan (1983) in case of alachlor and in case of trifluralin Ignatov (1972) and Lange (1969). Whereas, Varopai (1981) reported, trifluralin at higher level of 4.5 L ha^{-1} slightly decreased seedling survival.

5.5.2 Effect on plant height

The height of the plant differed significantly with various methods of weed control (Table 49). The highest plant height 69.74 and 66.50 cm was recorded during 2000-01 and 2001-02 respectively, were recorded in the cultural treatment two hoeings + two weedings at 30 and 60 DAT (T_9), followed by the integrated treatments, PPI of trifluralin @ 1 Kg a.i. ha^{-1} (T_4), PPI of fluchloralin @ 1 Kg a.i. ha^{-1} (T_5) and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} (T_6) each supplemented

Table 67: An extract of relevant information giving effect of various treatments on growth, yield, weed index, uptake of nutrients and economics during 2000-01 and 2001-02

Sr. No	Particulars	Year	Treatments									Mean
			T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	
1	Initial plant population $plot^{-1}$	2000-01	60.00	59.75	59.75	59.50	59.75	59.75	60.00	59.75	59.75	59.78
		2001-02	59.50	59.75	60.00	59.75	59.50	59.75	59.75	59.75	59.75	59.72
2	Plant population $plot^{-1}$ at harvest	2000-01	57.25	56.25	57.75	58.00	57.00	58.00	57.25	57.75	56.50	57.31
		2001-02	58.00	57.50	58.75	58.25	57.00	58.75	56.50	57.25	58.75	57.86
3	Plant height (cm) at 120 DAT	2000-01	50.92	45.60	45.06	65.32	60.86	59.26	55.00	39.80	69.74	54.62
		2001-02	45.98	40.90	40.22	60.52	55.74	54.56	50.30	34.66	66.50	49.93
4	Dry matter $plant^{-1}$ at harvest (g)	2000-01	26.93	22.61	20.49	42.22	38.81	35.98	31.73	15.16	47.26	31.24
		2001-02	24.11	18.93	19.79	38.45	32.88	33.04	28.00	14.25	45.53	28.33
5	Total number of fruits $plant^{-1}$	2000-01	50.40	40.25	39.25	80.65	71.90	71.15	58.75	24.10	86.25	58.16
		2001-02	43.15	33.05	31.50	71.10	61.80	61.30	52.10	20.70	77.25	50.22
6	Total weight of wet red fruits of chilli $plant^{-1}$(g)	2000-01	112.99	90.88	90.14	181.52	161.87	160.30	132.36	54.06	194.11	130.91
		2001-02	97.08	74.38	71.24	159.94	139.08	137.99	117.29	46.36	173.82	113.02
		Pooled mean	105.04	82.63	80.69	170.73	150.48	149.15	124.83	50.21	183.97	121.97

Table 67 contd.

7	Yield ha^{-1} of wet red fruits of chilli (q)	2000-01	31.72	27.96	27.71	49.54	45.13	45.09	36.94	14.67	53.20	38.88
		2001-02	27.52	22.92	22.05	43.49	39.15	38.98	32.99	13.19	47.66	31.99
		Pooled mean	29.62	25.44	24.88	46.52	42.14	42.03	34.96	13.93	50.43	34.44
8	Yield ha^{-1} of dry chilli fruits (q)	2000-01	11.54	10.15	10.03	18.03	16.20	16.18	13.08	05.49	19.53	13.36
		2001-02	10.02	08.33	07.99	15.86	14.08	14.01	11.70	05.19	17.49	11.63
		Pooled mean	10.78	9.24	9.01	16.95	15.14	15.10	12.39	5.34	18.51	12.50
9	Weed index (%)	2000-01	40.91	48.03	48.64	7.68	17.05	17.15	33.03	71.89	-	-
		2001-02	42.71	52.37	54.32	9.32	19.50	19.90	33.10	70.33	-	-
		Mean	41.81	50.20	51.48	8.50	18.28	18.53	33.07	71.11	-	-
10	Total uptake of nitrogen by chilli plant (Kg ha^{-1})	2000-01	71.64	61.96	60.14	114.70	101.01	99.85	81.85	35.38	124.58	83.46
		2001-02	61.77	50.85	49.46	101.78	88.18	87.94	72.85	32.80	111.77	73.04
11	Total uptake of phosphorus by chilli plant (Kg ha^{-1})	2000-01	11.33	09.71	09.22	19.29	16.91	17.11	13.44	05.32	21.28	13.73
		2001-02	09.91	07.44	07.37	16.88	14.26	14.14	11.68	04.89	18.91	11.72
12	Total uptake of potassium by chilli plant (Kg ha^{-1})	2000-01	74.59	63.75	62.06	119.32	105.90	103.42	85.74	37.33	133.13	87.25
		2001-02	67.88	54.40	54.10	110.79	95.52	94.79	79.65	35.98	126.58	79.96
13	Net return (+) or loss (-) by various treatments (Rs. ha^{-1})	2000-01	1157	(-) 2466	(-) 2684	16961	12725	12706	6597	(-)13454	21183	-
		2001-02	(-) 1875	(-) 6290	(-) 7092	12185	8015	7873	3801	(-) 13871	16888	-
		Mean	(-) 359	(-) 4378	(-) 4888	14573	10370	10290	5199	(-) 13638	19036	-

