

**Studies on Weed and Fertilizer Management  
on Growth, Yield and Quality of Onion  
(*Allium cepa* L.) Under Lucknow Conditions**

**THESIS**

Submitted to  
Babasaheb Bhimrao Ambedkar University  
(A Central University)  
Lucknow

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**Doctor of Philosophy**  
In  
**HORTICULTURE**

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**2018**

*Dedicated to my*

---

# *Beloved Parents*

*Who gave me a lot of moral support and encouragement  
which can not be expressed in words.*

*Tribhuvan Rai*

## **DECLARATION**

I, **Tribhuvan Rai**, (Enrollment No. 265/14), hereby declare that, I am a candidate for the Degree of **Doctor of Philosophy in Horticulture**, Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University (A Central University), Vidya-Vihar, Rae Bareli Road, Lucknow – 226025 (U.P.), India and have carried out my research work entitled **“Studies on Weed and Fertilizer Management on Growth, Yield and Quality of Onion (*Allium cepa* L.) Under Lucknow Conditions“**. This thesis submitted for the award of the degree of Doctor of Philosophy in Horticulture is my original research work.

Date:

Place: Lucknow

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Research Scholar

## **CERTIFICATE**

This is to certify that the thesis titled “**Studies on Weed and Fertilizer Management on Growth, Yield and Quality of Onion (*Allium cepa* L.) Under Lucknow Conditions**“ submitted by Ms./Mr. Tribhuvan Rai is an original research work and has not been previously submitted in part or full for the award of any other degree or diploma to this or any other university.

The thesis submitted to Babasaheb Bhimrao Ambedkar University Lucknow satisfies all the requirements as stipulated in the Doctor of Philosophy (Ph.D.) regulations -1999 as amended in 2008/2010/2013 and it is fit for submission and evaluation for the award of the degree of Doctor of Philosophy of the University.

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## LIST OF ABBREVIATIONS

%	:	Per cent
@	:	at the rate of
°C	:	Degree Centigrade
a.i.	:	Active ingredient
C.D.	:	Critical Difference
cm	:	Centimeter (s)
cv.	:	Cultivar
DAT	:	Days after transplanting
dm <sup>2</sup>	:	Square decimeter
<i>et al.</i>	:	et alli (and others)
etc.	:	et cetera (and so on)
<i>fb</i>	:	followed by
Fig.	:	Figure
g	:	gram (s)
ha	:	Hectare (s)
hr	:	Hours (s)
HW	:	Hand weeding
i.e.	:	id est (that is)
K	:	Potassium
K <sub>2</sub> O	:	Potash (Potassium oxide)
kg	:	Kilogram (s)
m.	:	Meter (s)
m <sup>2</sup>	:	Square meter
Max.	:	Maximum
Min.	:	Minimum
Met.	:	Meteorological
mg	:	Milligram (s)

mm	:	Millimeter
N	:	Nitrogen
N.S.	:	Non significant
No.	:	Number
P	:	Phosphorus
P <sub>2</sub> O <sub>5</sub>	:	Phosphorus pentoxide
PE	:	Pre-emergence
pH	:	Pussance de hydrogen
PoE	:	Post emergence
q ha -1	:	Quintal per hectare
RH	:	Relative humidity
S.E.m.±	:	Standard error
t	:	Tonnes
<i>viz.</i>	:	Videlicet (namely)

# *Introduction*

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**CHAPTER -I****INTRODUCTION**

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops cultivated extensively in India and it belongs to family Alliaceae, having chromosome number ( $2n = 2x = 16$ ). The number of species in the genus is around 600. It is one of the most important crops grown in Rabi season India and worldwide. It is a bulb vegetable crop used in daily diet of people in the whole world. It is only vegetable in which India figures prominently in the world for production and export (**Singh and Joshi, 1978**)

India ranks second in area and production of onion in the world followed by China. In India major onion growing states are Maharashtra, Karnataka, Madhya Pradesh, Bihar and Gujarat. Onion is cultivated in an area of 1320130 hectare with a production of 20931250 MT and productivity 15.86 Tonnes/ha in India. In Uttar Pradesh, it is grown in about 24.96 ha area with a production of 422.75 MT and productivity 16.94 Tonnes/ha. The maximum area 433.46 ha and production 6510.86 MT have Maharashtra state under onion crops. The second rank of area 207.15 ha and production 5331.59 MT under the Karnataka state. The maximum productivity 25.48 MT/ha in the Gujarat after that 24.09 MT/ha in Madhya Pradesh and 16.94 in Uttar Pradesh (**Anonymous, 2016**). Maharashtra is the leading onion growing state and other important states are Karnataka, Gujarat, Bihar, Madhya Pradesh, Andhra Pradesh, Rajasthan, Haryana, Uttar Pradesh and Tamil Nadu. The present level of productivity of onion of the country is very low as compared to major producers like USA, China, Netherlands and Korea Republic. Onion crop can generate income to farmer and can be exported to obtain foreign exchange needed by

many developing countries. Available statistics indicate that about 30% of the world production of onion is produced in tropical countries in an area estimated as nearly 0.9 million hectares.

Onion is a biennial herb with a characteristic smell. The leaves are tubular and the bulbs are formed by the attachment of swollen leaf bases to underground part of stem which is small and rudimentary. Flowers are produced during second phase after formation of bulbs. Flowering structure is called an 'umbel', which is an aggregate of many small inflorescences (cymes) of 5-10 flowers. Length of peduncle commonly known a 'scape' varies with variety .though individual flowers are hermaphrodite, they are cross pollinated due to protandry. Cross pollination is achieved by honey bees when they visit flowers for nectar. Stigma becomes receptive 3-4 days after shedding of pollen grains. Artificial selfing is done by covering all umbels of a plant together and by shaking or rubbing each other or by introducing flies. Onion is valued for its bulbs having characteristic odour, flavour and pungency, which is due to the presence of a volatile oil – allyl-propyl disulphide. Pungency is formed by enzymatic reaction when tissues are broken. Bulbs are suited for storage for a long period and for long distance transport. Onion is slow growing, shallow rooted crop with narrow, upright leaves and non branching habit. Onion is a shallow rooted crop a fairly high concentration of nutrient should normally be maintained at the surface of the soil for its optimum growth and yield.

**(Anonymous, 2012).**

Value addition in onion is done by marketing dehydrated onions and onion flakes. Onion bulb is rich in minerals like phosphorus (50 mg / 100 g) and calcium (180 mg / 100 g). Many medicinal uses are reported for bulbs and is commonly used as diuretic and

applied on wounds and boils. Onion greens are also used by harvesting crop at pencil thickness and when small bulb is formed. It becomes a major cash crop with higher market demand and price due to its culinary, dietary and medicinal values. Onion oil, which is extracted by steam distillation, is used as flavouring. Recently there has been more demand for dehydrated products for use primarily in the food industry while in some instances onions may be given as feed to livestock, but this may result in tainted milk. Onions also have a place in the folklore of many countries and their extracts have antibacterial properties (**Anon., 1985**).

In, onion, weeds emerges with transplanting of seedling and grows along with them. This causes severe competition between the crop and weed. If the weeds are present throughout the crop growth period, there may be complete loss of marketable yield. The reduction in bulb yields varies to the extent of 48 to 80% depending upon the duration, intensity of weeds growth and weed competition (**Patel et al., 1983**). Hand weeding in onion is a common practice in India, but it is a tedious expensive and time consuming task due to close spacing and shallow root system. Non-availability of labourer's during critical period of crop makes hand weeding difficult leading to heavy yield losses. The critical period of crop-weed competition in onion lies between 15 to 60 days after transplanting (**Singh and Singh, 1994**). Hence, managing the weeds meticulously in early stage is an imperative task to higher weed control efficiency and bulb yield.

Herbicides when used with one or two hand weeding showed improved efficiency in control of weeds. The control of weeds either through herbicide alone or in combination with hand weeding at 45 DAT registered higher net returns/rupee investment compared to weed free (**Ved et al., 2000**). Spraying of pre emergence herbicides keep the crop weed free

free conditions during early stages. Then, at later stages, hand weeding helps to reduce the cost of weeding and to keep the weed population below economic threshold level throughout the crop growth period. The production of onion can be greatly reduced by unrestricted weeds growth, scarcity of labour due to intensification and diversification of other cropping systems and concurrent rise in the cost of the hand weeding.( Makes timely removal of weeds by direct labour difficult and expensive ( **Babiker *et al.* , 1987**).

To best of our knowledge, limited work has been reported regarding weed and fertilizers management in onion under Lucknow conditions. Therefore, this study was planned with the following objectives:

1. To ascertain the effect of weed and fertilizers management practices on various vegetative growth parameters of onion.
2. To find out effect of weed and fertilizers management practices on yield and quality of onion.
3. To work out cost: benefit ratio of different treatment.

*Review*  
*of*  
*Literature*

## CHAPTER -II

## REVIEW OF LITERATURE

In this chapter, the review of literature obtained during the investigation entitled “**Studies on Weed and Fertilizer Management on Growth, Yield and Quality of Onion (*Allium cepa* L.) Under Lucknow Conditions**” was undertaken to evaluate the integrated weed management programme in using different organic fertilizer and some herbicides independently and in combination. The literature pertaining to the topic of study has been reviewed in the present chapter for reference to draw suitable conclusions for the observations recorded.

### 2.1 Weed flora

The most important weeds recorded in onion (*Allium cepa* L.) field were *Chenopodium album* L., *Chenopodium morale* L., *Spergula arvensis* L. *Anagallis arvensis* L., *Convolvulus arvensis* L., *Cyperus rotundus* L. and *Cynodon dactylon* (L.) Pers. as reported by **Porwal and Singh (1993)**.

**Singh and Singh (1982)** observed that the weed species viz. *Anagallis arvensis* L., rabi and *Cynodon dactylon* L. *Cyperus rotundus* L. *C.ria* L. in, *Amaranthus viridis* L. and *Ecllipta alba* during both the seasons were present in onion crop.

**Sharma and Mehta (1994)** reported that the predominant weed flora in onion fields of Gujarat were *Cyperus rotundus* L., *Dactyloctenium aegyptium* L., *Cynodon dactylon* Pers. and *Phyllanthus niruri* L. The weed flora of experimental field at Varanasi was found to be *Eragrostis tenella* (Raem) schutt, *Cyperus rotundus* L., *Trianthema portulacastrum* L., *Echinocloa crusgulli* (L.)Beauv., *Ageratum conyzoides* L., *Portulaca*

*oleracea* L., *Partulaca quadrifeda* L., *Cleomeviscosa* L., *Euphorbia hirta* L., and *Desmodium trifolium* L., during kharif seasons (Singh and Singh, 1994). They found that the monocotyledon weeds were more numerous than dicotyledon weeds. The monocotyledon weed population was found to increase up to 60 days after transplanting and decreased in subsequent stages, while dicotyledon weed was found to be increase with advancement in crop age.

Verma and Singh (1997) noticed that predominant weeds in onion fields at Faizabad (U.P) during rainy season were *Echinochloa colonum* *Echinochloa crus-galli* L., Beauv., *Cyperus rotundus* L., *Cynodon dactylon* pers., *Saccharum spontaneum* L., *Trianthema monogyna* L., *Solanum nigrum* L., *Eclipta alba* Hassk., *Phyllanthus simplex* Retz and *Euphorbia microphylla*.

Amrutkar *et al.* (1998) found *Cynodon dactylon*, *Cyperus rotundus*, *Parthenium hysterophorus*, *Chenopodium album*, *Anagallis arvensis*, *Physalis minima*, *Euphorbia hirta*, *Lagasca mollis* and *Partulaca oleracea* in onion crop.

Chauhan *et al.* (1998) reported the dominant weed flora of viz, *Cyperus rotundus* L., *Chenopodium album* L., *Chenopodium murale* L., *Digera arvensis* L., *Cynodon dactylon* L., *Anagallis arvensis* L. in the experimental plot of onion at Gurgaon (Haryana) during rabi season.

The weed flora in transplanted onion at Dharwad was *Echinocloa crusgalli*, *Parthenium hysterophores*, *Phyllanthus niruri* L., *Cyperus rotundus* L., *Cynodon doctylon* (L.). Pers. *Convolvulus arvensis*, *Hibiscus ponduriformis*, *Chenopodium album*, *Eclipta alba*,

*Amaranthus viridis*, *Commelina benghalensis* and *Cynotis cristata* was observed by **Atre (2001)**.

**Sukhadia et al. (2002)** observed that the dominant weed flora at Junagadh, Gujarat during *rabi* season were *Echinochloa colona*, *Eluopus villosus*, *Digera arvensis*, *Dactyloctenium aegyptium*, *Eclipta alba*, *Cyperus rotundus*.

**Rameshwar et al. (2002)**.The dominant weed flora in onion at Lari (H.P.) during summer were *Malva parviflora*, *Chenopodium album*, *Amaranthus spp.*, *Anagallis arvensis*, *Melilotus alba*, *Melilotus indica*, *Poa annua* and *Digitaria sanguinalis*

**Dobrzanski and Paczynski (2005)** reported that the main weed species in onion fields, namely *Chenopodium album*, *Galinsoga parviflora*, *Capsella bursa-pastoris*, *Sinapis arvensis*, *Thlaspi arvense*, *Lamium amplexicaule*, *Senecio vulgaris*, *Stellaria media*, *Fallopia convolvulus* [*Polygonum convolvulus*], *Polygonum persicaria*, *P. aviculare*, *Amaranthus retroflexus*, *Anthemis sp.*, *Matricaria sp.*, *Urtica urens*, *Galium aparine*, *Viola arvensis*, *Elymus repens*, *Echinochloa crusigalli* and *Poa annua*, are described. Different weed management strategies such as the combination of herbicides 4 (i.e. pendimethalin, glyphosate, propachlor and diquat) and agronomic techniques interrow cultivation, hand weeding and flaming) are discussed.

**Kachare et al. (2005)** reported that the effects of integrated weed management on the growth and yield of onion cv. N-53 were determined in a field experiment. The treatments was composed of hand weeding 3, 6 and 9 weeks after transplanting (T1), pre-emergence application of oxadiazon (T2), T2 + one hand weeding (T3), T2 + 2 hand weedings (T4), pre-emergence application of pendimethalin (T5), T5 + one hand weeding

(T6) and T5 + 2 hand weedings (T7). *Portulaca quadrifida*, *Cynodon dactylon*, *Ageratum conyzoides*, *Eleusine indica* and *Chenopodium album* comprised the weeds infesting onions in the experimental fields.

## 2.2 Critical period of crop weed competition in onion

**Patel et al. (1983)**. The reduction in bulb yield varied from 40-80 per cent depending upon the duration of crop weed competition and intensity.

**Khurana et al. (1985)** estimated that the loss in onion bulb yield was to an extent of 54 per cent due to uncontrolled weed growth.

Uncontrolled growth of weeds in onion caused 40.2 – 74.9 per cent reduction in bulb yield depending upon weed flora, their intensity and the duration of crop weed competition reported by **Mishra et al. (1986)**.

**Singh et al. (1986)** noticed that reduction of onion yield was noticed during 35-40 days after transplanting due to infestation of weeds and asserted that the stage of critical period of weed competition stand up to 40 DAT in different cultivars of onion. Whereas, the most sensitive period to weed competition lies between 15-60 DAT as reported by **Singh and Singh (1994)**.

**Babiker et al. (1987)** reported that onion was the most sensitive to weed competition between 2<sup>nd</sup> to 6<sup>th</sup> weeks after crop emergence in onion.

**Bannon et al. (1988)** observed that yields were reduced by 62, 92 and 99 per cent if weeds were allowed for 1, 2 and 3 weeks, respectively.

**Westra *et al.* (1990)** observed that the yield reduction was as high as 78 per cent in direct seeded onion and 53 per cent in transplanted onion. **Singh *et al.* (1996)** observed that reduction of bulb yield was to the tune of 86 per cent due to higher weed competition.

**Ahuja and Yaduraj (1997)** reported that the weed competition during 15-45 DAT was critical with respect to bulb yield.

**Prasad and Singh (1988)** found that the yield of onion bulb increased with decrease in crop weed competition. The highest yield was recorded with the treatment of repeated weeding.

**Tiwari *et al.* (2003)** reported that the weed competition throughout crop period causes 82 per cent average reduction in bulb yield. Weed infestation prevailed up to 15, 30, 45 and 60 DAT registering 1.2, 39.8, 56.1 and 69.3 per cent reduction in bulb yield over weed free-check.

### **2.3 Weed density/ Weed population**

**Verma and Singh (1997)** reported that the application of pendimethalin @ 1.5 kg ha<sup>-1</sup> reduces the weed population and weed dry matter m<sup>-2</sup> and increases bulb yield of onion (30.29 t ha<sup>-1</sup>).

**Singh *et al.* (1997)** observed that the application of pendimethalin @ 1.0 kg ha<sup>-1</sup> + one HW reduced the weed population and found superior over herbicidal application alone or mulching.

**Jayakumar and Bharati (2003)** obtained very good results with pendimethalin in reducing the weed population and increasing the bulb yield of onion crop.

**Bhutia *et al.* (2005)** the field experiment was conducted at Mohanpur, Nadia to studied the effect of herbicides integrated with manual weeding in onion. They observed that integration of HW at 45 DAT to initial Oxyfluorfen treatment significantly reduced weed population and biomass at harvest over the control.

**Khalid *et al.* (2006)** the field experiment was conducted National Agricultural Research Centre, Islamabad, Pakistan during 2004 and 2005, and reported that the control plots having no weed control produced maximum weed fresh biomass (635 and 679 g m<sup>-2</sup>) during 2003–04 and 2004–05, respectively. While pendimethalin in combination with hoeing at 60 DAT resulted in lower weed population (32 and 37 m<sup>-2</sup>) and weed fresh biomass production (60 and 79 g m<sup>-2</sup>) compared to oxadiazon during both the years.

**Chopra and Chopra (2007)** find out the appropriate and economic weed management practice for production of weed-free mother bulb of onion required subsequently for seed production. Pre-emergence application of oxyfluorfen integrated with one hand weeding at 35 days after transplanting (DAT) was significantly superior to pendimethalin. All the weed control treatments significantly reduced the weed density and dry weight of weeds and increased the bulb yield compared to the weedy control. Significantly lower bulb yield was recorded with alachlor (1.5 kg/ha ) compared to pendimethalin, fluchloralin and oxyfluorfen at

higher doses due to its inability to control broad leaf weeds, which had the maximum density in the experimental field.

**Yadav et al. (2009)** an investigation on weed management studies in onion (*Allium cepa*) was carried out during *rabi* seasons of 2006-07 and 2007-08 at CCS Haryana Agricultural University, Hisar. Early post emergence application (10 DAT) of oxadiargyl at 100 g/ha, pre-emergence application of oxadiargyl at 120 g/ha, oxyfluorfen at 250 g/ha, trifluralin at 1000 g/ha and pendimethalin at 1000 g/ha applied through spray supplemented with one hand weeding at 45 days after transplanting (DAT) resulted in significant reduction in population of *Chenopodium album*, *Coronopus didymus*, *Chenopodium murale* and *Melilotus indica* and higher bulb yield. Bio-efficacy of all herbicides applied by spray method was more as compared to sand mix broadcast application.

## 2.4 Weed dry matter

**Narasalagi (1999)** reported that the application of butachlor @ 1.0 kg ha<sup>-1</sup> in combination with HW at 45 DAS resulted in higher bulb yield, lesser weed population and weed dry weight in drill sown onion.

**Saimbhi et al. (2000)** noticed that the pendimethalin @ 0.56 kg ha<sup>-1</sup> + HW at 105 DAS gave excellent control of weeds, reduced weed density as well as weed dry matter in seed crop of onion.

**Ved Prakash et al. (2000)** reported that the pre emergence application of pendimethalin @ 1.0 or 1.5 kg ha<sup>-1</sup> in combination with hand weeding at 45 days after transplanting had

significantly reduced the plant population and dry matter of weeds and increased the plant height, bulb diameter, bulb weight, WCE and the bulb yield compared to alachlor 2 kg ha<sup>-1</sup> + HW and weed free check.

**Mondal *et al.* (2005)** observed that the effects of different herbicides on weeds yield of onions and their economics. Treatments comprised: 1500 g pendimethalin/ha, 750 g pendimethalin/ha + hand-weeding, 200 g oxyfluorfen/ha, 100 g oxyfluorfen/ha + hand-weeding, 100 g haloxyfopmethyl/ha , 80 g haloxyfop-methyl/ha + hand-weeding, hand-weeding at 25 and 40 days after treatment (DAT), and a weedy control. The lowest weed density at 30 DAT was observed upon treatment with oxyfluorfen, while that at 60 DAT was observed upon treatment with oxyfluorfen/ha + hand-weeding in 2002 and 2003. Weed dry matter was lowest with fluchloralin + hand weeding treatment in 2002 (3.3 g/m<sup>2</sup>) and with oxyfluorfen + hand-weeding treatment in 2003 (1.8g/m<sup>2</sup>).

**Warade *et al.* (2006)** studied on the field experiment which was conducted at Dr. PDKV, Akola to study the integrated weed management in onion. Observed that, during both the years at harvesting stage, fluchloralin at 1.0 kg ha<sup>-1</sup> supplemented with two hand weedings at 30 and 60 DAT recorded significantly minimum weed population. During both the years at 80 DAT, significantly lowest dry weight of weeds (11.4 and 13.0 g m<sup>-2</sup>) was recorded due to three hand weedings done at 20, 40 and 60 DAT. However, an application of fluchloralin at 1.0 kg ha<sup>-1</sup> followed by two hand weeding at 30 and 60 DAT produced significantly lowest dry weight of weeds at the harvesting stage (14.0 and 20.8 g m<sup>-2</sup>).

**Chopra and Chopra (2007)** conducted a field experiment during winter season of 2004 and 2005 to find out the appropriate and economic weed management practice for production of weed-free mother bulb of onion at the Indian Agricultural Research Institute, Karnal on sandy loam soil and reported that, both weed density and dry weight of weeds were significantly reduced on the application of pendimethalin, fluchloralin, oxyfluorfen and alachlor compared to weedy check. The first three herbicides supplemented with one weeding at 35 DAT recorded lower weed density and dry weight of weeds and increased the WCE compared to their sole application, alachlor alone and oxyfluorfen applied at 20 DAT.

**Patel et al. (2012)** conducted the field experiment at Department of Agronomy, N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat . Application of either pendimethalin at 1.0 kg/ha or oxyfluorfen at 0.24kg/ha supplement with one hand weeding at 40 days after transplanting recorded the least weed population. All the treatments applied with herbicides conjunction with one hand weeding resulted in significantly reduce dry weight of weeds. The population of sedge weed (*Cyperus rotundus*) was not influenced more due to different weed management treatments. Because, perennial nature and underground net-work of this weed.

## **2.5 Effect of weeds on crop growth and yield**

**Mishra et al. (1986)** noticed that in weedy check plot of onion crop, there was severe competition of weeds which produced poor sized bulbs resulting in lower yield. Any unrestricted weed growth reduced the bulb yield to an extent of 98 per cent. The presence of weeds affected the growth parameters, yield and yield components in onion as reported by **Manjunath et al. (1989)**.

**Singh and Singh (1994)** observed that the un-weeded onion plots reduced plant height, number of leaves, which in turn reduced the bulb diameter and bulb yield due to increased weed competition. Similarly, **Nandal *et al.* (2002)** recorded the lowest plant stand, less diameter of the bulb and lowest bulb yield in weedy check plot.

**Nadagouda (1995)** found that in un-weeded check, presence of weeds resulted in small sized bulbs and reduced the bulb yield. Similar results were obtained by **Chauhan *et al.* (1998)** in onion. Seed yield of onion was reduced due to the presence of weeds in un-weeded control as reported by **Saimbhi *et al.* (2000)**.

**Khang *et al.* (2011)** revealed that maximum bulb yield of onion, 302 q ha<sup>-1</sup> was obtained with 100 per cent RDF (100:50:50 kg ha<sup>-1</sup>) for onion in soybean-onion cropping sequence.

## **2.6 Effect of weed management practices on crop growth**

### **2.6.1 Growth attributes**

**Verma and Singh (1997)** observed that plant height, number of leaves per plant and dry weight of plant were significantly higher under weed free plot followed by application of pendimethalin 1.5 kg a.i. ha<sup>-1</sup>.

**Ved *et al.* (2000)** reported that Alachlor @ 2.0 kg/ha +HW at 45 DAT, being *at par* with pendimethalin @ 1.5 kg/ha + HW at 45 DAT and weed free, proved to be the superior integrated weed control approach to control weeds and increased the plant height, bulb weight and weed control efficiency.

**Chopra and Chopra (2007)** conducted a field experiment at Karnal on sandy loam soil and reported that, the bulb diameter was significantly reduced in weedy check compared to weed control treatments. There was reduction of 24.8 per cent in weedy check compared to oxyfluorfen at  $0.15 \text{ kg ha}^{-1}$  supplemented with HW at 35 DAT. There was reduction of 8.0 and 12.1 per cent in bulb diameter with alachlor  $1.0 \text{ kg ha}^{-1}$  + one hand weeding and alachlor  $1.5 \text{ kg ha}^{-1}$  respectively, compared to oxyfluorfen  $0.15 \text{ kg ha}^{-1}$  + HW at 35 DAT, perhaps owing to competition provided by broad-leaf weeds that alachlor failed to control.

**Yumnam *et al.* (2009)** reported that the treatments comprised of quizalofop-ethyl 5% EC at 1.5 ml/l of water at 20 DAP ( $T_1$ ), quizalofop-ethyl 5% EC at 2.0 ml/l of water at 20 DAP ( $T_2$ ), quizalofop-ethyl 5% EC at 2.5 ml/l of water at 20 DAP ( $T_3$ ), quizalofop-ethyl 5% EC at 1.5 ml/l of water at 20 DAP followed by one hand weeding at 40 DAP ( $T_4$ ), quizalofop-ethyl 5% EC at 2.0 ml/l of water at 20 DAP followed by one hand weeding 40 DAP ( $T_5$ ), quizalofop-ethyl 5% EC at 2.5 ml/l of water at 20 DAP followed by one hand weeding at 40 DAP ( $T_6$ ), hand weeding at 20 and 40 DAP ( $T_7$ ) and untreated control ( $T_8$ ). Data on the effect of different treatments on plant height, number of leaves, bulb diameter, neck thickness of bulb, bulb weight per plot, bulb yield, weed population, and dry weight of weeds. Hand weeding at 40 days after transplanting along with application of quizalofop-ethyl 5% EC at 2.5 ml/l of water at 20 DAP ( $T_6$ ) significantly reduced weed density (25.5) and dry weight (55.3 g) of weed compared to other treatments. The highest plant height was found in ( $T_1$ ) (44.41 cm) followed by  $T_4$  (36.82 cm) compared to the lowest plant height in  $T_6$  (31.42 cm). Application of quizalofop-ethyl 5% EC at 2.0 ml/l of water at 20 DAP along with hand weeding at 40 DAP ( $T_5$ ) had the highest number of

leaves and neck thickness (1.16 cm). Hands weeding at 40 DAP along quizalofop-ethyl 5% EC at 2.5 ml /me of water (T<sub>6</sub>) had the highest bulb diameter (4.09 cm), bulb weight (13.42 kg) and bulb yield (335.64 q/ha), followed by T7 (3.45 cm,13.23 kg and 330.83 q/ha) compared to the control (2.86 cm,9.74 kg and 243.50 q/ha, respectively).

**Patel et al. (2011)** conducted field experiment to examine the effect of weed management and plant nutrition practices on weed biomass, growth parameters and bulb yield of onion at Navsari Agriculture University, Navsari and observed higher plant height, neck thickness and dry matter accumulation per plant under the application of pendimethalin 1.0 kg ha<sup>-1</sup> + HW at 40 DAT, while the lowest values of all these growth parameters were observed with unweeded control.

**Tripathy et al. (2013)** reported that the plant height was greatest (60.65 cm) for T4. The highest number of leaves per plant (12.17), marketable bulb yield (182.37 quintal/ha) and total bulb yield (206.92 quintal/ha) were highest for T7. T6 resulted in the lowest weed density (297.33/m<sup>2</sup>),(1.0 quintal= 100.0 kg).

**Sable et al. (2013)** the study revealed that economically effective weed control was under oxyfluorfen 0.26 kg a.i./ha with hand weeding (30 DAT) which was next to weed free check, followed by oxyfluorfen 0.26 kg a.i./ha+oxyfluorfen 0.26 kg a.i./ha (30 DAT). The same treatment showed significantly reduced weed dry weight (2.64 g/0.25 m<sup>2</sup>, 0.61 g/0.25 m<sup>2</sup> and 3.61 g/0.25 m<sup>2</sup>, respectively) which was next to weed free checking (0.00 g/0.25 m<sup>2</sup>). These treatments also exhibited significantly higher plant height, number of leaves per plant, leaf area of plant, total dry weight of plant as well as bulb weight, bulb diameter at each stage of crop growth, The significantly higher bulb yield per hectare was

also observed in these treatments (302.77 q/ha in weed free check followed by 291.94 q/ha in oxyfluorfen 0.26 kg a.i./ha with hand weeding at 30 DAT), The significantly reduced plant growth, yield attributing parameters and bulb weight per hectare (60.83 q/ha) were recorded in un-weeded control. The better B: C ratio was recorded in oxyfluorfen 0.26 kg a.i. /ha with hand weeding at 30 DAT (7.81) followed by weed free checks (6.38).

**Kumar (2014)** study revealed that effective weed control was recorded under application of Oxyflurofen 23.5EC before planting one hand weeding at 40 days after transplanting (T<sub>7</sub>) or combined spray of Pendimethalin 30EC+quizalofop ethyl 5EC at the time of planting and second application at 30 days after transplanting (T<sub>6</sub>). The same treatment (T<sub>7</sub>) recorded significantly highest plant height (58.33 cm) and number of leaves (9.87) than rest of the treatments. Significantly highest marketable and total bulb yield was recorded in T<sub>7</sub> (211.68 and 242.33 q/ha, respectively) followed by T<sub>6</sub> (202.20 and 232.62 q/ha, respectively) than rest of the treatments. The result indicated that significantly highest weed population (1107.91 per sq m) was recorded in weedy check plot (T<sub>8</sub>) while lowest in T<sub>6</sub> (195.42 per sqm). The WCE varies from 41.01 (T<sub>3</sub>) to 68.23 (T<sub>6</sub>). The BC ratio estimated in different weed treatment practice over weedy check indicated maximum B: C ratio of 2.30 in T<sub>7</sub> closely followed by 1.75 in T<sub>1</sub> and 1.70 in T<sub>6</sub>.

### 2.6.2 Yield attributes and bulb yield of onion

**Manjunath *et al.* (1989)** observed that the un-weeded plots gave only 1.54 tonne ha<sup>-1</sup> bulb yield when compared with the weed free control 29.8 t ha<sup>-1</sup>.

**Vidyasagar and Monika (1993)** observed that, bulb yield was associated significantly and positively with the bulb size, equatorial and polar diameter, plant height, leaf breadth and neck thickness.

**Nadagouda (1995)** observed that two hand weeding at 30 and 45 DAS recorded the highest onion bulb yield(While, Singh *et al.* (1997) recorded the highest onion bulb yield and the highest weed control efficiency in treatment combination of one HW at 30 DAT + mulching.

**Maw *et al.* (1996)** examined that the overall mean equatorial diameter was 62 mm and polar diameter was 42 mm of the matured bulb onion.

**Nandal and Singh (2002 )** revealed that oxyfluorfen applied @ 0.25 kg ha<sup>-1</sup> along with HW at 40 DAT as well as @ 0.37 kg ha<sup>-1</sup> were the superior treatment combinations for effective weed control and maximum onion bulb yield.

**Singh and Singh (1996)** found better weed control and more yield of onion by the pre-emergence application.

**Nandal and Singh (2002)** revealed that oxyfluorfen applied at 0.25 kg/ha+HW at 40 DAT and at 0.37 kg/ha were the best treatment combinations for effective weed control and maximum onion bulb yield.

**Ghosh *et al.* (2004)** found that the bulb yield was highest with weed-free treatment, followed by oxyfluorfen+hand weeding at 45 DAT, which was at par with twice hand weeding at 25 and 45 DAT.

**Bhutia et al. (2005)** reported that the effect of herbicides integrated with manual weeding on onion. The treatment combinations were weedy check/control, hand weeding at 25 and 45 DAT, weed free, Oxyfluorfen @ 100 g/ha as POE at 25 DAT, Pendimethalin @ 750 g/ha as PP at 2 DBT, Agil @ 100 g/ha as PE at 2 DAT, Oxyfluorfen+HW at 45 DAT, Agil+HW at 25 DAT and Oxyfluorfen+Agil. The result revealed that integration of hand weeding at 45 DAT to initial Oxyfluorfen treatment significantly reduced weed population and biomass at harvest over the control. The highest bulb yield was obtained with weed free treatment followed by Oxyfluorfen+HW at 45 DAT which was at par with twice HW at 25 & 45 DAT while the season long crop-weed competition (control) reduced the bulb yield by 38.26%. Preemergence application of Pendimethalin @ 750/ha was found to be the most effective treatment among sole herbicidal treatments.

**Khalid et al. (2006)** conducted an experiment at National Agricultural Research Centre, Islamabad, Pakistan. They observed that in both the seasons all weed control treatments were resulted in significantly higher bulb weight compared to the untreated control. The highest average bulb weight (120 and 111 g) was recorded with the application of pendimethalin 2 DAT + HW at 60 DAT, whereas, the lowest bulb weights (53 and 47 g) were recorded in the weedy check.

**Khokhar et al. (2006)** reported that the weed management studies in transplanted onion were conducted during 2004 and 2005 at Pakistan. The pendimethalin and oxadiazon were applied post-emergence 2 days and 4 week after transplanting and their efficacy alone and in combination with one manual weeding was evaluated to reduce weed competition and its effects on marketable bulb yield. Hand weeded and weedy check was included. Compared to weed free condition, weed crop competition caused 71% and 76%

reduction in the marketable bulb yield during the first and second year, respectively. *Cyperus rotundus* (41%) and *Coronopus didymus* (19%) were the dominant weeds recorded in the field. Both pendimethalin and oxadiazon when applied 2 DAT in combination with one weeding at 60 DAT were found more effective in enhancing marketable bulb yield and recorded higher net returns than other treatments.

**Nargis and Jilani (2006)** reported the effect of integrated weed management in the onion cultivars Naurang, Dark Red and Swat-I. Two chemical treatments (2.5 liter 2,4-D and 3.0 liter pendimethalin/ha ) and 2 manual weeding treatments (single hoeing at 25 days and double hoeing at 50 days after sowing. Controls were compared for weed control and their effect on the yield and yield components of onion. Weedicides were applied at the pre-emergence stage and significantly controlled the weed population

**Nadas and Wagner (2007)** reported that the two widely used pre emergence herbicides: Dual Gold 960EC(S-metolachlor; 2l/ha) and Stomp 330 (pendimethalin; 3 l/h) in green onion. The herbicide application modified the effect of the nitrogen fertilizer. Dual Gold 960 EC inhibited the biomass production of green onion because the herbicide inhibited the protein and nucleic acid synthesis of the plants. Weeding (at 45 days after transplanting; DAT) or two hand weedings at 30 and 60 DAT. The results indicated that, the pre-emergence application of fluchloralin at 1.0 kg/ha supplemented with superimposition of two hand weedings at 30 and 60 DAT recorded the least weed count and dry matter production, and favoring the highest yield of onion bulbs (72.4 t/ha ). An application of fluchloralin, pendimethalin, alachlor, trifluralin and oxyfluorfen at lower rates in combination with one and two hand weedings produced significantly higher yields than an application of these herbicides alone at higher rates.