with one hoeing at 45 DAT and one weeding at 60 DAT. This may be due to decrease in weed competition owing to better weed control and increased nutrient availability. Similar findings were reported by Biradar (1999), Narasalagi (1999) and Anonymous (2001b). Among the herbicidal treatments, PPI of trifluralin @ 1 Kg ha^{-1} recorded the more plant height than T_2 and T_3 treatments but were lower than the integrated treatments (T_4, T_5 and T_6) which may be attributed to the fact that hoeing and weeding operations were not done in these treatments and there by crop could not get advantage of surface mulching and soil aeration for better crop growth. However, the highest crop weed competition with respect to nutrients, moisture, light and space in unweeded control (T_8) recorded the lowest plant height, 39.80 and 34.66 cm during 2000-01 and 2001-02 respectively.

5.5.3 Effect on dry matter accumulation plant^{-1}

The dry weight of plant was significantly influenced by various method of weed control (Table 50). During both the years, unweeded check recorded significantly lower dry matter accumulation by chilli plant at harvest. This might be attributed to severe crop-weed competition for growth factors like soil moisture, nutrients, light and space, which reduce the crop vigour and growth. Similar, findings were reported by Siriwardhana, Amarsingh (1982) and Tei (1986). The highest dry matter by chilli plant was noticed in cultural treatment two hoeings + two weedings at 30 and 60 DAT (T_9) which might be due to full utilization of resources as a result of minimum crop-weed competition and vigourous plant growth. Similar findings were obtained by Narayana Rao (1988), Irfan Raza (1998) and Yadav *et al.* (2000).

The next highest dry matter production by chilli plant was obtained in integrated treatment, pre-plant soil incorporation (PPI) of trifluralin @ 1 Kg a.i. ha^{-1} supplimented with one hoeing at 45 DAT and one weeding at 60 DAT (T_4) which was superior over rest of the integrated (T_5 and T_6), cultural (T_7) and chemical treatments (T_1, T_2 and T_3). This might be due to higher selectivity of this (trifluralin) herbicide and subsequent control with cultural operation, establishment of the crop in early stage of crop growth, lesser crop weed competition at critical period and ultimately higher resources utilization by crop, as a result the crop had prominent growth and produced more dry matter plant^{-1}. Similar results were observed by Bhalla (1980) and Anonymous (2001b). PPI of fluchloralin @ 1 Kg a.i. ha^{-1} (T_5) and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} (T_6) each supplemented with one hoeing + one weeding at 45 and 60 DAT were showed equal in effect regarding the production of dry matter plant^{-1}.

5.5.4 Effect on yield contributing components

Yield is the net result of various interactions viz., Climate, soil moisture, growth component, crop weed competition, nutrient uptake by crop and weeds and various metabolic and biochemical interaction taking place during crop growth.

During both the years, the yield contributing component mainly number of fruits plant^{-1}, weight of red chilli obtained plant^{-1} were affected significantly due to various weed control treatments(Table 51 and 54).

From pooled data (Table 67) all the weed management treatments produced higher number of chilli fruits and their yield than that of unweeded control (T_8). However, none of them increased chilli yield to the level of cultural treatment, two hoeings + two weedings at 30 and 60 DAT (T_9) this treatment was likely to be weed free check. It was mainly due to the maintenance of lowest weed population throughout the critical period of crop-weed competition, thus enabling the crop for maximum utilization of available resources which help to increase growth and yield components. Similar observations were reported by Singh *et al.* (1985), Labrada and Paredes (1983) who reported that highest fruit yields were obtained when the crop was weeded during the first 70 days or during the whole growth period. Among the all other treatments highest number of fruits and weight of wet red Chilli plant^{-1} were obtained in the integrated treatment PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4), followed by PPI of fluchloralin @ 1 Kg a.i. ha^{-1} (T_5) and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} (T_6) each combined with one hoeing + one weeding at 45 and 60 DAT. It could be due to reduced the weed population, dry weight accumulation which resulted to vigourous growth of chilli plant and lead to increased number of fruits and weight of fruits plant^{-1} Similar were the results obtained by Bhalla (1980) and Anonymous (2001b) in integration with trifluralin, in fluchloralin Sharma *et al.* (1988), Singh and Tripathi (1990) and Singh *et al.* (1991). Whereas, in case of alachlor, Rajagopal *et al.* (1976), Bhalla and Nakhtore (1980) and Biradar (1999).

Lowest number of fruits and weight of wet red chilli plant^{-1} was recorded in unweeded control (T_8). This may be due to less availability of resources, susceptibility of the crop toward weeds and smothering effect of weeds over the chilli crop. These results are in conformity with those of Adigun *et al.* (1991) who reported that unchecked weed growth throughout the crop life resulted in 90-97 per cent losses in yield.