**Warade et al. (2007)** the results indicated that, the pre-emergence application of fluchloralin, pendimethalin, alachlor, trifluralin and oxyfluorfen did not show any phytotoxic effect on the onion crop. An integrated treatment of pre-emergence application of fluchloralin @ 1.0 kg ha<sup>-1</sup> followed by two hand weedings at 30 and 60 DAT recorded the highest yield of onion bulbs (724.70 q ha<sup>-1</sup>). All the herbicides at lower doses in combination with one and two hand weedings produced significantly the higher yield than the treatment of these herbicides applied alone in higher doses.

**Yumnam et al. (2009)** reported that, hand weeding at 40 DAP along with quizolofop-ethyl 5 per cent EC at 2.5 ml L<sup>-1</sup> of water hand weeding at 20 and 40 DAP had the highest bulb diameter (4.09 cm), bulb weight (13.42 kg) and bulb yield (335.64 q ha<sup>-1</sup>), followed by untreated control (3.45 cm, 13.23 kg and 330.83 q ha<sup>-1</sup>, respectively) compared to the control (2.86 cm, 9.74 kg and 243.50 q ha<sup>-1</sup>), respectively.

**Chandrika et al. (2009)** reported that the application of pendimethalin 1.0 kg/ha, oxyfluorfen 0.25 kg/ha and quizalofop-p-ethyl 0.25 kg/ha. Weed management with their Three hand weeding at 30, 60, and 90 DAT recorded significantly maximum yield parameters in onion viz. number of umbels plant-1, umbels diameter(cm), Seed weight per umbel, seed yield (kg plot-1 and qha-1) germination percent, seedling vigor index. Followed by application of pendimethalin pre-transplanting @ 1.25 kg ha-1 (fb) pendimethalin @ 1.25 kg ha-1 at 30 DAT which was found practically more convenient and economically feasible weed management method for seed production in kharif onion.

**Saini et al. (2010)** conducted a field experiment at Punjab Agricultural University, Ludhiana during *rabi* 2006-07 and 2007-08 and reported that the fresh weight and

diameter of onion bulb were recorded significantly higher under oxyfluorfen which was statistically at par with pendimethalin and two hand weedings, but significantly superior over fluchloralin and unweeded control.

**Bharathi et al. (2011)** revealed that integration of oxyfluorfen @ 0.15 kg a.i. ha<sup>-1</sup>, oxadiargyl @ 0.1 kg a.i. ha<sup>-1</sup> and pendimethalin @ 1.0 kg a.i. ha<sup>-1</sup> with one hand weeding at 45 days after transplanting proved to be effective in significantly reducing weed density and increasing the bulb yield over application of herbicides alone. Among the herbicides oxyfluorfen @ 0.15 kg a.i. ha<sup>-1</sup> with one hand weeding at 45 days after transplanting recorded highest bulb yield and was on par with oxadiargyl @ 0.1 kg a.i. ha<sup>-1</sup> and pendimethalin @ 1.0 kg a.i. ha<sup>-1</sup> with one hand weeding at 45 days after transplanting. Hand weeding at 15, 30, 45 and 60 days after transplanting has recorded highest weed control efficiency of 80-88%, improved the plant height, number of leaves per plant, pseudo stem diameter, bulb diameter, bulb weight and yield per hectare and significantly superior over herbicide alone or integrated weed management treatments.

**Patel et al. (2011)** reported that the highest onion bulb yield of 39.3 t ha<sup>-1</sup> during 2008, 36.6 t ha during 2009 were obtained at Navsari Agriculture University, Navsari under application of pendimethalin 1.0 kg ha<sup>-1</sup> supplement with one HW followed by oxyfluorfen 0.24 kg ha<sup>-1</sup> pre emergence + 1 HW at 40 DAT and weed free control (hand weeding at 20, 40 and 60 DAT) during both the years as well as on pooled basis.

**Patel et al. (2011)** studied that the weed management practices included alone application of herbicides, viz. pendimethalin, oxyfluorfen and fluazipop-p-butyl, their combination with hand weeding, weed free and weedy check. The crop was fertilized

with three levels viz., 75% RDF, RDF (100:50:50 NPK kg/ha) and 125% RDF. The results indicated that weed management and fertilizer levels had a significant effect on weed population dynamics and onion bulb crop. The total weed density decreased significantly with application of pendimethalin 1 kg/ha or oxyfluorfen 0.24 kg/ha+one hand weeding at 40 days after transplanting (DAT) during both the seasons of investigation. *Echinochloa ssp.*, *Trianthema portulacastrum*, *Digera arvensis* Forsk. *Physalis minima* L. and *Cynodon dactylon* L. Pers. were found as major weeds in the crop. Higher onion bulb yield (38.0 t/ha) was recorded with pendimethalin 1 kg/ha+one hand weeding at 40 DAT. The increase in yield was 83.7% compared to the yield obtain in weedy check. Increasing level of fertilizer applications increased the total biomass of grassy and broad leaves weeds. Application of 125% RDF significantly improved bulb yield and increase in yield was 19.4 and 10.5% over 75% RDF and RDF respectively. On the basis of interaction, combination of pendimethalin 1 kg/ha fb 1 hands weeding at 40 DAT and 100% RDF were most productive (39.8 t/ha) and profitable (Net return Rs 2, 69,422/ha and benefit: cost ratio 7.85).

**Patel et al. (2013)** reported that the Weed population was decreased significantly with application of pendimethalin 1 kg/ha or oxyfluorfen 0.24 kg/ha supplement with one hand weeding at 40 DAT (W<sub>5</sub> or W<sub>6</sub>) during both the seasons of investigation. and also reported that pendimethalin @ 1.0 kg/ha followed by one hand weeding (W<sub>5</sub>) produced higher onion bulb yield of 39.3, 36.6 and 38.0 t/ha during both years as well as in pooled, respectively.

## 2.7 Chemical method of weed management in onion

**Sandhu *et al.* (1987)** reported that the highest bulb yield was recorded in oxyfluorfen @ 0.25 kg a.i. ha<sup>-1</sup> along with hand weeding which was followed by 0.37 kg a.i. ha<sup>-1</sup> as compared to weedy check.

**Phogat *et al.* (1989)** reported that onion bulb yields were increased to the tune of 11.06 to 11.82 t ha<sup>-1</sup> with application of pendimethalin @ 1.0 to 1.5 kg a.i. ha<sup>-1</sup> as pre emergence. herbicide combination of oxyfluorfen @ 0.1 kg ha<sup>-1</sup> + pendimethalin @ 1.0 kg ha<sup>-1</sup> proved to be best in checking the weeds throughout the crop season.

**Kumar *et al.* (1992)** observed that an application of pendimethalin @ 1.0 kg ha<sup>-1</sup> was most effective in reducing dry weight of weeds and resulted into higher uptake of N, P and K. The single application of pendimethalin @ 1.32 kg ha<sup>-1</sup> as pre emergence proved to be better for the control of weeds for the entire season and resulted in higher onion yield.

**Jaykumar *et al.* (1999)** concluded that an application of pendimethalin 1.0 kg a.i ha<sup>-1</sup> was found effective in reducing weed population and their dry weight in enhancing the onion yield.

**Thakral *et al.* (2003)** studied that the weed-free treatment provided the maximum number of total and healthy seedlings. Among the herbicidal treatments, trifluralin @ 1.00 kg/ha as pre-sowing soil incorporation, pendimethalin @ 1.00 kg/ha and alachlor @ 2.00 kg/ha applied as pre emergence were the most effective herbicides for controlling weeds and producing healthy seedlings.

**Qasem (2006)** reported that the effect of different herbicides on onion seedlings and weed growth were investigated in two field experiments conducted at the central Jordan Valley during the 1998/1999 growing season. Weed competition reduced average onion fresh yield by 62% compared with the weed-free control. Out of 14 herbicides tested in 16 treatments, oxadiazon at a dose of 0.75 kg a.i./ha and oxyfluorfen at 0.6 kg a.i./ha , both applied as pre-sowing and post-emergence to onion seedlings resulted in the highest seedlings yield and the lowest weed biomass. Oxadiazon in pre-sowing and oxyfluorfen in post-emergence application were the best in controlling many "hard to kill" weeds including *Chenopodium murale*, *MaIva sylvestris*, and *Cyprus rotundus*, and in increasing seedlings yield, while oxyfluorfen in a post-emergence application treatment was the best of all herbicides used.

**Warade et al. (2007)** the field experiments were conducted during rabi season of the years 2003 and 2004 at the Main Garden, University Department of Horticulture, Dr. PDKV, Akola, Maharashtra, India. The prominent weeds in the experimental plots were *Cyperus rotundus*, *Cynodon dactylon*, *Physalis minima*, *Chenopodium album*, *Portulaca oleracea*, *Euphorbia hirta*, *Amaranthus viridis*, *Tribulus terrestris* and *Parthenium hysterophorus*. The pre emergence application of fluchloralin at 1.0 kg/ha+2 hand weedings at 30 and 60 DAT reduced weed incidence and recorded highest yield of onion bulbs. Significantly lowest uptake of nitrogen by weed and higher uptake by onion crop were observed under herbicides along with two hand weedings as compared to other treatment under study.

**Dalavai et al. (2008)** evaluated herbicides and their application techniques for control of weeds in transplanted onion and to study the herbicide residue in soil through bioassay

techniques. The cucumber and ragi were used as test crops for bioassay study. Both the test crops did not show residual toxicity to pre-emergence herbicides, i.e. fluchloralin at 1000 g/ha, pendimethalin at 750 g/ha, oxyfluorfen at 150 g/ha and oxadiargyl at 75 g/ha applied for onion crop. The study convincingly proved that germination and growth of bioassay crop were not affected by herbicides and their application techniques.

**Kathepuri et al. (2011)** the results indicated that the application of two hand weedings at 20 and 40 days after transplanting was significantly superior for weed control followed by spraying of pendimethalin 30 EC @ 1 kg a. i. ha<sup>-1</sup> as pre plant in corporation one hand weeding at 40 days after transplanting in Rabi onion in clayey textured and slightly alkaline soils under Pune region.

**Bawazir (2013)** results indicated that weed species *Echinochloa colonum* and *Dactyloctenium aegyptium* dominated in the first season, whereas *Solanum dubium* followed later by *E. colonum* dominated in the second season. The weeds biomass was often lower with banded or sprayed nitrogen than with broadcasted nitrogen. The Application of pendimethalin+handweeding 45 days after treatment was satisfactory in reducing weed biomass and increased onion yield. Using oxyfluorfen was effective in the second season only. Hand weeding twice was the most efficient in reducing biomass of weeds but the least on crop yield. Strong interaction among nitrogen and weed management indicated that the combination of nitrogen placement is an important component of integrated weed management with chemical control of weeds to reduce weeds biomass and increase crop yield.

## 2.8 Integrated weed management in onion

**Singh *et al.* (1982)** reported that the pendimethalin @ 1.0 - 1.5 kg ha<sup>-1</sup> followed by one HW was effective in controlling the weeds in onion.

**Singh *et al.* (1985)** reported that the supplementary weeding at 45 DAT over the application of alachlor @ 2.0 kg ha<sup>-1</sup> resulted in significant increase in bulb yield but oxadiazon @ 1.0 kg ha<sup>-1</sup> was more effective than other herbicides applied.

**Mehta *et al.* (1985)** observed that the pre-planting or pre-emergence application of fluchloralin @ 2 kg ha<sup>-1</sup> or butachlor@1.0 kg ha<sup>-1</sup> followed by one hand weeding were at par with three hand weedings in decreasing the dry weight of weeds upto harvest.

**Prasad and Singh (1988)** Application of alachlor @ 1.0 kg ha<sup>-1</sup> + HW at 45 DAT resulted in reduced dry weight of weeds and increased the bulb yield of onion next to repeated hand weeding.

**Mustafee (1990)** noticed that the application of pendimethalin @ 0.75 kg ha<sup>-1</sup> as pre-emergence with irrigation at two DAS recorded best weed control in onion. However, the highest bulb yield was obtained with pendimethalin @ 1.0 kg ha<sup>-1</sup>. Application of pendimethalin @ 1.0 kg ha<sup>-1</sup> + HW at 60 DAT resulted in the lowest populations of weeds.

**Nadagouda (1995)** application of pendimethalin @ 1.0 and 1.25 kg ha<sup>-1</sup> with HW at 60 DAT was more effective against weeds as reported by Sharma and Mehta (1994).

While, pendimethalin @ 1.0 kg ha<sup>-1</sup> coupled with HW at 45 DAT was found effective in controlling weeds and increased the direct drill sown onion bulb yield.

**Porwal (1995)** the pre-emergence application of alachlor at 2.0 kg ha<sup>-1</sup>+ HW at 40 DAS increased WCE as compared to lower rate of its application.

**Nekar (1997)** reported that the application of pendimethalin @ 1.0 kg ha<sup>-1</sup> + HW at 60 DAT resulted in the lowest population of weeds per 0.5 m<sup>2</sup>.

**Tiwari et al., (1998)** reported that pendimethalin at 1.0 kg per hectare followed by hand weeding 65 days after transplanting gave the best results in terms of weed control followed by linuron and oxadiazon applied at 1.0 kg per hectare along with hand weeding 65 days after transplanting.

**Vora and Mehta (1998)** field experiments conducted at GAU, Junagadh, showed that application of fluchloralin @ 0.90 kg ha<sup>-1</sup>, alachlor @ 1.0 kg ha<sup>-1</sup>, butachlor @ 1.0 kg ha<sup>-1</sup>, oxadiazone @ 0.50 kg ha<sup>-1</sup> and oxyfluorfen @ 0.18 kg ha<sup>-1</sup> alone did not control weeds effectively. Herbicide application coupled with HW at 40 DAT gave higher bulb yields and monetary returns than herbicide alone.

**Kolhe (2001)** reported that the pre-emergence application of pendimethalin and oxyfluorfen at 1.0 kg a.i ha<sup>-1</sup> and 0.15 kg a.i ha<sup>-1</sup> respectively and each supplemented with one HW at 35 DAT was significantly superior over the single application of herbicide at higher rates reducing weed dry matter and enhancing bulb yield of onion.

**Singh *et al.* (2001)** observed that the application of oxyfluorfen at 0.25 and 0.37 kg a.i ha<sup>-1</sup> + hand weeding 40 DAT increased the number of leaves per plant and bulb diameter.

**Rameshwar *et al.* (2002)** reported that the lowest weed density and dry matter were noticed in plots treated with pendimethalin @ 1.5 kg ha<sup>-1</sup> + HW at 60 DAT. This treatment combination also recorded maximum net returns.

**Nandal and Singh (2002)** the minimum N, P and K uptake by weeds was obtained when oxyfluorfen at 0.25 kg ha<sup>-1</sup> was supplemented with hand weeding at 40 DAT followed by oxyfluorfen at 0.37 kg ha<sup>-1</sup>. Maximum N, P and K uptake by onion bulbs was obtained due to oxyfluorfen at 0.25 kg ha<sup>-1</sup> + HW at 40 DAT followed by oxyfluorfen at 0.37 kg ha<sup>-1</sup>.

**Yumnam *et al.* (2009)** conducted a field experiment during the winter season of 2006 in West Bengal, India, to provide economically acceptable and eco-friendly weed control in onion and reported that hand weeding at 40 DAT along with application of quizolofop-ethyl 5% EC at 2.5 ml L<sup>-1</sup> of water at 20 DAP, HW at 20 and 40 DAT significantly reduced weed density (25.5) and dry weight (55.3 g) of weed compared to other treatments.

## 2.9 Weed control efficiency

**Calamai and Martini (1994)** observed that the application of oxyfluorfen @ 0.12 kg ha<sup>-1</sup> at 35 DAT + hoeing produced higher bulb yield (24.57 t ha<sup>-1</sup>) and better (98 %) weed control efficiency.

**Singh *et al.* (1996)** reported that the pre-emergence application of pendimethalin @ 0.75 kg ha<sup>-1</sup> + HW at 40 DAT. While, oxyfluorfen @ 0.07 kg ha<sup>-1</sup> + HW at 40 DAT prevented weed competition registering 91 per cent and 74 per cent WCE, respectively in garlic (Tewari *et al.* 1998).

**Patil (1999)** bulb yield was significantly higher in oxadiazon @ 0.5 and 0.4 kg a.i. ha<sup>-1</sup> followed by pendimethalin @ 1.0 kg a.i ha<sup>-1</sup> and these treatments recorded significantly higher weed control efficiency and lower values for weed index.

**Chittapur and Shenoy (2002)** conducted a field experiment during the kharif season to assess the performance the different herbicides for weed control in onion cv. Nasik red. The treatment comprised alachlor, metalachlor, trifluralin and btachlor including weed free and un-weeded controls. The highest numbers of monocot and dicot and total weeds were recorded in unweeded control both 30 day after planting at harvest. The weed free control recorded the highest onion bulb yield 105q/ha. Metalachlor recorded the highest weed control efficiency (67.20%).

**Kathiresan *et al.* (2004)** reported that application of oxadiargyl 90 g a.i. ha<sup>-1</sup> at three DAT recorded higher weed control efficiency and lower weed index in onion.

**Ghadage *et al.* (2006)** study the effect of herbicides (pendimethalin at 1.0 kg and Oxyfluorfen at 0.2 kg/ha), alone and in combination with hand weeding (20 and 40 days after transplanting), on weeds and onion (*Allium cepa* L.) cv. N-2-4-1. All the weed control treatments significantly reduced the population and dry weight of weeds and in turn increased bulb yield significantly compared to the weedy control. Pendimethalin at 1.0 kg/ha + hand weeding 40 days after transplanting and two hand weedings at 20 and

40 days after transplanting (weed-free) proved to be the superior integrated weed control approach to control weeds and increase weed control efficiency.