5.5.5 Effect on yield of chilli

Crop yield was satisfactory during 2000-01 whereas, it was comparatively less during 2001-02 that might be due to partial shedding of flowers of chilli during 2001-02.

During both the years of experimentation similar trend was noticed in respect of chilli fruit yield. From the pooled data (Table 57) the differences observed in chilli fruit yield ha^{-1} due to weed control through cultural, chemical and integrated treatments resulted in an increase in fruit yield significantly over unweeded control (T_8). The cultural treatment two hoeings + two weedings at 30 and 60 DAT (T_9) was significantly superior over all other treatments and it increased the yield 262.02 per cent over unweeded control (T_8). This could be due to better weed control, higher dry matter production plant^{-1}, greater nutrient uptake and improvement in other yield contributory component Viz., number of fruits and their weight plant^{-1}. These results are in agreement with those reported by Labrada and Paredes (1983), Adigun *et al.* (1987), Narayana Rao (1988), Lanini and Strange (1994) and Anonymous (2001 b).

Integrated treatment PPI of trifluralin @ 1 Kg ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) was the next best treatment that recorded significantly more yield than remaining treatments which recorded 233.96 per cent more yield over unweeded control (T_8). The higher yield in T_4 treatment might be due to better weed control, increased in number and weight of wet red fruits plant^{-1}, it was also evident from the positive correlation obtained between number and weight of fruits per plant and yield of wet red chilli fruit. Similar results were obtained by Bhalla (1980) and Anonymous (2001 b). However, other integrated treatments PPI of fluchloralin @ 1 Kg a.i. ha^{-1} (T_5) and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} (T_6) each supplemented with one hoeing and one weeding at 45 and 60 DAT were noticed equal in effect and increased 202.51 and 201.72 per cent yield respectively over unweeded control (T_8). These results are in conformity with those of Lankroo *et al.* (1990), Anonymous (1997 b), Anonymous (1998) and Biradar (1999). Among the chemical treatments, PPI of trifluralin @ 1Kg a.i. ha^{-1} recorded significantly more yield than the PPI of fluchloralin @ 1 Kg a.i. ha^{-1} (T_2) and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} (T_3). This may be due to comparatively less weed competition during early growth period of chilli crop in T_1 treatment than T_2 and T_3. Whereas, both the treatments (T_2 and T_3) were at par with each other and superior over control. Superiority of trifluralin in chilli for increasing yield has reported earlier by Stoian *et al.* (1984), Beste (1985) and Irfan Raza (1998).

5.5.6 Effect on weed index (WI)

Weed index (Table 67) indicated yield reduction due to weed competition was highest in unweeded control (T_8) which recorded highest weed index 71.89 and 70.33 per cent over cultural treatment (T_9) during 2000-01 and 2001-02 respectively. This was due to unchecked weed growth, resulting in the highest loss of yield. But lowest 7.68 and 9.32 per cent weed index was recorded in integrated treatment PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) during first and second season respectively. This may be due to satisfactory control of weeds and reduced crop weed competition, which enabled the crop to utilize the available resources effectively resulted in higher yield. Similar, results were reported by Bhalla (1980), Sharma *et al.* (1988) and Anonymous (2001 b).

The next lower WI obtained with PPI of fluchloralin @ 1 Kg a.i. ha^{-1} + one hoeing at 45 DAT and one weeding at 60 DAT (T_5) and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_6). This might be due to lower weed competition and greater control of weeds which lead to more yield. Similar were the observations of Sharma *et al.* (1991), Anonymous (1997b) and Narasalagi (1999).

Among the herbicidal treatments PPI of trifluralin @ 1 Kg a.i. ha^{-1} (T_1) indicated lower weed index than PPI of fluchloralin @ 1 Kg a.i. ha^{-1} (T_2) and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} (T_3). The probable reason for this might be due to comparatively higher yield in PPI of trifluralin This result is in comformity with that of Irfan Raza (1998).

5.5.7 Effect on uptake of nutrient by chilli plant

All the weed control treatments recorded significantly higher uptake of N, P and K by chilli plant as compared to unweeded control (Table 60). The differences in uptake of nutrients in different treatments were due to the differential weed control efficiency. In general, uptake of nutrient by chilli plant was inversely proportional to the uptake by weeds.

Average total uptake of NPK by chilli plant at harvest was 83.46, 13.73 and 87.25 Kg ha^{-1} in 2000-01 and 73.04, 11.72 and 79.96 Kg ha^{-1} in 2001-02 respectively. Cultural treatment, two hoeings + two weedings at 30 and 60 DAT (T_9) resulted in significantly higher nutrient uptake by chilli plant and proved superior to all other treatments. The reason for higher uptake in treatment T_9 was due to better weed control and elimination of weeds during grand growth period coupled with favourable conditions for growth and yield of chilli crop. The best treatment among integrated method was PPI of trifluralin @ 1 Kg ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) that recorded more uptake of nutrient than other integrated treatments (T_5 and T_6) and herbicidal treatments (T_1, T_2 and T_3). This might be due to the reason that there was better control of weeds during early crop growth period which attained better crop growth and dry matter accumulation $plant^{-1}$ in T_4 as compared to rest of treatments. Similar were the findings of Biradar (1999) and Narasalagi (1999).