**Channappagoudar and Biradar (2007)** reported that pendimethalin and oxadiargyl in combination with one HW registered higher weed control efficiency at all the growth stages of crop.

**Dalavai (2009)** reported that hebetation through irrigation against weeds of onion was evaluated in Oxyfluorfen and pendimethalin exhibited the greatest weed control efficiency 62.9 and 60.4%, respectively.

**Shinde *et al.* (2013)** reported that the effects of pendimethalin 38.7% CS (1.25, 1.50 and 1.75 liter/ha), pendimethalin 30.0% EC (2.5 liters/ha), and oxyfluorfen 23.5% EC (1.0 or 0.625 liter/ha) on weed incidence and onion (cv. N-2-4-1) yield were studied in Rahuri, Maharashtra, India, during 2008-09. Pendimethalin 38.7% CS at 1.75 liter/ha exhibited the greatest grass weed control efficiency (90.19%) and resulted in the highest yield (422.58 quintal/ha), whereas oxyfluorfen 23.5% EC at 1.0 liter/ha showed the greatest broadleaved weed control efficacy (82.95%). [1.0 quintal=100.0 kg].

**Sankar *et al.* (2015)** observed that among the various herbicides evaluated, application of Oxyfluorfen 23.5% EC @ 1.5 ml/L before planting and one hand weeding at 40-60 days after onion seedlings transplanting recorded the higher marketable bulb yield (43.5 t/ha) with maximum weed control efficiency of 78.4%. The same treatment was also recorded higher cost benefit ratio of 1:3.06.

## 2.10 Nutrient uptake by weeds and onion

**Kathepuri *et al.* (2007)** conducted a field experiment at College of Agriculture, Pune, and reported that, the weed control methods showed significant difference in N removal by weeds. Nitrogen uptake through weeds was minimum under weed free condition i.e. 2 HW at 20 and 40 DAT followed by pendimethalin 1.0 kg + HW at 40 days after transplanting. Weedy check removed the highest amount of nitrogen. The onion crop removed the highest amount of nitrogen under 2 HW at 20 and 40 DAT followed by pendimethalin 1 kg ha<sup>-1</sup> + HW at 40 DAT and oxyfluorfen 0.2 kg ha<sup>-1</sup> + HW at 40 DAT.

**Chandrika *et al.* (2009)** from experimentation at S. V. Agricultural College, Tirupati observed that, HW twice resulted in the highest yield attributes and the highest bulb yield, which was at par with weed management practices i.e. pre-emergence application of oxyfluorfen @ 0.24 kg ha<sup>-1</sup>+ HW at 40 DAT and pre-emergence application of pendimethalin @ 0.75 kg ha<sup>-1</sup>+ HW at 40 DAT.

**Rajkumara *et al.* (2010)** reported that, weeds removed significantly higher nitrogen in weedy check (141.5 kg ha<sup>-1</sup>) compared to rest of the treatments. Nitrogen uptake by weeds was significantly lower and zero in weed free check and weed free up to 120 DAS with which it was on par. The nitrogen uptake was recorded significantly higher in onion in weed free check (115.2 kg ha<sup>-1</sup>) compared to the rest of treatments except weed free up to 100 DAS (89.3 kg ha<sup>-1</sup>) and 120 DAS (93.8 kg ha<sup>-1</sup>) which was on par. Nitrogen uptake was significantly low in weedy check (0.62 kg ha<sup>-1</sup>) in onion over rest of the treatments.

## 2.11 Economics of weed control methods

**Singh et al. (1992)** reported that the application of oxyfluorfen @ 0.25 kg ha<sup>-1</sup> as pre-planting spray gave the maximum net returns in onion while the B: C ratio per rupee of investment due to the herbicide was highest with oxyfluorfen @ 0.12 kg ha<sup>-1</sup>. While Hanumantharaju (1992) asserted that profit per rupee spent on weed control was the highest with pre-emergence application of oxyfluorfen @ 0.15 kg ha<sup>-1</sup>.

**Nadagouda (1995)** concluded that the net returns per rupee spent on weed control was highest with mixture of pendimethalin @ 0.50 kg ha<sup>-1</sup> + fluchloralin @ 0.50 kg ha<sup>-1</sup>, but the highest B: C ratio was observed with pendimethalin @ 1.0 kg ha<sup>-1</sup> + HW at 45 DAT. The income of onion was noticed higher in weed free check followed by HW at 30 DAT + mulch, but the highest C: B ratio was recorded with pendimethalin @ 1.0 kg ha<sup>-1</sup> + HW at 60 DAT (**Singh et al. 1997**).

**Singh et al. (1998)** reported that the fluchloralin @ 1.0 kg ha<sup>-1</sup> + HW at 45 DAT recorded highest net return as well as B: C ratio followed by oxyfluorfen @ 0.25 kg ha<sup>-1</sup> + HW at 45 DAT.

**Kolhe (2001)** a field experiment was carried out in Madhya Pradesh, India for two consecutive years during summer seasons of 1998 and 1999 to find out the appropriate and economic weed management practice in onion cv. N 53. Treatments comprised: pendimethalin; pendimethalin+hand weeding; metolachlor; metolachlor+hand weeding; oxyfluorfen; oxyfluorfen+hand weeding; hand weeding at 20 and 35 days after transplanting (DAT). Pre-emergence application of pendimethalin, metolachlor and oxyfluorfen at 1.0, 0.75 and 0.15 kg/ha, respectively,

and each supplemented with one hand weeding at 35 DAT was 5 significantly superior over the single application of these herbicides at higher rates in reducing weed dry matter and in enhancing bulb yield of onion. Pre-emergence application of oxyfluorfen at 0.15 kg/ha supplemented with one hand weeding at 35 DAT was equally effective to that of hand weeding twice at 20 and 35 DAT in alleviating weed competition and increasing bulb yield. There was reduction in bulb yield to the extent of 78.63% due to weed competition under weedy control. On the contrary, increase in bulb yield in the range of 159.36-447.25% was observed due to adoption of weed management practices. Although hand weeding twice recorded the highest additional returns (Rs. with one hand 95 760/ha) over the weedy control, the maximum weed control efficiency (92.2%), net additional returns (Rs. 91 070/ha) over the control and benefit: cost ratio (56.6) was obtained under pre-emergence application of oxyfluorfen at 0.15 kg/ha supplemented weeding at 35 DAT.

**Rameshwar et al. (2002)** reported that the pendimethalin @ 1.5 kg ha<sup>-1</sup> supplemented with one hand weeding gave a higher net return which was 43.4 per cent more than farmer's practice. The higher marginal B: C ratio of 53.95 was in alachlor @ 1.5 kg ha<sup>-1</sup> and the lowest marginal B: C ratio of 7.51 was recorded with farmer's practice of weeding.

**Kalhature and Shete (2012)** found the highest weed control efficiency (100%), plant height (60.63 cm), Number of leaves (8.80), leaf area (427.67 sq. cm), average bulb weight (92.65 g), total yield (315.76 q ha<sup>-1</sup>) and zero per cent weed control index were observed in weed free check followed by weed control efficiency (75.75%), plant height (58.77 cm), Number of leaves (8.60), leaf area (410.87 sq. cm), total yield (308.52 q ha-

1), 2.31% weed control index and highest BC ratio (2.73:1) with application of pre-emergence spray of Oxyfluorfen 23.5% EC @ 0.25 kg ai ha<sup>-1</sup> + post-emergence spray of ½ dose of (Quizalofop ethyl 5% EC @ 0.05 kg ha<sup>-1</sup> + Oxyfluorfen 23.5% EC @ 0.25 kg ai ha<sup>-1</sup>) at 40 DAT.

**Kalhature *et al.* (2013)** studied the weed management with three hand weedings (HW) at 20, 40 and 60 DAT recorded significantly lowest weed density, dry weight of weeds and higher weed control efficiency and maximum in all the growth and yield attributes of onion viz. plant height, neck thickness, bulb weight, bulb diameter and bulb yield. Highest net monetary returns (Rs110.3×103/ha) and B:C ratios (2.76) were obtained with the application of pendimethalin @ 1.0 kg/ha (PPI)+oxyfluorfen @ 0.250 kg/ha (PoE)+One hand wedding at 40 DAT, which was found practically more convenient and economically feasible weed management method in onion.

**Gandolkar *et al.* (2015)** studied that the weed free check significantly reduced the dry weight of weeds at all the stages. Among herbicide treatments, oxyfluorfen @ 0.25 kg ha<sup>-1</sup> followed by (fb) oxyfluorfen @ 0.25 kg ha<sup>-1</sup> was reduced the dry weight of weeds by 86.21, 85.23 and 84.84 per cent at 30, 60 and at harvest, respectively, compared to unweeded check. At 30 DAT and harvest, farmer's practice showed its superiority in WCI and was on par with oxyfluorfen @ 0.25 kg ha<sup>-1</sup> fb oxyfluorfen @0.25 kg ha<sup>-1</sup>. It also recorded significantly higher bulb yield (19.93 t ha<sup>-1</sup>). The weed index was also lowest in this treatment. Crop uptake of N, P and K was higher in weed free check at both the stages. Among the herbicide treatments, oxyfluorfen @ 0.25 kg ha<sup>-1</sup> fb oxyfluorfen @ 0.25 kg ha<sup>-1</sup> (T10) recorded maximum uptake of N, P and K by crop. This treatment also recorded significantly higher gross returns (Rs. 1, 22, 046 ha<sup>-1</sup>) except weed free check.

Maximum net returns (Rs. 87, 163 ha<sup>-1</sup>) and B: C (3.50) was obtained by application of oxyfluorfen 0.25 kg ha<sup>-1</sup> followed by oxyfluorfen 0.25 kg ha<sup>-1</sup>.

**Vikas *et al.* (2015)** reported that the growth and yield attributes of onion viz., plant height (58.87 cm), no. of leaves (15.11), neck thickness (1.4 cm), A grade bulb (42.60%), fresh bulb weight (70 g), bulb diameter (5.75 cm) and bulb yield (40.9 t ha<sup>-1</sup>) were recorded maximum in weed free plots. This treatment also recorded minimum bolters (0.0%) and doubles (1.12%), the highest gross (Rs 3, 27,200 ha<sup>-1</sup>) & net return (2, 87,471) and maximum B: C ratio (7.12). However, treatment combined spray of oxyfluorfen @ 0.240 kg ha<sup>-1</sup> and propaquizafop @ 0.090 kg ha<sup>-1</sup> as PE followed by second spray as POE at 45 DAT was equally effective with this treatment.

*Materials*  
*and*  
*Methods*

## CHAPTER-III

**MATERIALS AND METHODS**

The present investigation entitled “**Studies on Weed and Fertilizer Management on Growth, Yield and Quality of Onion (*Allium cepa* L.) Under Lucknow Conditions**” was conducted at the Horticultural Research Farm of the Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, (A Central University), Vidya-Vihar, Rae Bareli Road, Lucknow, Uttar Pradesh during the year 2015-16 and 2016-17.

This chapter deals with the details of the materials used, experimental procedure followed and techniques adopted during the entire course of the investigation. The climatic and edaphic conditions prevailing there in during the crop period have also been presented at an appropriate place with a suitable tables, plates and diagrams. The details of the methodology adopted in this investigation have been presented under the following headings.

**3.1 Experimental site:**

The present investigation was conducted at the Horticultural Research Farm of the Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, (A Central University), Vidya-Vihar, Rae Bareli Road, Lucknow, Uttar Pradesh. The location of the farm is situated in main campus of the university.

**3.2 Topography and climatic conditions:**

Geographically, the experimental site is situated at 80° 52' East longitude and 26° 56' North latitude and 111 meter above MSL (mean sea level). The climate of Lucknow is characterized by Sub-tropical with hot, dry summer and cool winter. The cold season from

about the end of November to the beginning of the march. The hot season prevails from April to June. The climate of region is sub tropical with maximum temp ranging from 29.3<sup>0</sup>C to 45<sup>0</sup>C in summer and the minimum temp ranging from 3.5<sup>0</sup>C to 12<sup>0</sup>C and relative humidity is 50 to 77% in different seasons of the year hot dry summer and cold winter. This region received an averages annual rainfall of 750mm, which is distributed over a period of more than 100 days with peak period during last week of June to September It also received scattered showers during winter months. In general, the temperature ranges from 5.5 to 40<sup>0</sup>C. The coldest month of the year is January, while the maximum temp recorded during the mo0nth of May and June, respectively. The weather parameters which prevailed during the course of investigation were recorded at the Meteorological Observatory of the Indian Institute of Sugarcane Research (IISR), Lucknow.

### **3.3 Meteorological Observations:**

Data recorded during the period of the study from Indian Institute of Sugarcane Research (IISR), Lucknow, (UP). Observations are presented in table- 3.1 In order to get an idea about the climatic conditions that prevailed during the period of investigation, the data on weather parameters were obtained from the meteorological observatory situated at Indian Institute of Sugarcane Research (IISR), Lucknow.

**Table 3.1: Average weekly meteorological data during crop season 2015-16 and 2016-17 at Lucknow (U.P.)**

Month	Met. week	Temperature				Relative humidity		Total rainfall(mm)		Sunshine(hours/day)	
		Min.		Max.		15-16	16-17	15-16	16-17	15-16	16-17
		15-16	16-17	15-16	16-17						
Oct.	40	23.4	22.5	31.6	33.5	93	92	11.9	0.00	3.0	3.0
	41	20.4	21.6	32.5	33.6	94	93	0.8	5.60	3.6	1.6
	42	16.7	22.8	31.5	32.7	91	96	0.00	0.00	2.1	5.1
	43	11.8	17.5	30.2	31.9	85	95	0.00	0.00	2.6	4.6
Nov.	44	13.4	14.1	30.8	29.4	87	90	0.60	0.00	0.9	0.9
	45	14.8	15.6	30.1	30.2	89	89	0.00	0.00	0.0	3.0
	46	18.7	16.3	25.8	29.1	90	82	0.00	0.00	0.5	2.5
	47	9.01	14.5	25.2	24.6	84	74	0.00	0.51	0.9	0.4
	48	7.07	11.4	26.3	25.8	96	75	3.14	0.00	0.7	0.9
Dec.	49	7.07	8.9	26.2	25.1	92	90	0.00	9.20	0.9	0.1
	50	10.5	8.6	25.4	24.6	91	86	0.00	0.00	0.7	3.7
	51	8.7	6.4	24.2	23.4	86	75	0.00	0.00	1.9	4.9
	52	5.8	8.9	21.5	24.7	84	71	0.00	0.00	2.7	6.7
Jan.	1	8.2	6.8	15.7	14.6	94	65	9.60	0.00	3.1	7.1
	2	7.6	3.1	15.2	15.4	98	68	0.00	0.00	0.0	2.0
	3	8.8	6.0	16.1	21.2	93	69	3.20	0.00	0.0	3.0
	4	6.3	8.9	18.2	24.1	92	62	0.00	0.00	3.4	3.4
Feb.	5	8.5	7.9	25.6	23.4	90	76	0.00	0.00	3.5	3.5
	6	11.5	9.5	25.3	26.6	76	72	1.20	8.65	5.4	0.4
	7	12.4	12.0	24.2	25.8	82	73	0.00	5.21	2.0	0.0
	8	11.6	9.3	26.6	24.2	76	68	0.00	0.00	3.0	3.0
Mar.	9	15.4	12.1	30.2	27.1	70	92	0.00	0.00	4.1	4.1
	10	14.9	14.4	30.5	29.6	69	92	0.00	0.00	0.0	2.0
	11	14.7	14.6	32.8	31.4	62	96	0.00	0.00	5.3	5.3
	12	18.6	16.1	36.8	34.8	68	86	4.02	3.00	1.3	0.3
	13	20.2	18.1	38.7	33.7	63	80	0.00	0.00	3.3	3.3
Apr.	14	19.6	17.1	39.4	35.6	74	87	0.00	5.01	2.6	0.6
	15	22.3	19.8	41.7	36.1	78	83	0.00	0.00	0.0	2.0
	16	24.8	20.5	42.0	37.6	72	84	0.00	0.00	5.9	5.9
	17	25.0	19.0	40.4	36.7	79	69	3.60	0.00	8.4	8.4
May.	18	24.7	24.6	37.5	39.3	84	68	0.00	6.89	0.0	0.0
	19	25.0	23.9	38.6	40.2	93	62	0.00	2.32	0.0	0.0
	20	26.8	25.9	39.5	39.4	98	74	0.00	0.00	5.6	5.6
	21	25.9	23.6	38.1	37.3	69	79	5.14	2.14	1.0	1.0
	22	24.1	23.8	37.5	36.0	62	72	0.00	0.25	0.3	0.7

The experimental plot was irrigated at regular intervals depending on the moisture condition of the soil. Generally, weather conditions were quite favorable for the growth of the onion crop.

### 3.4. Soil status of experimental area:

The soil of experimental field is sandy loam and slightly alkaline in nature with the soil pH 8.3. The physical properties of soil are presented in Table 3.2 and chemical properties of soil are presented Table 3.3.

**Table 3.2 Physical properties of soil**

Sl.N	Soil status	Percentage	Method of determination
1	Sand	34.50	Hydrometer methods (Block, 1965)
2	Silt	50.20	
3	Clay	15.30	
4	Texture class	Sandy loam	Triangular method (Sigmoid,1928)

**Table 3.3 Chemical properties of soil**

Sl.N	Components	Amounts	Methods determination
1	Available N <sub>2</sub> (kg/ha)	110.50	Kjeldahl's method (A.O.A.C.,1980)
2	Available P <sub>2</sub> O <sub>5</sub> (kg/ha)	40.50	Olsen's method (Jackson,1983)
3	Available K <sub>2</sub> O (kg/ha)	190.40	Flame photometer (Jackson,1983)
4	Organic carbon (%)	0.12	Rapid titration method (Jackson,1983)
5	pH	8.6	Glass electrode, pH meter (Jackson,1983)
6	E.C (1:1)	0.26	Conductivity meter (Jackson,1983)
7	E.S.P	14.80	Conductivity meter (Jackson,1983)

### **3.5 Experimental material:**

For present experiment a promising variety of onion namely Pusa Red was under taken. Seed of this variety was collected from Indian Agricultural Research Institute, Pusa New Delhi. The main characteristic of Pusa Red is described here under.

**Pusa Red :** Released from IARI, New Delhi Bulb medium in size, average weight 70-90 g, bronze red in colour, flat to globular shaped and less pungent. Keeping quality is good. Plants mature in 140-145 days after transplanting. TSS is about 12 -13%. Average yield is 25 t/ha. It can be grown both in late Kharif and Rabi season in Maharashtra, suitable for export purpose.

### **3.6 Preparation of nursery beds and sowing of seeds:**

For raising of a nursery, sandy loam soil was used. Before sowing the seeds, the soil was well pulverized and prepared raised bed about 3 meter long, 1 meter width and 15 cm above the ground level was prepared. Seed were thiram @ 2.5g/kg of seed prior to sowing in the nursery bed. Treated seeds were sown in well prepared nursery beds by opening the miniature furrows. After sowing the seeds in miniature furrows, a light film of FYM was spread over them. The seeds bed was covered with paddy straw, mulches with polythene paper above the bed to protect the young seedling from adverse climate condition. After covering the seed, a light irrigation was given with the help of hazara and subsequent irrigation was also given as and where required. 60 to 65 days after sowing, seedlings were ready for transplanting.



**Plate: 1** A general view of nursery of onion crop

### **3.7 Field preparation:**

The experimental field was prepared thoroughly by ploughing, after deciding the site for the experiment. The land was lightly irrigated to have an optimum moisture condition. The field was prepared by preparatory tillage operations such as one deep ploughing and two cross harrowing to bring the soil to a fine tilth followed by planking. After leveling, the field is divided into 54 plots according to treatment and size of beds were

prepared 1.80 x1.20 m as per layout and fertilizer and herbicide were applied as per treatments. The field was kept ready for transplanting of seedlings.

### **3.8: Uprooting and transplanting of seedlings:**

Six week old, healthy, uniform, vigorous and disease free, seedling were used for transplanting. Before uprooting the seedlings, the bed was thoroughly drenched with water to facilitate the easy removal of seedlings without much injury. Transplanting was done at 15cm x 10cm spacing on the sides of ridges and furrows. At the time of transplanting upper one third portion of seedling (green top) were removed to reduce the transpiration losses and better establishment of seedlings. The entire seedling was carefully transplanted in the experimental plots where the places in the experimental plots were already marked out for the purpose of transplanting. After transplanting the seedlings a light irrigation was given.

### **3.9 Experimental layout:**

During the Rabi season the field experimental was laid down in Randomized Block Design (R.B.D.) with eighteen treatments were replicated in thrice. The details of the treatment are presented in table 3.10



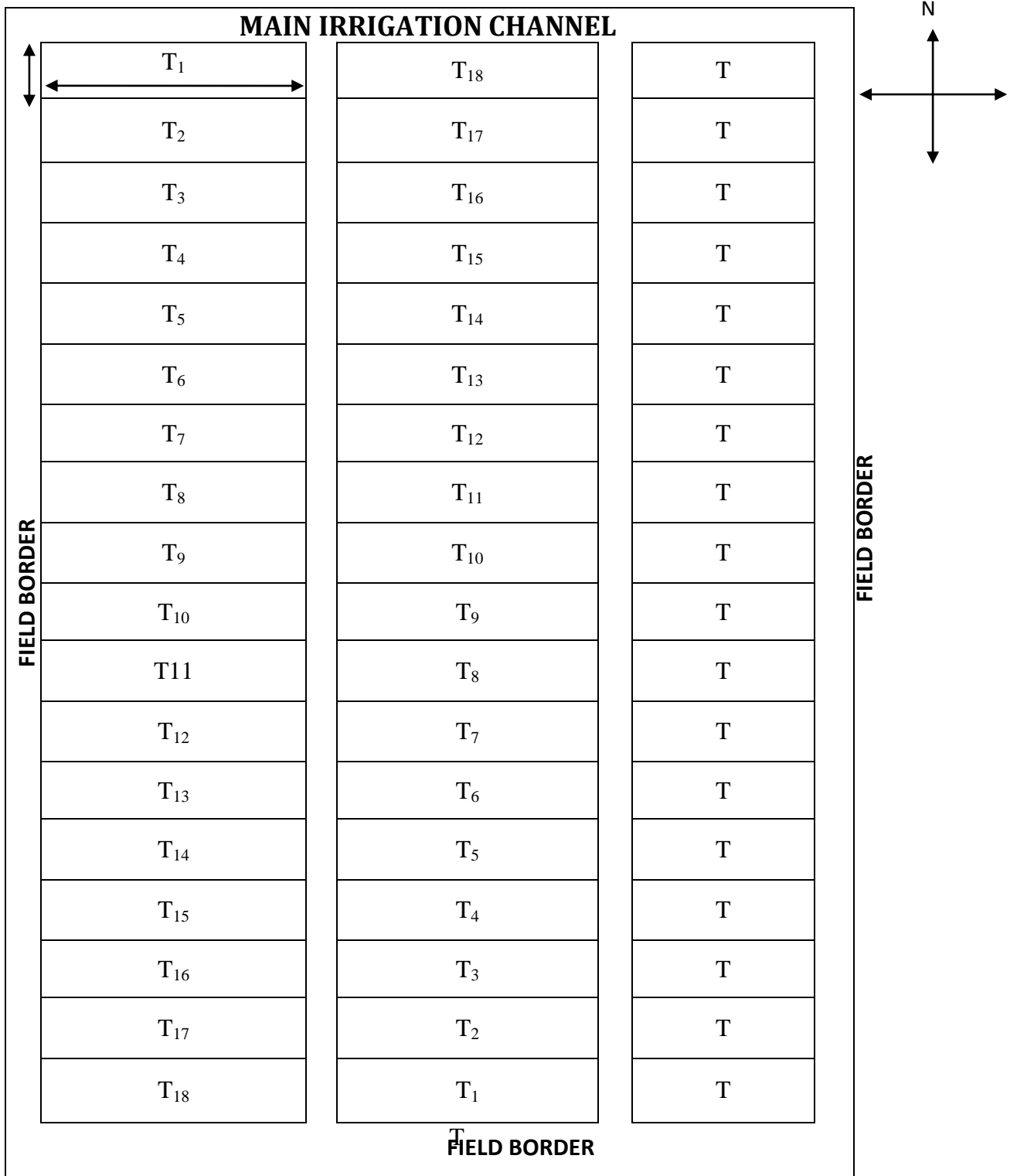
**Plate:2 A general view of field preparation and transplanting**

**3.10 Treatment combinations:**

<b>S.NO.</b>	<b>Treatment</b>	<b>Symbol used</b>
1	Pendimethalin @1.0 kg a.i/ha(PE)	T <sub>1</sub>
2	Oxyfluorfen@0.250 kg a.i/ha(POE)	T <sub>2</sub>
3	Fluazipop-p-butyl@0.250 kg a.i/ha(POE)	T <sub>3</sub>
4	Hand weeding	T <sub>4</sub>
5	Weed free	T <sub>5</sub>
6	Weedy check	T <sub>6</sub>
7	Pendimethalin+HW	T <sub>7</sub>
8	Oxyfluorfen+Weed free	T <sub>8</sub>
9	Fluazipop-p-butyl+Weed check	T <sub>9</sub>
10	Pendimethalin+75% RDF+HW	T <sub>10</sub>
11	Pendimethalin+100% RDF+HW	T <sub>11</sub>
12	Pendimethalin+125% RDF+HW	T <sub>12</sub>
13	Oxyfluorfen+75%RDF+WF	T <sub>13</sub>
14	Oxyfluorfen+100%RDF+WF	T <sub>14</sub>
15	Oxyfluorfen+125%RDF+WF	T <sub>15</sub>
16	Fluazipop-p-butyl +75%RDF+WC	T <sub>16</sub>
17	Fluazipop-p-butyl +100%RDF+WC	T <sub>17</sub>
18	Fluazipop-p-butyl +125%RDF+WC	T <sub>18</sub>

**3.11 Details of layout plan:**

<b>Crop</b>	<b>=</b>	<b>Onion</b>
<b>Cultivar</b>	<b>=</b>	<b>Pusa red</b>
<b>Design</b>	<b>=</b>	<b>RBD</b>
<b>Number of treatments</b>	<b>=</b>	<b>18</b>
<b>Replication</b>	<b>=</b>	<b>3</b>
<b>Total plots</b>	<b>=</b>	<b>54</b>
<b>Gross plot size</b>	<b>=</b>	<b>1.80 x1.20 m</b>
<b>Spacing</b>	<b>=</b>	<b>15 x10 cm</b>
<b>Plot size</b>	<b>=</b>	<b>1.5×1.0 m</b>
<b>Width of main irrigation channel</b>	<b>=</b>	<b>1.0 m</b>
<b>Width of sub- irrigation channel</b>	<b>=</b>	<b>0.50 m</b>
<b>Width of experiment border</b>	<b>=</b>	<b>0.30m</b>
<b>With of bund</b>	<b>=</b>	<b>0.30</b>
<b>Total width of experiment field</b>	<b>=</b>	<b>7.30m</b>
<b>Total length of experiment field</b>	<b>=</b>	<b>31.50m</b>
<b>Size of experiment field</b>	<b>=</b>	<b>31.50× 7.30m</b>
<b>Gross cultivated area of experiment</b>	<b>=</b>	<b>229.95m<sup>2</sup></b>
<b>Planting time</b>	<b>=</b>	<b>December</b>



### 3.12 Cultural practices:

The cultural practices i.e. irrigation, weeding, hoeing, application of herbicide etc. was done according to requirement of experimental crop.

### 3.13: Source of Irrigation:

The experimental area was irrigated with the help of hosepipe as and when required. Just after transplanting very light irrigation was given. There after the field is regularly irrigated at interval about 10-15 days. All the irrigation is very light. The irrigation is ceased 15 days before harvesting.

### 3.14 Plant protection:

To control the pest and disease, necessary plant protection measures were take up as per the recommended package of practices for the trail crop.

### 3.15 Fertilizer application:

FYM @ 20 t ha<sup>-1</sup> applied at the time of preparatory tillage operation. The basal dose of 50 kg N, 50 kg P<sub>2</sub>O<sub>5</sub> and 50 kg K<sub>2</sub>O ha<sup>-1</sup> was applied on the sides of ridges in the row lines where seedlings were transplanted through urea, single super phosphate and murate of potash, respectively. The left over half dose of nitrogen @50 kg ha<sup>-1</sup> was top dressed through urea at 25 DAT.

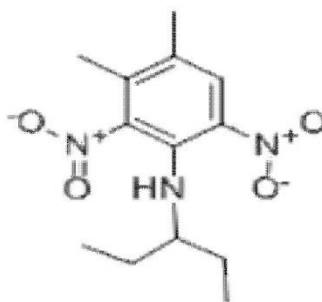
### 3.16 Herbicides application:

The required quantities of all the herbicides mentioned in the treatments were worked out as per concentrations given in the treatments and dissolved in required quantity of

water @500 l ha<sup>-1</sup> the prepared solution were sprayed with the help of a knap-sack sprayer separately. Pre- planting herbicide, pendimethalin 30 EC@1.0kg a.i ha<sup>-1</sup> were sprayed three day after transplanting and different dose of herbicide were sprayed in the post emergence treatment at 20 and 45 DAT.

### 3.17 Pendimethalin (Stomp<sup>®</sup>):

#### Structural formula



#### Nomenclature

Chemical name: [N-(1-ethylpropyl)-3, 4-dimethyl 1,2, 6 dinitrobenzenamine]

Common name: Pendimethalin 30EC

Trade name : Stomp

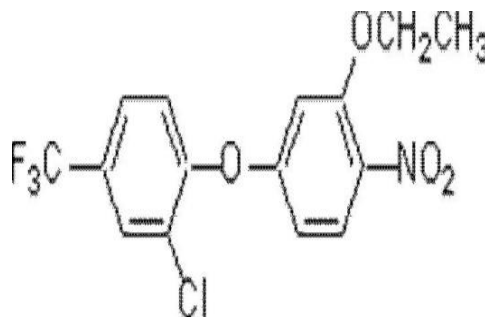
#### Mode of action:

Stomp disrupts cell division and cell elongation in shoot and root meristems of susceptible plants. Germination of plants is unaffected by the herbicide; growth inhibition and subsequent death occur following germination of the seed or shortly after emergence from the soil. The primary site of action of stomp is the growing points of a plant. Because stomp does not translocate a great deal from the site of uptake, it is necessary for the emerging seedling to absorb pendimethalin from the soil (i.e. following pre-plant incorporated or pre-emergence applications). An alternative for pendimethalin to be applied directly

to the meristematic region of the plant. Differential susceptibility is caused by differences in germination depth and exposure of growing points to direct applications.

### 3.18 Oxyfluorfen:

#### Structural formula



#### Nomenclature

Chemical name: 2-chloro-4-(trifluoromethyl)phenyl-3-oxy-4-nitrophenol ether.

Common name: Oxyfluorfen 23.5 EC

Trade name: Oxygold®, Goal®.

#### Mode of action:

The herbicide has both foliar and soil activity. It mostly controls broadleaves. Oxyfluorfen is used pre-emergence for Cole crops and post-emergence for mint, onions and conifer nurseries. This herbicide group is relatively unaffected by soil texture and organic matter. It is commonly applied as pre-emergence to control germinating annual weeds.

### 3.19 Fluazipop-p-butyl:

**Formula**  $C_{19}H_{20}F_3NO_4$

Chemical name: FLUAZIFOP-P-BUTYL

**Mode of action:**

Selective post-emergence control of annual and perennial grass weeds in certain crops. Systemic herbicide, absorbed from the leaf surface, with translocation throughout the plant, moving in both the xylem and phloem, and accumulating in the meristematic tissue.

**3.20 Method of application of herbicides:** The required amount of herbicides for the experimentation was calculated by using the following formula

$$\text{Required chemical} = \frac{\text{a.i. /ha} \times 100}{\text{EC\%}}$$

Where,

a.i. = active ingredient

Ha = hectare

EC = Emulsifiable concentration

**3.21 Gap filling:** The gap filling was done at 10 days after transplanting.

**3.22 Irrigation:**

First irrigation was given at the time of transplanting and the second irrigation was given 6 DAT for better establishment of the crop. Thereafter, irrigation was given as and when essential. Total nine irrigations were given during the crop growth period.

### 3.23 Harvesting:

After appropriate maturity of the crop, harvesting was carried out by uprooting the bulbs manually and bulbs were separated and cleaned by removing roots and dried leaves.

### 3.24 Observation recorded:

In the field trial, it is rather difficult to record the observation in each plant. Since, all the plant have equal opportunity for their growth and development. Hence, a technique of random sampling was adopted for recorded observations on various growth and yield attribute during the course of investigation. A ample of five plants from ach plot was assigned to record the observation. All the five plant were tagged randomly for recording the data.

#### A- Growth Attributes

- Height of plant (cm)
- No of leave//plant
- Neck thickness(cm)
- No of days required for bulb formation
- No of days taken to maturity

#### B- Weed parameter

- Weed density(no./m)<sup>2</sup>
- Weed control efficiency (%)
- Dry weight of weeds(g/m<sup>2</sup>)

**C- Yield and Yield attributing traits**

- Bulb weight (gm).
- Bulb diameter(cm)
- Bulb shape
- Bulb colour
- No of scales/bulb
- Bulb yield/plot(kg)

**D- Quality traits (Chemical aspect)**

- Calcium (mg/100g)
- Phosphorus ( mg/100g)
- Sulphur(mg/100g)
- Total soluble solid (<sup>0</sup>B)
- Ascorbic acid(Vitamin C)
- Reducing sugars %
- Non reducing sugars %
- Total sugars %

**E- Economics**

- Cost of cultivation.
- Gross income.
- Net return.
- B: C ratio.

The observations were recorded under the following heads:

**A- Growth Attributes**

- **Height of plant (cm):** The height of tagged plant was measured with help of digital Vernier callipers in cm at 30 days interval as the vertical distance between ground

level and highest growing tip of plants and the average height of these plants were computed and mean values were worked out and reported finally.

- **No of leave//plant :** Total number of leaves of each tagged and selected plants under various treatment was recorded at 30, 60 and 90 DAT and the average was calculated for further statistical analysis and reporting .
- **Neck thickness (cm):** The thickness was recorded at 30, 60 and 90 DAT. the thickness of neck each of the five bulbs was measured with the help of digital Vernier callipers and the mean thickness were considered as neck thickness of the bulb.
- **No of days required for bulb formation:** Bulb formation of randomly selected plants was carefully recoded. The crop was kept under regular visual observation from 60 days up to 90 days from the time of transplanting for recording days taken for bulb formation.
- **No of days taken to maturity:** The stage of maturity was determined on randomly selected plants from each plot and observation were taken very carefully. The maturity of bulb under different treatments was differed and necessary records were maintained. It was worked out in days after transplanting till the fifty per cent neck fall were recorded as number of days required for maturing the bulbs.

**B- Weed parameter**

**Sampling methods:** The weeds are sampled by list count quadrat method as per **Mishra et al., (1986)** at 30, 60, and 90 days after transplanting. The size of quadrat was 1.0 square meter (1.0 x 1.0m). One quadrat was randomly thrown in each plot and the occurring weed species and their number were recorded.