5.6 Correlation and regression studies

5.6.1 Simple correlation coefficient

There was inverse relationship between the nutrient uptake by chilli plant and by weeds. Similar result was obtained by Satao (1990) and Biradar (1999).

5.6.2 Phenotypic correlation coefficient

Correlation coefficient at phenotypic level revealed that the chilli fruit yield was positive and significantly associated with plant height, dry weight per plant, number of fruits per plant and weight of fruits per plant. These highly significant association of these characters with chilli fruit yield, indicating that increase in any one of the characters may result in increase in chilli fruit yield. Similar results were recorded by Ramkumar *et al.* (1981), Manikantan Nair *et al.* (1984), Ahmed *et al.* (1997), Biradar (1999) and Sarala Devi and Arumugam (1999) who noted positive and highly significant correlation between fruit yield and height of plant, dry weight of plant and number of fruits per plant.

5.6.3 Path analysis

Path analysis indicated, the number of fruits per plant had maximum positive direct effect (0.441) followed by weight of fruits per plant (0.406), height of plant (0.131) and dry weight of plant (0.018), in increasing chilli fruit yield. Similar associations were recorded by Dutta *et al.* (1979), Solanki *et al.* (1986) and Ahmed *et al.* (1997) who reported, number of fruits per plant excercised the maximum positive direct contribution towards yield of chilli fruit.

5.6.4 Regression analysis

The regression coefficients showed that significantly contributed to the yield with the two variables, number of fruits per plant and weight of fruits per plant. These findings indicated that the variables under study have very higher predictability with regards to yield of chilli and therefore monitoring of these variables is substantially important in increasing chilli fruit yield.

5.7 Economics

Use of herbicides by farming community largely depends on the comparative economics. Hence, operation cost of cultural, chemical and integrated weed control treatments and profit or loss were worked out for different treatments for two seasons (Table 67). It was observed that maximum gross and net returns were obtained under cultural treatment two hoeings +two weedings at 30 and 60 DAT (T_9) followed by integrated treatment PPI of trifluralin @ 1 Kg a.i. ha^{-1} (T_4), PPI of fluchloralin @ 1 Kg a.i. ha^{-1} (T_5) and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} (T_6) each supplemented with one hoeing + one weeding at 45 and 60 DAT, during both the years this was due to highest chilli fruit yield.

Similar were the findings of Irfan Raza (1998) and Biradar (1999) in case of cultural treatment (T_9) and Patel *et al.* (1986) and Sharma *et al.* (1990) in case of integrated treatments (T_4, T_5 and T_6).

Cultural treatment of one hoeing + one weeding at 30 and 45 DAT (T_7) recorded more gross and net returns as compared to chemical treatments. Among the herbicidal treatments (T_1, T_2 and T_3) during both years, PPI of trifluralin @ 1 Kg a.i. ha^{-1} recorded the highest gross returns than the treatments T_2 and T_3, in respect of net returns during 2000-01, T_1 recorded the profit (Rs. 1157 ha^{-1}). However, T_2 and T_3 recorded the losses but during 2001-02 all the chemical treatments (T_1, T_2 and T_3) noticed losses in net returns that was due to low yield during second season of experiment. Similar effects of herbicide trifluralin were observed by Ignatov (1972).

CHAPTER VI

SUMMARY AND CONCLUSIONS

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CHAPTER VI

SUMMARY AND CONCLUSIONS

6.1 Summary

The present investigation entitled "Studies on integrated weed management in chilli (*Capsicum annum* L.)" was conducted during Kharif season of 2000-01 and 2001-02 at the farm of Chilli and Vegetable Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.).

The experiment was conducted with nine treatments replicated four times in a randomized block design, with a view:

1. To screen out the best herbicide for minimizing the weed menace in chilli
2. To evaluate the effect of herbicide separately and in combination with mechanical method
3. To study the effect of weed control, on growth and yield of chilli
4. To study the economics of weed control in chilli

A summary of important research findings of the present investigation is as under:

1. During crop growth period, monocot weeds viz., *Cyperus rotundus, Cynodon dactylon* and *Echinochloa crusgalli* were dominant in the experimental plot. Dicot weeds viz., *Psorulea corylifolia, Corchorus acutangulas, Lagasca mollis, Euphorbia hirta, Parthenium hysterophorus, Ipomea reniformis*, and *Chenopodium album* were also prominent in the experimental plot.