**Weed Composition:****Table 3.4 Weeds observed in the experiment control plot:**

S.No	English Name	Botanical Name	Family
1	Congress grass/wild carrot	<i>Parthenium hysterophorus L.</i>	Asteraceae
2	Burmuda grass	<i>Cynodon dactylon L.</i>	Poaceae
3	Nut sedge	<i>Cyperus rotundus L.</i>	Cyperaceae
4	Black night shade	<i>Solanum nigrum L.</i>	Solanaceae
5	Kharbathua/Nettle leaf	<i>Chenopodium murale L.</i>	Chenopodiaceae
6	Lamb sqarters	<i>Chenopodium album L.</i>	Chenopodiaceae
7	Satyanashi	<i>Argemone maxicana L.</i>	Papaveraceae
8	Morning glory	<i>Convolvulus arvensis L.</i>	Convolvulaceae
9	Chhoti lunea	<i>Portulaca oleracea L.</i>	Portulacaceae
10	Goat weed	<i>Agoratum conyzoides L.</i>	Compositae
11	Kakai	<i>Abutilon spp. L.</i>	Malvaceae

- **Weed flora:** The major weed species observed during the course of investigation in the experimental plot including dicot weeds and monocot weeds were recorded periodically.
- **Weed count:** The number of weeds present in 1 m<sup>2</sup> area of each net plot selected at random. Were counted at 30, 60, 90 DAT and at harvest. They were further classified into monocot and dicot weeds.
- **Species wise weed population:** A quadrant (1m x 1m) was randomly fixed at two places in each net plot and the weeds were counted separately according to species in the quadrant and recorded at 30, 60 and 90 DAT and at harvest.
- **Relative weed density (No. /m<sup>2</sup>) monocot weeds:** Weed density of monocot weeds are observed at 30, 60 and 90 days regularly.

$$\text{RWD (monocot)} = \frac{\text{Number of monocot weeds}}{\text{Total number of weed}} \times 100$$

**Weed density (no. /m<sup>2</sup>) dicot weeds:** Weed density of dicot weeds are observed at 30, 60 and 90 days regularly.

$$\text{RWD (dicot)} = \frac{\text{Number of dicot weeds}}{\text{Total number of weeds}} \times 100$$

- **Species wise relative weed density:** species wise relative weed density was calculated by the formula.

$$\text{SRWD} = \frac{\text{Number of weeds of species}}{\text{Total number of weed}} \times 100$$

- **Fresh weight of weed (g/m<sup>2</sup>) monocot weeds:** Fresh weight of weeds of monocot was measured after removing the field.
- **Fresh weight of weed (g/m<sup>2</sup>) dicot weeds:** Fresh weight of weeds of dicot was measured after removing the field.
- **Dry weight of weed (g/m<sup>2</sup>):** Dry weight of weeds are measured the removing the weeds in field plot. The weeds present inside the quadrat were uprooted and sun dried, after sun drying weeds were dried in the oven dried at 65<sup>0</sup> C till they attained a constant weight. Weeds brittle and free from moisture and then weighted. The weights were recorded separately as per treatment.

**Weed control efficiency (%):** Weed population was counted before harvesting in each treatment and weed Control efficiency was calculated by the formula as suggested by suggested by **Gomez and Gomez (1984)**. Weed control efficiency by **Gill and Kumar (1969)** were calculated as per the standard method

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

Where

WCE - Weed control efficiency%

DMC- Weed dry matter in control plot

DMT- Weed dry matter in treatment plot

### C- Yield and Yield attributing traits

- **Bulb weight (gm):** The weight of randomly selected bulbs was taken and average bulbs weight was calculated in gram with the help of weighing balance.

- **Bulb Diameter (cm):** The diameter of randomly selected bulbs was measured with the help of Digital Vernier Calipers.
- **Number of Scales:** The sampled onion bulb was cut horizontally with the help of sharp knife and the numbers of rings were counted.
- **Bulb colour:** The colour of onion bulb was determined on the basis of visual observation.
- **Bulb shape:** The shape of onion bulb was determined on the basis of visual observation.
- **No of scales/bulb:** Total number of scales of each tagged and selected plants under various treatments was recorded and the average was calculated for further statistical analysis and reporting.
- **Bulb yield/plot (kg):** The bulbs were harvested at proper stage and the total yield of each treatment was recorded. For determining the yield data on hectare basis the yield of each plot was converted into quintals per4 hectare.

#### **D- Quality traits (Chemical aspect)**

- **Calcium (mg/100g):** Pipette an aliquot (20 to 100ml) of ash solution obtained by dry ashing to 250ml beaker. Add 25 to 50ml of water, if necessary. At 10 ml of saturated ammonium oxalate solution and 2 drop methyl red indicator. Make the solution slightly alkaline by the addition of dilute ammonia and then slightly acid with a few drop of acetic acid until the colour is faint pink (pH 5.0). Heat the solution to boiling point. Filter through whatman no. 42 paper and wash with water, till the filtrate

is oxalate free. Break the point of the filter paper with platinum wire or pointed glass rod. Wash the precipitate first using hot dilute  $\text{H}_2\text{SO}_4$  (1+4), from wash bottle into the beaker in which the calcium was precipitated. Then wash with hot water and titrate while still hot, (temperature 70 to 80 °C) with 0.01 N  $\text{KMNO}_4$  to the first permanent pink colour. Finally, add filter paper to solution and complete the titration. Values were commutated using the following formula:

$$\text{Calcium (mg/100g)} = \frac{\text{Titre} \times 0.2 \times \text{total volume of ash solution} \times 100}{\text{Volume taken for estimation} \times \text{wt. of sample taken for ashing}}$$

- **Phosphorus (mg/100g):** To 5 ml of ash solution obtained by dry ashing, add 5 ml of molybdate reagent and mix. Add 2 ml of aminonaphthol sulphonic acid solution, mix, and make up the volume to 50 ml. prepare similarly blank using water in place of sample. Allow to stand for 10 minute and measure the colour at 650nm setting the blank at 100% transmission.

Standard curve: Dilute 10 ml standard potassium phosphate solution to 50 ml with water (1ml= 0.02mg P). Pipette aliquots of this solution from 5 to 40 ml into 50 ml volumetric flask. Add 5 ml of molybdate reagent and mix. Then add ml of aminonaphthol sulphonic acid reagent, mix, makeup the volume of 50 ml and measure the colour as in sample. Plot concentration against observance. Values were computed using the following formula.

$$\text{Phosphorus (mg/100g)} = \frac{\text{mg of P in the aliquot of ash solution taken} \times \text{Total volume of ash solution} \times 100}{\text{ml of ash solution taken for estimation} \times \text{wt. of sample taken for Ashing}}$$

**Total soluble solid (<sup>0</sup>B):** The T. S. S. of onion bulbs was measured with the help of digital hand Refractometer (0-32<sup>0</sup>Brix, Erma Japan). The juice was extracted by crushing the scales of onion bulb with the help of mortar and pestle. The Refractometer wiped clear with a moist muslin cloth. The Refractometer was set at zero .After that a drop of juice of crushed pulp was taken on refractometer and the value was against light. Value thus, obtained were expressed in percentage (**Ranganna, 1991**).

**Ascorbic acid (Vitamin C):** Ascorbic acid was determined by the usually using titration method using 2, 6-Dichlorophenol indophenols solution, as described by **Ranganna(1991)**. Ten gram sample was made up to 100 ml with 3% Meta phosphoric acid and filtered. Ten gram of aliquot was titrated against dye (2, 6-Dichlorophenol indophenols) to obtain a pink colour which persisted for at least 15 seconds. Ascorbic acid content was calculated using following formula.

$$\text{Ascorbic acid (mg/100g)} = \frac{\text{Titre} \times \text{Dye factor} \times \text{volume made up} \times 100}{\text{Volume of extract} \times \text{weight or volume of sample taken for estimation}}$$

- **Reducing sugar %:** Ten ml of Fehling's solution was taken in a beaker .The burette was filled with sugar solution. The contents of the beaker were mixed and heated to boiling for 2 minutes. Without removing from the heater added 3 drops of methylene

blue solution taking care not to touch the sides of beaker. Titration was completed within one minute until brick red colour was obtained at end point. Formula for computing reducing sugar

$$\text{Reducing sugar\%} = \frac{\text{Factor x Dilution}}{\text{Titre X weight or volume of sample}} \times 100$$

- **Non reducing sugar %:** Non Reducing sugar was obtained by subtraction of reducing from total sugar. Non reducing sugar = (total sugars –reducing sugar) X 0.95
- **Total sugars %:** The total sugars percentage was determined by the method using Fehling solution A and B .To 100 ml of clarified sugar solution in a 250 ml conical flask added 5 ml of HCL (Hydrochloric acid) and 50 ml distilled water and keep 24 hrs to complete inversion of sugars. This solution was neutralized with 1N NaOH and final volume was made up to 250 ml. Sample was titrated against pre standardized mixed Fehling solution as followed in the estimation of reducing sugars. Values were computed using the following formula.

$$\text{Total sugars\%} = \frac{\text{Factor x Dilution}}{\text{Titre X weight or volume of sample}} \times 100$$

**E- Economics studies:** As per existing market prices, input and output costs were computed treatment wise and different economic parameters, net return and cost benefit ratio were calculated.

- **Cost of cultivation:** The cost of cultivation (Rs. per hectare) of onion crop was calculated including treatment cost on the basis of local market price of different inputs used in cultivation.
- **Gross income:** The monetary value of onion bulb yield was computed in rupees by using local market price. Gross income (Rs. per hectare) was obtained by adding monetary value of onion bulb. Gross income (Rs. per hectare) = Pod yield (q per hectare) x price (Rs per quintal).
- **Net return:** The net return (Rs. per hectare) of each treatment was calculated by deducting the cost of cultivation from the respective gross income of individual treatment.

Net return = Gross income (Rs) - cost of cultivation (Rs)

**Cost: Benefit ratio:** The cost benefit ratio (C: B ratio) was worked out by dividing the net return of a treatment by the expenditure incurred. Cost: Benefit ratio for each treatment was calculated by using the formula.

$$\text{Cost: Benefit ratio} = \frac{\text{Net return obtained (Rs/ha)}}{\text{Expenditure incurred}}$$

**Statistical analysis:** The data recorded during the course of investigation were subjected to statistical analysis by “Analysis of Variance” (ANOVA) technique (Fisher, 1958) for drawing conclusions.

**Analysis of variance:** The data collected on various characters were analyzed by using randomized block design. The Analysis of Variance (ANOVA) was given as below.

**“ANOVA TABLE”**

Sources of variation	D.F.	S.S	M.S.S	F.tab	F.cal
Replication	r-1	s.s.r	M.s.r	-	-
Treatments	t-1	s.s.t	M.s.t	-	-
Error	(r-1) x (t-1)	s.s.e	M.s.e	-	-
Total	Rt-1				

The standard error SEM (+ or -) for the difference of treatment means were computed as follows

$$\text{SEM } (\pm) = \sqrt{\text{MSE}/r}$$

Where,

MSE= Mean sum of square due to error

r = number of replication

**Critical Difference:** The calculation of C.D. at 0.5% at table values will be carried out with help of following formula.  $\text{C.D.} = \text{SEM } (\pm) \times \sqrt{2} \times t \text{ error d.f.}$

Where,

CD = critical difference at 5% level of probability

SEM ( $\pm$ ) = Standard error of mean

*Experimental*

*Findings*

## CHAPTER-IV

## EXPERIMENTAL FINDINGS

In this chapter, the experimental findings obtained during the investigation entitled “**Studies on Weed and Fertilizer Management on Growth, Yield and Quality of Onion (*Allium cepa* L.) Under Lucknow Conditions**“ carried out during Rabi season of the year 2015-16 and 2016-17. at Horticulture Research Farm, Department of Applied Plant Science, Babasaheb Bhimrao Ambedkar University (A central University), Vidya- Vihar, Rae Bareli Road, Lucknow (U.P.), India. The field experiment was designed with 18 treatments with 3 replication and laid out in a Randomized Block Design. The experiment was conducted as per methods elaborated in the previous chapters.

#### **4.1 Vegetative Growth Character:**

##### **4.1.1 Plant height (cm) at 30 DAT**

The data gathered in connection with plant height at 30 DAT after transplanting due to influence of weed management have been displayed in table 4.1 and graphically represented in Figure 4.1 the analysis of variance of data on this attribute has been mentioned in Appendix- 1.

Critical analysis of data presented in above table revealed the expressive differences in plant height at 30 DAT due to various treatments of weed management. The maximum plant height at 30 DAT i.e. 26.29 cm and 26.62 cm were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 26.10 cm and 26.77 cm during 2015-16 and 2016-17, respectively and this improvement was

significantly highest than rest of the treatment however, lowest value i.e. 16.19 cm and 16.53 cm were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

During both the years, mean plant height was recorded noticed to be maximum 26.45 cm in the treatment T<sub>5</sub> (weed free) followed by treatment T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 26.43 and minimum 16.36 cm was reported in treatment T<sub>6</sub> i.e. (Weedy check (Control)). These results are in consistency with the conclusion of **Manjunath *et al.* (1989); Singh *et al.* (2001) and Yumnam *et al.* (2009).**

#### **4.1.2 Plant height (cm) at 60 DAT**

The data gathered in connection with plant height at 60 DAT after transplanting due to influence of weed management have been displayed in Table 4.2 and graphically represented in Figure 4.2 the analysis of variance of data on this attribute has been mentioned in Appendix- 2.

Critical analysis of data presented in above table revealed the expressive differences in plant height at 60 DAT due to various treatments of weed management.

The maximum plant height at 60 DAT i.e. 37.56 cm and 37.23 cm were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 37.06 cm and 36.73 cm during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 26.30cm and 25.98 cm were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

During both the years, mean plant height was recorded noticed to be maximum 37.39cm in the treatment T<sub>5</sub> (weed free) followed by treatment T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 36.89 and minimum 26.14 cm was reported in treatment T<sub>6</sub> i.e. (Weedy check (Control)).

### 4.1.3 Plant height (cm) at 90 DAT

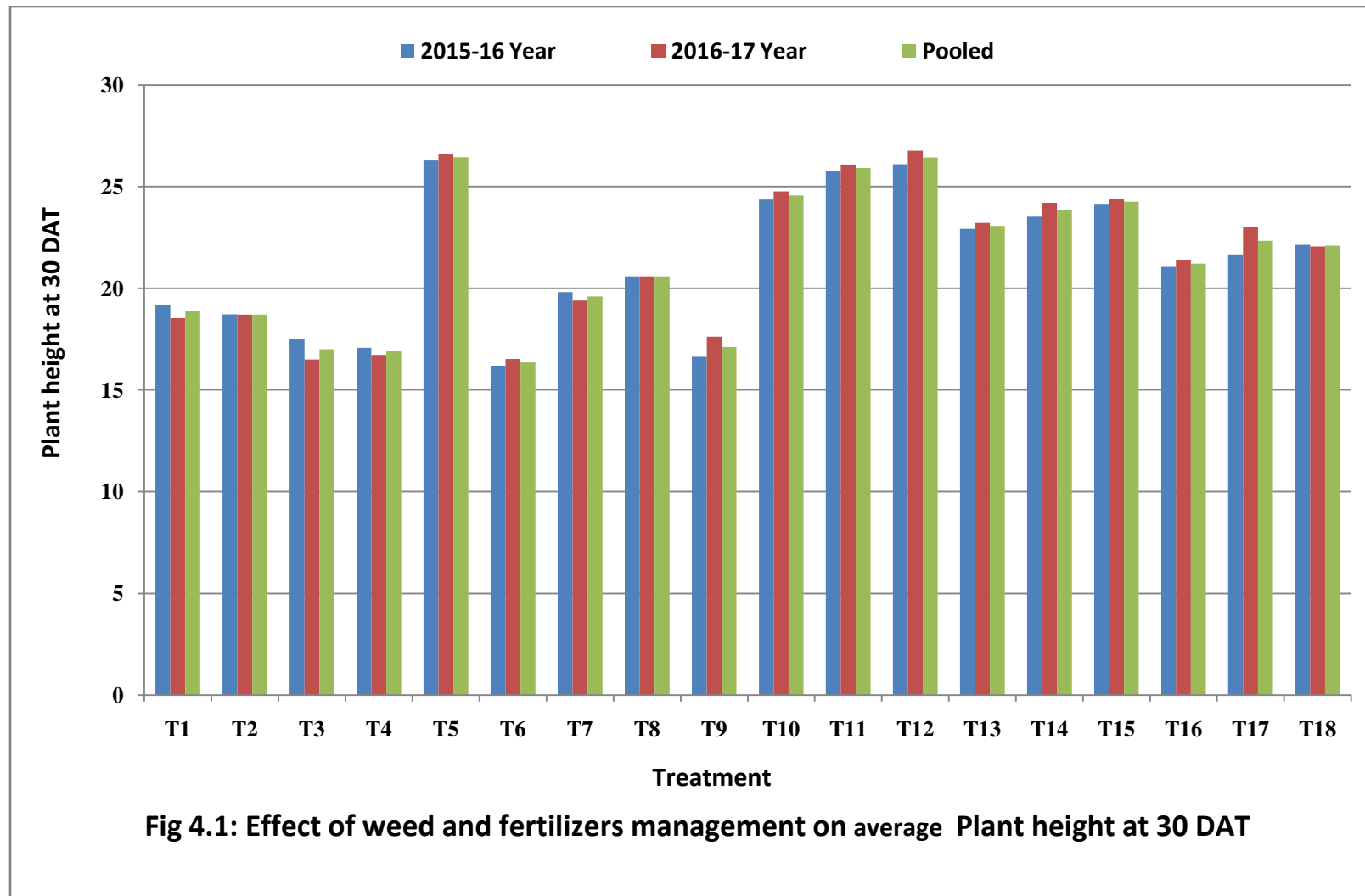
The data gathered in connection with plant height at 90 DAT after transplanting due to influence of weed management have been displayed in Table 4.3 and graphically represented in Figure 4.3 the analysis of variance of data on this attribute has been mentioned in Appendix- 3.