2. Cultural method, two hoeings + two weedings at 30 and 60 DAT and integrated method, pre-plant soil incorporation of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing at 45 DAT and one weeding at 60 DAT controlled *Commelina benghalensis*, *Cynotis oxilaries*, *Dinebra arebica* *Echinochloa crusgalli* and *Panicum spp.* monocot weeds but the weeds like *Cynodon dactylon* and *Cyperus rotundus* could not be controlled by this herbicide.

3. Two hoeings + two weedings at 30 and 60 DAT controlled the maximum number of dicot weeds and proved best among all the treatments.

4. Cultural treatments, two hoeings + two weedings at 30 and 60 DAT, and one hoeing + one weeding at 30 and 45 DAT, chemical treatments and integrated weed control treatments were found effective in reducing the weed population. Two hoeings + two weedings at 30 and 60 DAT (T_9) reduced maximum total weed population. Integrated treatments PPI of trifluralin @ 1 Kg a.i. ha^{-1} (T_4), PPI of fluchloralin @ 1 Kg a.i. ha^{-1} (T_5) and pre-plant soil application of alachlor @ 2 Kg a.i. ha^{-1} (T_6) each supplimented with one hoeing + one weeding at 45 and 60 DAT also reduced more weed population and proved better than the chemical treatments (T_1, T_2 and T_3).

5. The infestation of weeds was to the extent of 15.88 and 16.65 q ha^{-1} during 2000-01 and 2001-02 respectively in unweeded control. The cultural, herbicidal and integrated treatments significantly reduced the dry matter accumulation by weeds as compared to unweeded control.

Cultural treatment, two hoeings + two weedings at 30 and 60 DAT reduced more dry weight of weeds and proved best in the experiment. Integrated treatment, PPI of trifluralin @ 1 Kg ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) rank secondly to reduce more dry weight of weeds than rest of integrated and chemical treatments.

6. Two hoeings + two weedings at 30 and 60 DAT (T_9) showed maximum weed control efficiency (81.23 and 80.54 per cent during 2000-01 and 2001-02 respectively) as compared to integrated treatment, PPI of trifluralin @ 1 Kg ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) which recorded 73.49 and 76.46 per cent during first and second season.

7. All the herbicides (Trifluralin, Fluchloralin and Alachlor) used during experimentation did not adversely affect chilli crop.

8. Growth attributes, mean plant height, dry matter accumulation per plant were significantly affected due to weed competition in unweeded control. These attributes were improved due to suppression of weeds either with cultural or herbicidal or integrated methods of weed control.

9. Control of maximum weeds were observed due to cultural treatment, two hoeings + two weedings at 45 and 60 DAT (T_9) followed by integrated treatments, PPI of trifluralin @ 1 Kg ha^{-1} (T_4), PPI of fluchloralin @ 1.0 Kg ha^{-1} (T_5) and pre-plant soil application of alachlor @ 2 Kg ha^{-1} (T_6) each combined with one hoeing and one weeding at 45 and 60 DAT. The favourable effects of these treatments were observed in respect of number and weight of fruits $plant^{-1}$.

10. Two hoeings + two weedings at 30 and 60 DAT (T_9) recorded 262.02 per cent increase in fruit yield over unweeded control (T_8) followed by integrated treatments, PPI of trifluralin @ 1 Kg ha^{-1} (T_4), PPI of fluchloralin @ 1 Kg ha^{-1} (T_5) and pre-plant soil application of alachlor @ 2 Kg ha^{-1} (T_6) each supplemented with one hoeing + one weeding at 45 and 60 DAT. These treatments recorded 233.96, 202.51 and 201.72 per cent increase in fruit yield respectively over unweeded control.

11. Integrated treatment, PPI of trifluralin @ 1 Kg ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) recorded lowest weed index (7.68 and 9.32 per cent during 2000-01 and 2001-02 respectively) than other integrated, chemical and cultural (T_7) treatments. Highest weed index was noticed under unweeded control treatment.

12. Uptake of N, P and K by weeds was reduced in all treated plots as compared to unweeded plot. Two hoeings + two weedings (T_9) recorded lowest uptake of nitrogen, phosphorus and potassium during both the years of experimentation among all the treatments.

13. Higher uptake of N, P and K by chilli crop was noted in weed control treatments as compared to unweeded control. Two hoeings + two weedings (T_9) recorded highest uptake of nitrogen, phosphorus and potassium during both the years of experimentation.

14. The uptake of nutrient by chilli plant and by weeds were negatively correlated with each other as revealed by the values of correlation coefficient (r).

15. The phenotypic correlation between wet red chilli yield and plant characters showed highly significant and positive association. This indictes, the association could be fruitfully exploited for enhancing yield potential.

16. Path analysis indicated that the number of fruits per plant, weight of fruits per plant and plant height had maximum positive direct effect in contributing chilli fruit yield.

17. The regression coefficient were found significant with the characters, number of fruits per plant and weight of fruits per plant.

18. The cultural treatment, two hoeings + two weedings (T_9) gave highest net returns (Rs. 21,183 and Rs. 16,888 ha^{-1} during 2000-01 and 2001-02 respectively) and was followed by integrated treatments, PPI of trifluralin @ 1 Kg a.i. ha^{-1} (T_4), PPI of fluchloralin @ 1 Kg a.i. ha^{-1} (T_5) and pre-plant application of alachlor @ 2 Kg a.i. (T_6) each supplemented with one hoeing + one weeding at 45 and 60 DAT.

6.2 Conclusions

The following conclusions can be drawn from the results of the experiment.

1. Among the different herbicides, pre-plant soil incorporation of trifluralin @ 1 Kg a.i. ha^{-1} was the best herbicide for minimizing the weed menace in chilli. However, integrated method of weed control proved better than chemical method.

2. Cultural treatment of two hoeings + two weedings at 30 and 60 DAT proved to be the best method of weed control resulting in vigorous

growth of chilli and highest yield ha^{-1}, followed by integrated treatment, in which PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding was done at 45 and 60 DAT.

3. Maximum net returns and cost benefit ratio was recorded under two hoeings + two weedings (T_9) followed by integrated method of pre-plant soil incorporation of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT (T_4) which gave more returns and cost benefit ratio as compared to rest of integrated and chemical treatments.

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APPENDICES

APPENDIX I

Monthly weather data for the year "2000-2001" recorded at Agril.Met. observatory, Dr.P.D.K.V.,Akola

N = Normal (1971-95)
A = Actual (2000-2001)

MONTH	RF		Tmax		Tmin		BSH		WS		RHI		RHII		EVAP	
	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A
JAN	9.5	0.0	30.0	30.2	11.4	11.3	9.0	9.2	5.5	4.4	67	66	28	27	5.0	4.3
FEB	9.2	25.2	32.6	30.0	13.2	13.5	9.6	7.5	6.4	6.1	56	61	21	29	6.8	5.2
MAR	10.7	0.0	37.3	35.9	17.8	16.8	9.7	8.9	7.3	7.0	41	39	20	17	10.1	9.1
APR	3.6	0.5	41.2	42.4	23.2	24.0	10.1	9.4	9.1	9.2	35	34	14	12	13.9	13.6
MAY	17.9	13.4	42.6	39.9	27.1	26.3	10.0	9.2	14.4	13.5	46	51	17	25	17.1	13.6
JUN	155.2	102.3	37.2	34.7	25.6	24.4	7.2	5.6	15.0	14.2	71	75	41	45	11.0	9.3
JUL	224.3	226.3	32.5	30.9	23.7	23.3	4.7	3.7	12.0	11.5	84	85	61	64	5.6	4.8
AUG	220.5	150.7	30.3	31.6	22.9	23.7	4.1	5.1	11.6	10.8	87	83	68	60	4.4	4.9
SEP	103.2	55.0	32.7	32.5	22.1	22.5	6.9	6.4	8.0	7.0	83	80	55	51	5.2	5.0
OCT	47.3	0.0	33.9	35.7	18.5	18.9	8.5	8.4	4.7	3.5	76	65	37	26	5.5	6.0
NOV	14.7	0.0	31.7	33.4	13.9	14.5	8.8	8.6	4.9	3.9	70	55	30	20	5.0	5.4
DEC	8.6	0.0	28.2	31.0	10.5	9.5	9.0	8.7	4.8	2.8	70	50	29	22	4.5	4.8
Jan	9.5	38.2	30.0	29.4	11.4	12.8	9.0	7.0	5.5	4.7	67	61	28	28	5.0	4.4

APPENDIX II

Monthly weather data for the year "2001-2002" recorded at Agril.Met. observatory, Dr.P.D.K.V.,Akola

N = Normal (1971-2000)
A = Actual (2001-2002)

MONTH	RF		Tmax		Tmin		BSH		WS		RHI		RHII		EVAP	
	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A
JAN	9.0	38.2	29.8	29.4	11.4	12.8	8.8	7.0	5.3	4.7	68	61	29	28	4.8	4.4
FEB	10.2	0.0	32.5	34.5	13.3	14.0	9.4	8.4	6.2	5.3	57	37	22	13	6.6	7.3
MAR	9.5	48.0	37.3	36.3	17.8	19.6	9.6	8.3	7.2	8.0	41	50	19	19	6.0	9.4
APR	3.1	13.1	41.2	39.9	23.2	22.3	10.0	8.4	9.0	7.4	35	51	14	22	13.7	10.8
MAY	16.6	12.8	42.5	42.3	27.0	28.2	9.9	9.0	14.2	14.7	46	45	18	22	16.8	16.3
JUN	150.5	204.5	37.2	34.5	25.6	24.6	7.2	4.8	14.9	14.7	71	76	41	50	10.9	8.7
JUL	212.2	89.2	32.5	31.1	23.7	23.7	4.5	2.4	11.9	10.9	84	83	61	62	5.5	5.2
AUG	215.7	112.4	30.4	29.8	23.0	22.9	4.1	2.9	11.4	10.2	87	88	68	70	4.4	3.7
SEP	111.1	76.4	32.5	34.0	22.2	22.5	6.6	6.2	7.9	6.3	84	77	57	47	5.0	5.5
OCT	52.3	136.6	33.7	32.2	18.6	19.2	8.4	6.4	4.8	3.8	76	80	39	52	5.5	3.8
NOV	20.0	0.0	31.6	31.7	14.1	13.8	8.7	8.5	4.7	3.4	70	61	31	30	4.8	4.3
DEC	8.4	0.0	28.3	30.8	10.6	10.5	8.8	8.6	4.6	3.0	70	58	30	24	4.3	4.1
Jan 02	9.0	0.0	29.8	29.0	11.4	10.2	8.8	8.3	5.3	4.4	68	61	29	27	4.8	4.6
Feb 02	10.2	1.8	32.5	33.0	13.3	15.9	9.4	7.7	6.2	5.2	57	55	22	25	6.6	6.5