Critical analysis of data presented in above table revealed the expressive differences in plant height at 90 DAT due to various treatments of weed management. The maximum plant height at 90 DAT i.e. 51.43 cm and 50.44 cm were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 51.12cm and 50.12cm during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 39.84 cm and 38.84 cm were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

During both the years, mean plant height was recorded noticed to be maximum 50.93 cm in the treatment T<sub>5</sub> (weed free) followed by treatment T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 50.62 and minimum 39.34 cm was reported in treatment T<sub>6</sub> i.e. (Weedy check (Control)).

Table 4.1: Effect of weed and fertilizers management on average plant height at 30 DAT

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @ 1.0 kg a.i/ha	19.20	18.53	18.86
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	18.72	18.71	18.71
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	17.53	16.50	17.01
T <sub>4</sub>	Hand weeding at 30 DAP	17.07	16.73	16.90
T <sub>5</sub>	Weed free	26.29	26.62	26.45
T <sub>6</sub>	Weedy check (Control)	16.19	16.53	16.36
T <sub>7</sub>	Pendimethalin+HW	19.81	19.40	19.60
T <sub>8</sub>	Oxyfluorfen+Weed free	20.59	20.59	20.59
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	16.63	17.62	17.12
T <sub>10</sub>	Pendimethalin+75% RDF+HW	24.36	24.76	24.56
T <sub>11</sub>	Pendimethalin+100% RDF+HW	25.76	26.09	25.92
T <sub>12</sub>	Pendimethalin+125% RDF+HW	26.10	26.77	26.43
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	22.92	23.22	23.07
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	23.52	24.21	23.86
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	24.11	24.41	24.26
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	21.05	21.38	21.21
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	21.67	23.01	22.34
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	22.14	22.06	22.10
	<b>SE.m ±</b>	0.801	0.951	0.865
	<b>CD at 5%</b>	2.312	2.744	0.288



**Table 4.2: Effect of weed and fertilizers management on average Plant height at 60 DAT**

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @ 1.0 kg a.i/ha	30.11	29.45	29.78
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	29.86	29.53	29.69
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	28.33	28.00	28.16
T <sub>4</sub>	Hand weeding at 30 DAP	27.19	27.20	27.19
T <sub>5</sub>	Weed free	37.56	37.23	37.39
T <sub>6</sub>	Weedy check (Control)	26.30	25.98	26.14
T <sub>7</sub>	Pendimethalin+HW	30.72	30.39	30.55
T <sub>8</sub>	Oxyfluorfen+Weed free	31.69	31.36	31.52
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	26.97	26.64	26.80
T <sub>10</sub>	Pendimethalin+75% RDF+HW	35.64	35.31	35.47
T <sub>11</sub>	Pendimethalin+100% RDF+HW	36.49	35.50	35.99
T <sub>12</sub>	Pendimethalin+125% RDF+HW	37.06	36.73	36.89
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	34.50	34.18	34.34
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	34.68	34.35	34.51
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	35.05	34.72	34.88
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	32.16	31.83	31.99
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	32.81	32.48	32.64
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	33.06	32.73	32.89
	<b>SE.m ±</b>	0.973	0.982	0.300
	<b>CD at 5%</b>	2.809	2.833	0.100

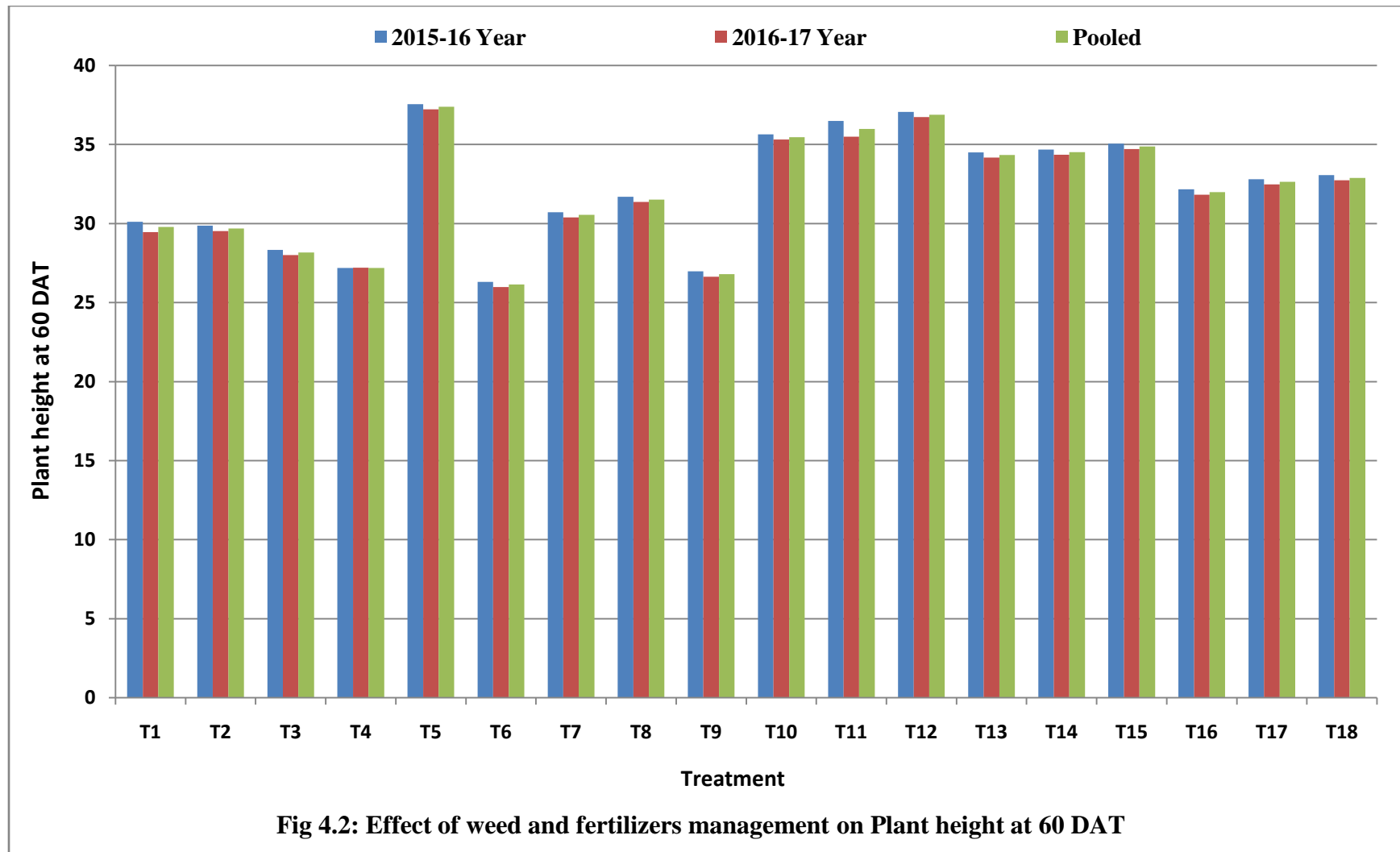
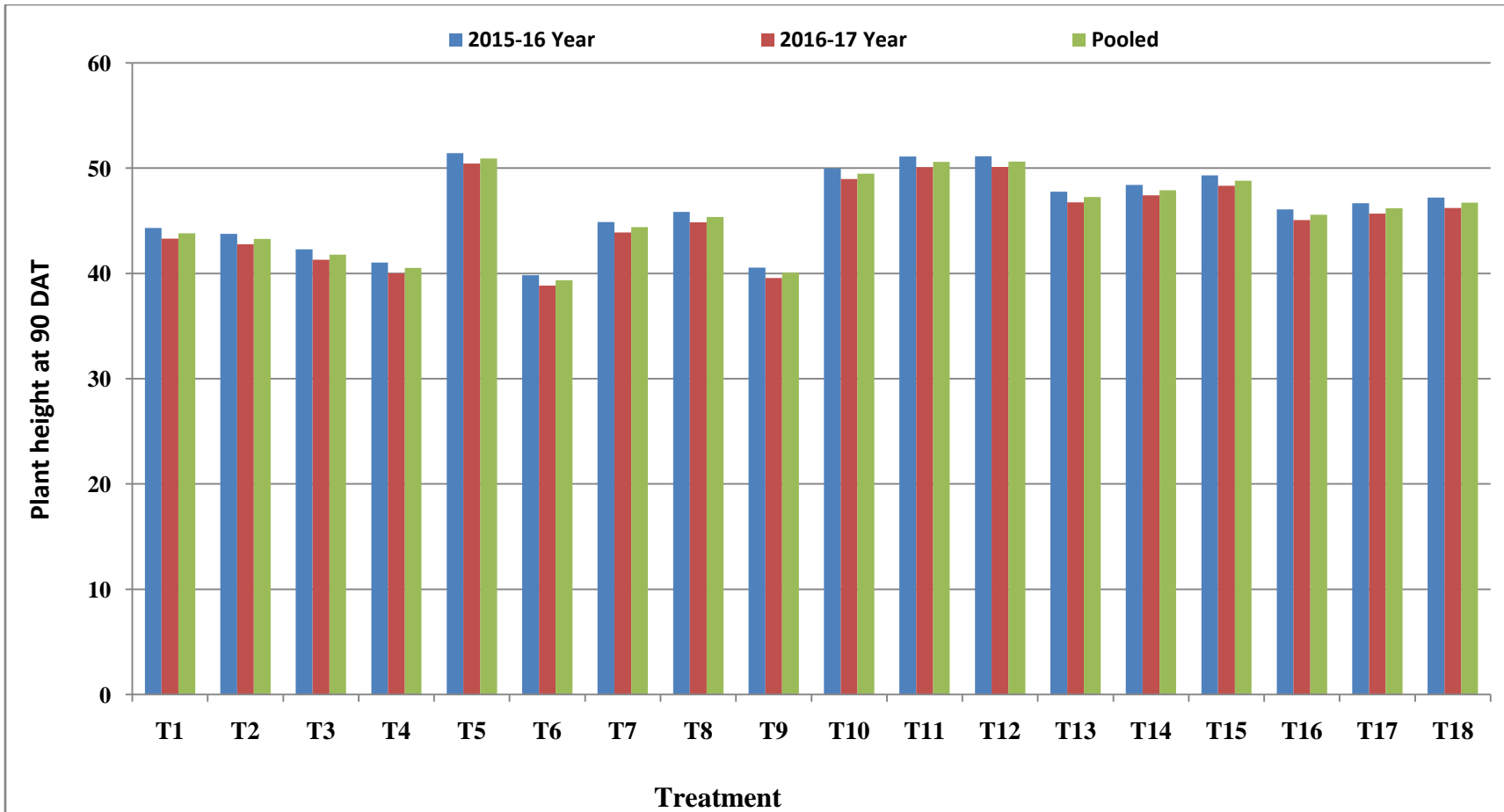


Table 4.3: Effect of weed and fertilizers management on average plant height at 90 DAT

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	44.31	43.31	43.81
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	43.77	42.77	43.27
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	42.29	41.29	41.79
T <sub>4</sub>	Hand weeding at 30 DAP	41.03	40.02	40.53
T <sub>5</sub>	Weed free	51.43	50.44	50.93
T <sub>6</sub>	Weedy check (Control)	39.84	38.84	39.34
T <sub>7</sub>	Pendimethalin+HW	44.89	43.89	44.39
T <sub>8</sub>	Oxyfluorfen+Weed free	45.85	44.85	45.35
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	40.56	39.56	40.06
T <sub>10</sub>	Pendimethalin+75% RDF+HW	49.97	48.97	49.47
T <sub>11</sub>	Pendimethalin+100% RDF+HW	51.10	50.09	50.60
T <sub>12</sub>	Pendimethalin+125% RDF+HW	51.12	50.12	50.62
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	47.76	46.76	47.26
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	48.41	47.41	47.91
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	49.32	48.32	48.82
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	46.08	45.08	45.58
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	46.68	45.68	46.18
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	47.21	46.21	46.71
	SE.m ±	0.975	0.975	0.066
	CD at 5%	2.815	2.816	0.022



**Fig 4.3: Effect of weed and fertilizers management on Plant height at 90 DAT**

### 4.2.1. Number of leaves at 30 DAT:

The data gathered in connection with number of leaves of per plant at 30, days after transplanting due to influence of weed management have been displayed in Table 4.4 and graphically represented in Figure 4.4 the analysis of variance of data on this attribute has been mentioned in Appendix- 4.

Critical analysis of data presented in above table revealed the expressive differences in number of leaves of per plant at 30, DAT due to various treatments of weed management. The maximum number of leaves of per plant at 30 DAT i.e. 2.97cm and 3.61cm were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 2.93 cm and 3.26 cm during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 2.11 cm and 2.11 cm were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

During both the years, mean number of leaves of per plant at 30 DAT was recorded noticed to be maximum 3.29 cm in the treatment T<sub>5</sub> (weed free) followed by treatment T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 3.09 and minimum 2.11 cm was reported in treatment T<sub>6</sub> i.e. (Weedy check (Control)).

### 4.2.2. Number of leaves at 60 DAT:

The data gathered in connection with number of leaves of per plant at 60, days after transplanting due to influence of weed management have been displayed in Table 4.5 and graphically represented in Figure 4.5 the analysis of variance of data on this attribute has been mentioned in Appendix- 5.

Critical analysis of data presented in above table revealed the expressive differences in number of leaves of per plant at 60, DAT due to various treatments of weed management. The maximum number of leaves of per plant at 60 DAT i.e. 5.94cm and 6.61 cm were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 5.83 cm and 6.19 cm during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 3.86 cm and 3.42 cm were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

During both the years, mean number of leaves of per plant at 60 DAT was recorded noticed to be maximum 6.27 cm in the treatment T<sub>5</sub> (weed free) followed by treatment T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 6.01 and minimum 3.64 cm was reported in treatment T<sub>6</sub> i.e. (Weedy check (Control)).



**Plate.3 A general view of vegetative growth, data recording and hand weeding**

Table 4.4: Effect of weed and fertilizers management on average number of leaves at 30 DAT

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	2.54	2.38	2.46
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	2.50	2.32	2.41
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	2.47	2.27	2.37
T <sub>4</sub>	Hand weeding at 30 DAP	2.42	2.24	2.33
T <sub>5</sub>	Weed free	2.97	3.61	3.29
T <sub>6</sub>	Weedy check (Control)	2.11	2.11	2.11
T <sub>7</sub>	Pendimethalin+HW	2.58	2.42	2.50
T <sub>8</sub>	Oxyfluorfen+Weed free	2.61	2.48	2.54
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	2.29	2.17	2.23
T <sub>10</sub>	Pendimethalin+75% RDF+HW	2.87	2.80	2.83
T <sub>11</sub>	Pendimethalin+100% RDF+HW	2.91	2.84	2.87
T <sub>12</sub>	Pendimethalin+125% RDF+HW	2.93	3.26	3.09
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	2.75	2.70	2.72
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	2.78	2.75	2.76
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	2.81	2.77	2.79
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	2.64	2.54	2.59
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	2.67	2.59	2.63
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	2.71	2.63	2.67
	<b>SE.m ±</b>	0.015	0.115	0.309
	<b>CD at 5%</b>	0.044	0.332	0.103