APPENDIX III

Uptake of nitrogen, phosphorus and potassium by weeds (Kg ha^{-1}) during 2000-01 and 2001-02 as influenced by different treatments

Treatments	Uptake of nitrogen (Kg ha^{-1})		Uptake of phosphorus (Kg ha^{-1})		Uptake of potassium (Kg ha^{-1})	
	2000-01	2001-02	2000-01	2001-02	2000-01	2001-02
T_1	10.82	10.73	2.56	2.72	15.16	10.96
T_2	15.96	14.78	3.35	3.30	20.70	15.81
T_3	16.63	15.66	3.67	3.50	22.93	16.46
T_4	4.65	4.02	1.09	1.03	6.32	4.99
T_5	6.85	5.91	1.49	1.55	8.76	6.72
T_6	7.29	6.64	1.57	1.62	9.21	7.37
T_7	9.24	9.23	1.98	2.18	12.16	9.61
T_8	25.17	23.11	5.91	5.44	34.41	24.45
T_9	2.96	3.16	0.69	0.52	3.86	4.03
S.E.(m) ±	0.53	0.33	0.12	0.16	0.77	0.25
C.D. at 5%	1.55	0.97	0.36	0.48	2.24	0.73
Mean	11.06	10.36	2.48	2.43	14.83	11.15

APPENDIX IV

Uptake of Nitrogen, Phosphorus and Potassium (Kg ha^{-1}) by chilli plant (Straw) and chilli fruits during 2000-01 and 2001- 02 as influenced by different treatments

Treatments	Uptake of Nitrogen (Kg ha^{-1})						Uptake of Phosphorus (Kg ha^{-1})						Uptake of Potassium (Kg ha^{-1})					
	2000-01			2001-02			2000-01			2001-02			2000-01			2001-02		
	Chilli plant	Chilli fruit	Total	Chilli plant	Chilli fruit	Total	Chilli plant	Chilli fruit	Total	Chilli plant	Chilli fruit	Total	Chilli plant	Chilli fruit	Total	Chilli plant	Chilli fruit	Total
T_1	16.47	55.17	71.64	14.06	47.71	61.77	3.71	7.62	11.33	3.69	6.22	9.91	31.42	43.17	74.59	30.99	36.89	67.88
T_2	13.43	48.53	61.96	11.22	39.63	50.85	3.01	6.70	9.71	2.36	5.08	7.44	25.78	37.97	63.75	23.77	30.63	54.40
T_3	12.21	47.93	60.14	11.43	38.03	49.46	2.60	6.62	9.22	2.49	4.88	7.37	24.56	37.50	62.06	24.69	29.41	54.10
T_4	27.61	87.09	114.70	25.64	76.14	101.78	7.03	12.26	19.29	6.73	10.15	16.88	50.97	68.35	119.32	51.78	59.01	110.79
T_5	23.24	77.77	101.01	20.90	67.28	88.18	6.05	10.86	16.91	5.39	8.87	14.26	45.14	60.76	105.90	43.44	52.08	95.52
T_6	22.17	77.68	99.85	20.99	66.95	87.94	6.26	10.85	17.11	5.31	8.83	14.14	42.73	60.69	103.42	42.97	51.82	94.79
T_7	19.21	62.64	81.85	16.92	55.93	72.85	4.68	8.76	13.44	4.42	7.27	11.68	36.70	49.04	85.74	36.47	43.18	79.65
T_8	9.20	26.18	35.38	8.16	24.64	32.80	1.75	3.57	5.32	1.72	3.17	4.89	16.86	20.47	37.33	16.89	19.09	35.98
T_9	30.27	94.31	124.58	27.82	83.95	111.77	8.00	13.28	21.28	7.71	11.20	18.91	59.71	73.42	133.13	61.52	65.06	126.58
S.E(m) ±	0.92	1.93	2.04	0.86	2.53	2.80	0.24	0.27	0.36	0.16	0.33	0.39	1.51	1.51	2.08	1.61	1.96	2.72
C.D.at 5%	2.71	5.64	5.95	2.52	7.39	8.18	0.69	0.78	1.06	0.46	0.96	1.14	4.40	4.41	6.08	4.71	5.72	7.93
Mean	19.31	64.14	83.46	17.46	55.58	73.04	4.79	8.95	13.73	4.42	7.29	11.72	37.10	50.15	87.25	36.94	43.02	79.96

VITA

VITA

Nemade Suresh Uttam was born on 21st January, 1965 at Digras, District Yavatmal (M.S.). He has completed his matriculation from Rashtriya Vidyalaya, Digras in 1981 in first division. Later on, he passed higher secondary school examination from Dinabai Junior Science College, Digras in the year 1984.

He joined the college of Agriculture, Nagpur for B.Sc. (Agri.) degree course and passed in first division in the year 1988 and obtained M.Sc. (Agri.) degree in Agronomy discipline in the year 1990 from Post Graduate Institute Dr. P.D.K.V., Akola in first division.

Thereafter he joined as Agri. Assistant in Dr. P.D.K.V., Akola in 1989. He was selected as Agri. supervisor (JRA) in 1990 and subsequently Assistant Professor in 1993. He is now working as officer incharge, Agriculture Research Station, Yavatmal under Dr. P.D.K.V., Akola (M.S.).

He was selected as a regular student leading to Ph.D. in Agronomy on 18/12/99.

THESIS ABSTRACT

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a.	Title of the thesis	:	STUDIES ON INTEGRATED WEED MANAGEMENT IN CHILLI (*Capsicum annum* L.)
b.	Name of student	:	Nemade Suresh Uttam
c.	Name and address of major advisor	:	Dr R.N.Satao Ex-Associate Professor of Agronomy Dr. PDKV, Akola
d.	Degree to be awarded	:	Ph.D. (Agri.) in Agronomy
e.	Year of award of degree	:	2003
f.	Major Subject	:	Agronomy
g.	Total number of pages in the thesis	:	164
h.	Total number of words in the thesis abstract	:	457
i.	Signature of the student	:	
j.	Signature, name and address of forwarding authority	:	

(V.S. Shinde)
Head
University Department of Agronomy
Dr. P.D.K.V., Akola

ABSTRACT

An experiment was conducted during *Kharif* seasons of 2000 and 2001 at Chilli and Vegetable Research Unit. Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola on clayey soil. The investigation was conducted to screen out the best herbicides for minimizing the weed menace in chilli, to evaluate the effect of herbicides separately and in combination with mechanical method on growth and yield of chilli and to find out best economical method of weed control in chilli.

The experiment was laid out in randomized block design with four replications and nine treatments consisting of three pre-plant herbicides, Trifluralin @ 1 Kg a.i. ha^{-1}, Fluchloralin @ 1 Kg a.i. ha^{-1} and Alachlor @ 2 Kg a.i. ha^{-1}, three treatments combinations of above mention herbicides with one hoeing at 45 DAT and one weeding at 60 DAT, two cultural treatments, two hoeings and two weedings at 30 and 60 DAT and second cultural treatment was one hoeing and one weeding at 30 and 45 DAT respectively and one treatment was unweeded control (Weedy check). The seedling of chilli variety Jayanti (AKC 86-39) was transplanted on 10.7.2000 and 17.7.2001 at a spacing of 60x60 cm. NPK applied were at 150:50:50 Kg ha^{-1} respectively.

During crop growth period, monocot weeds *Cyperus rotundus, Cynodon dactylon* and *Echinochloa crusgalli* and dicot weeds, *Psorulea corylifolia, Corchorus acutangulas, Lagasca mollis, Euphorbia hirta, Parthenium hysterophorus, Ipomea reniformis* and *Chenopodium album* were prominent.

Weed population and their dry matter weight were reduced significantly by weed control treatments and maximum reduction was in cultural treatment, two hoeings + two weedings at 30 and 60 DAT of chilli followed by integrated treatments PPI of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing and one weeding at 45 and 60 DAT. Among the herbicidal treatment, PPI of trifluralin @ 1 Kg a.i. ha^{-1} proved to be the best.

From the investigation, it could be inferred that the improvement in growth attributes, plant height and dry matter accumulation per plant, yield contributory characters, number of fruits picked plant^{-1}, weight of fruits per plant weed control efficiency and better uptake of NPK by chilli plant. However, reduction in weed population, dry matter of weeds, weed index and NPK uptake by weed were lower under cultural treatment, two hoeings + two weedings at 30 and 60 DAT followed by pre-plant soil incorporation of trifluralin @ 1 Kg a.i. ha^{-1} + one hoeing at 45 DAT and one weeding at 60 DAT.

Two hoeings + two weedings at 30 and 60 DAT proved to be the best treatment resulting in highest yield, gross monetary returns, net returns per hectare and cost: benefit ratio followed by integrated method of weed control in which, pre-plant soil incorporation of trifluralin @ 1 Kg a.i. ha^{-1} supplimented with one hoeing and one weeding at 45 and 60 DAT respectively was undertaken.

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