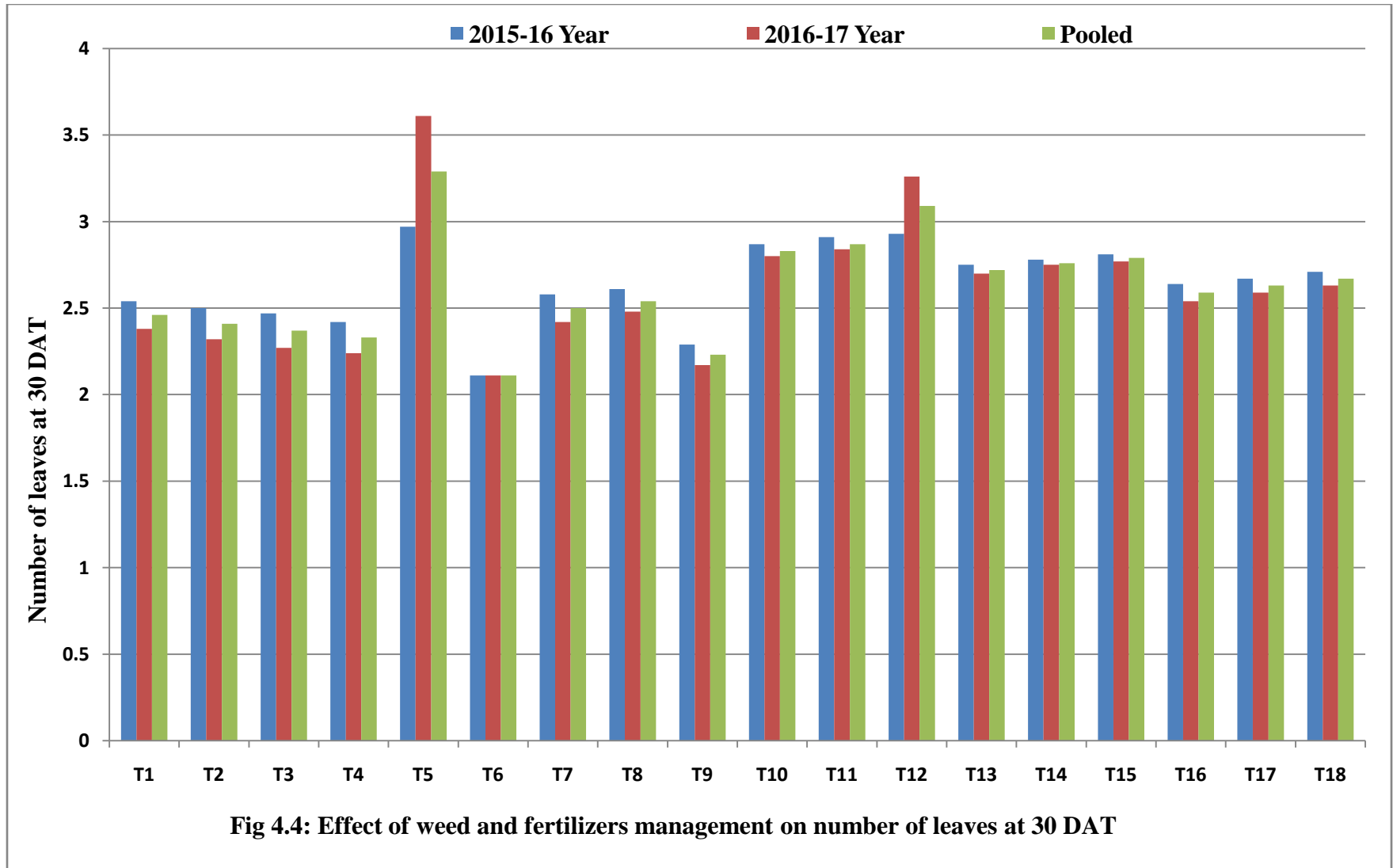
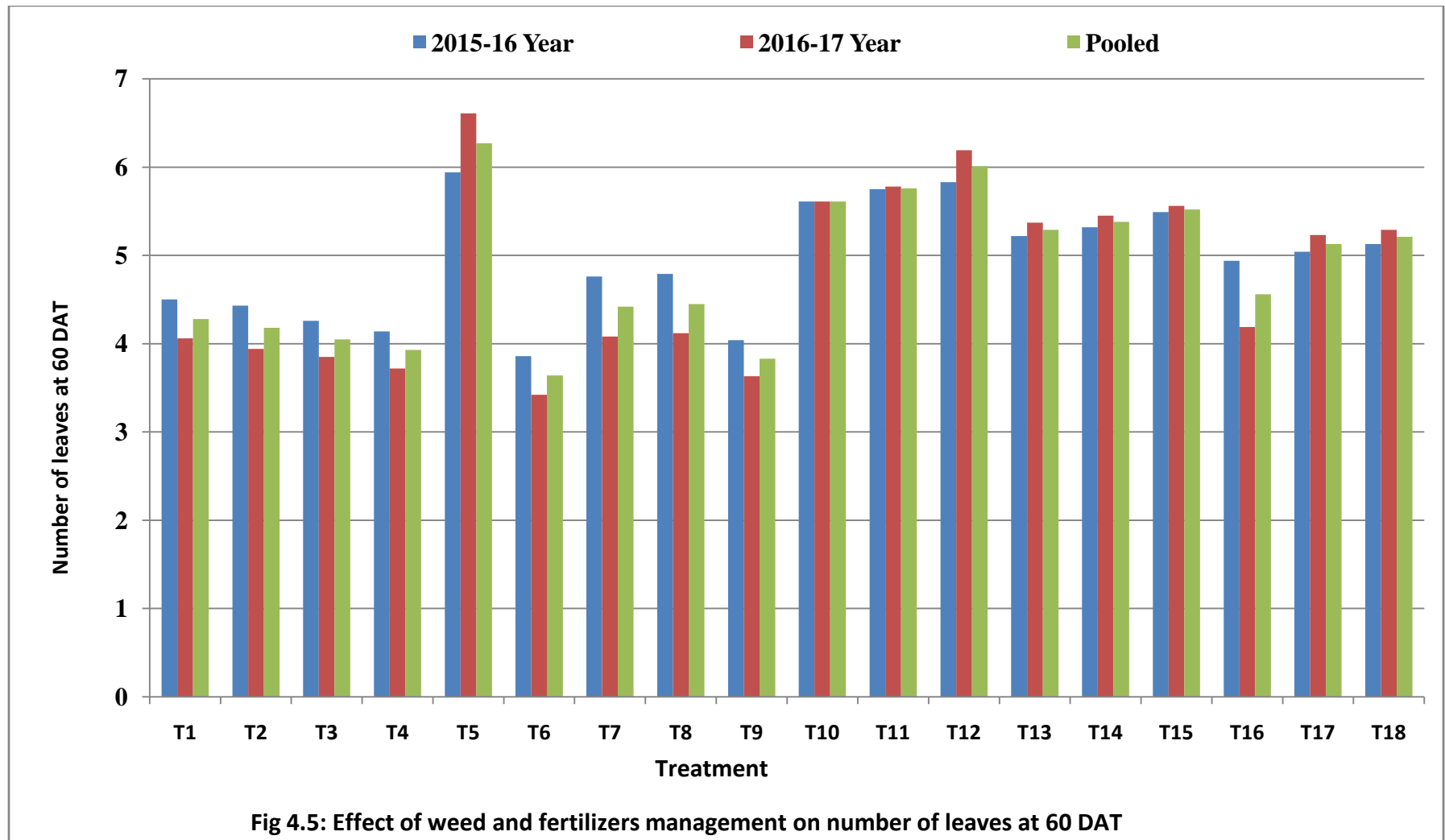


Table 4.5: Effect of weed and fertilizers management on average number of leaves at 60 DAT

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	4.50	4.06	4.28
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	4.43	3.94	4.18
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	4.26	3.85	4.05
T <sub>4</sub>	Hand weeding at 30 DAP	4.14	3.72	3.93
T <sub>5</sub>	Weed free	5.94	6.61	6.27
T <sub>6</sub>	Weedy check (Control)	3.86	3.42	3.64
T <sub>7</sub>	Pendimethalin+HW	4.76	4.08	4.42
T <sub>8</sub>	Oxyfluorfen+Weed free	4.79	4.12	4.45
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	4.04	3.63	3.83
T <sub>10</sub>	Pendimethalin+75% RDF+HW	5.61	5.61	5.61
T <sub>11</sub>	Pendimethalin+100% RDF+HW	5.75	5.78	5.76
T <sub>12</sub>	Pendimethalin+125% RDF+HW	5.83	6.19	6.01
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	5.22	5.37	5.29
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	5.32	5.45	5.38
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	5.49	5.56	5.52
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	4.94	4.19	4.56
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	5.04	5.23	5.13
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	5.13	5.29	5.21
	SE.m ±	0.047	0.109	0.614
	CD at 5%	0.136	0.315	0.204



### **4.2.3. Number of leaves at 90 DAT:**

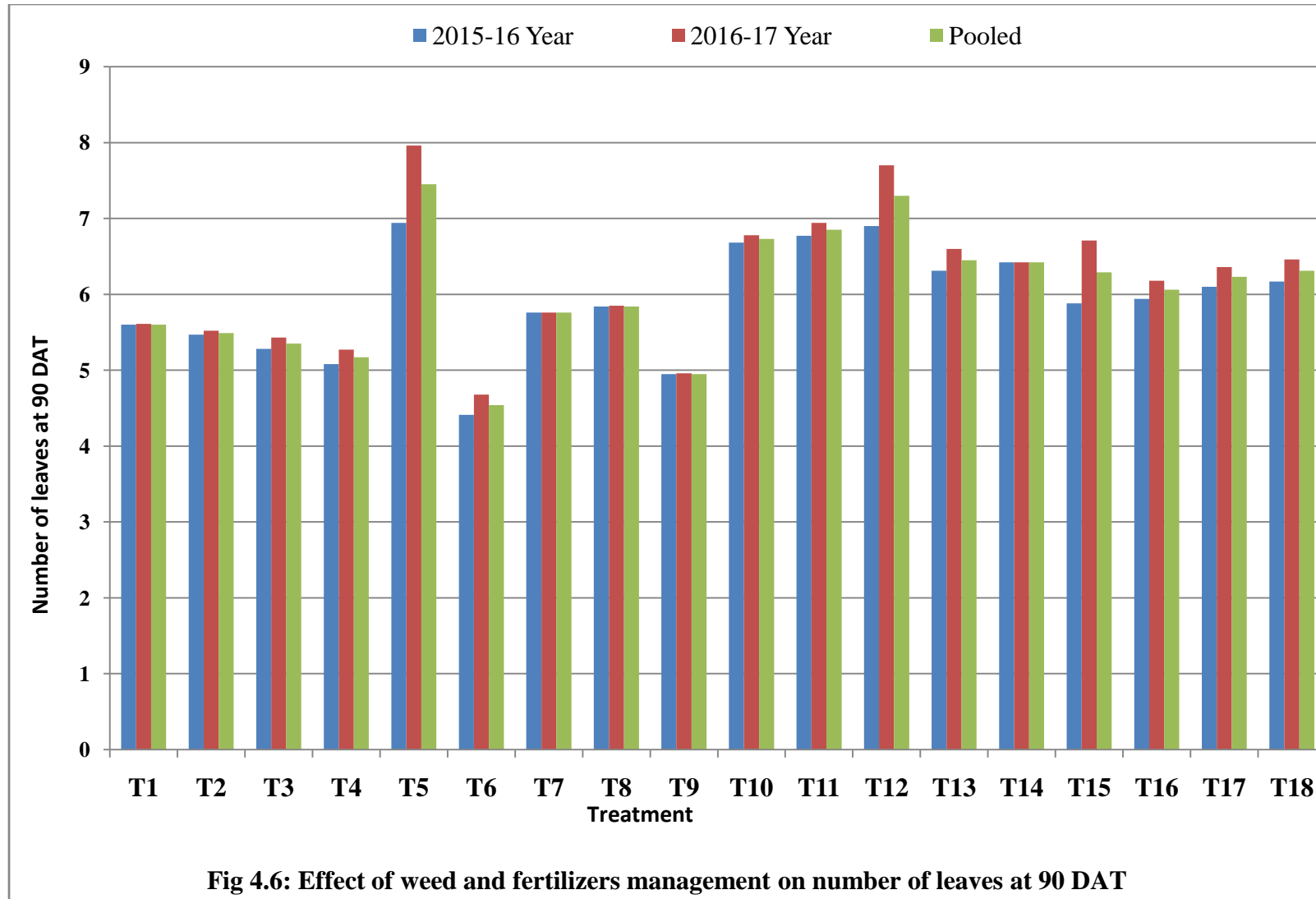
The data gathered in connection with number of leaves of per plant at 90, days after transplanting due to influence of weed management have been displayed in Table 4.6 and graphically represented in Figure 4.6 the analysis of variance of data on this attribute has been mentioned in Appendix- 6.

Critical analysis of data presented in above table revealed the expressive differences in number of leaves of per plant at 90, DAT due to various treatments of weed management. The maximum number of leaves of per plant at 90 DAT i.e. 6.94 cm and 7.96 cm were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 6.90 cm and 7.70 cm during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 4.41 cm and 4.68 cm were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

During both the years, mean number of leaves of per plant at 90 DAT was recorded noticed to be maximum 7.45 cm in the treatment T<sub>5</sub> (weed free) followed by treatment T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 7.30 cm and minimum 4.54 cm was reported in treatment T<sub>6</sub> i.e. (Weedy check (Control)).

Table 4.6: Effect of weed and fertilizers management on average number of leaves at 90 DAT

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	5.60	5.61	5.60
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	5.47	5.52	5.49
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	5.28	5.43	5.35
T <sub>4</sub>	Hand weeding at 30 DAP	5.08	5.27	5.17
T <sub>5</sub>	Weed free	6.94	7.96	7.45
T <sub>6</sub>	Weedy check (Control)	4.41	4.68	4.54
T <sub>7</sub>	Pendimethalin+HW	5.76	5.76	5.76
T <sub>8</sub>	Oxyfluorfen+Weed free	5.84	5.85	5.84
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	4.95	4.96	4.95
T <sub>10</sub>	Pendimethalin+75% RDF+HW	6.68	6.78	6.73
T <sub>11</sub>	Pendimethalin+100% RDF+HW	6.77	6.94	6.85
T <sub>12</sub>	Pendimethalin+125% RDF+HW	6.90	7.70	7.30
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	6.31	6.60	6.45
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	6.42	6.42	6.42
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	5.88	6.71	6.29
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	5.94	6.18	6.06
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	6.10	6.36	6.23
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	6.17	6.46	6.31
	SE.m ±	0.088	0.029	0.461
	CD at 5%	0.253	0.084	0.153



### **4.3. Neck thickness (cm):**

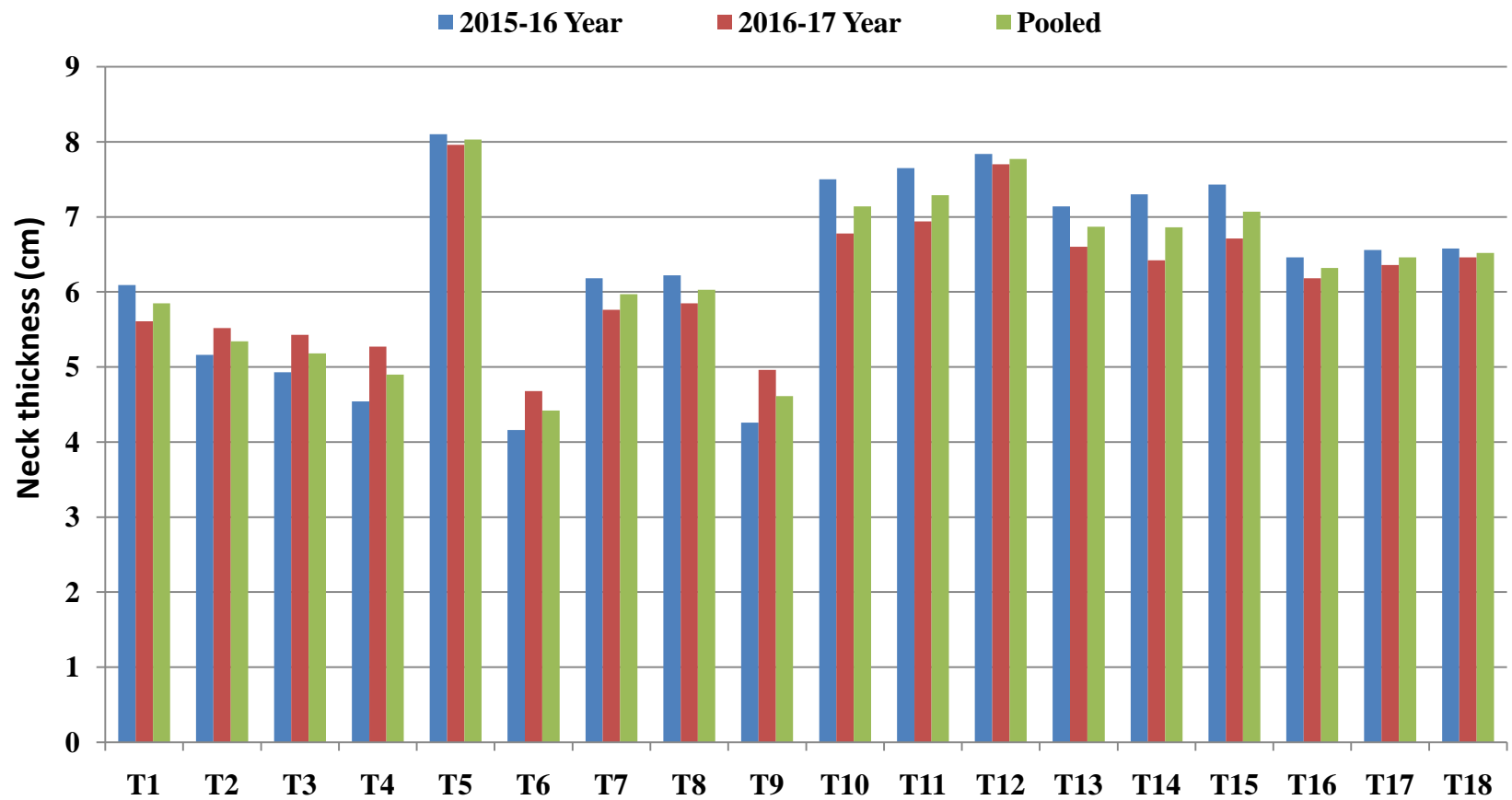
The data gathered in connection with Neck thickness at 90, days after transplanting due to influence of weed management have been displayed in Table 4.7 and graphically represented in Figure 4.7 the analysis of variance of data on this attribute has been mentioned in Appendix- 7.

Critical analysis of data presented in above Table revealed the expressive differences in Neck thickness at 90, DAT due to various treatments of weed management. The maximum Neck thickness at 90 DAT i.e. 8.10 cm and 7.96 cm were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 7.84 cm and 7.70 cm during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 4.16 cm and 4.68 cm were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

During both the years, mean Neck thickness at 90 DAT was recorded noticed to be maximum 8.03 cm in the treatment T<sub>5</sub> (weed free) followed by treatment T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 7.77 and minimum 4.42 cm was reported in treatment T<sub>6</sub> i.e. (Weedy check (Control)),

Table 4.7: Effect of weed and fertilizers management on average neck thickness (cm)

TREATMENTS	TREATMENTS COMBINATION	2015-2016	2016-2017	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	6.09	5.61	5.85
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	5.16	5.52	5.34
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	4.93	5.43	5.18
T <sub>4</sub>	Hand weeding at 30 DAP	4.54	5.27	4.90
T <sub>5</sub>	Weed free	8.10	7.96	8.03
T <sub>6</sub>	Weedy check (Control)	4.16	4.68	4.42
T <sub>7</sub>	Pendimethalin+HW	6.18	5.76	5.97
T <sub>8</sub>	Oxyfluorfen+Weed free	6.22	5.85	6.03
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	4.26	4.96	4.61
T <sub>10</sub>	Pendimethalin+75% RDF+HW	7.50	6.78	7.14
T <sub>11</sub>	Pendimethalin+100% RDF+HW	7.65	6.94	7.29
T <sub>12</sub>	Pendimethalin+125% RDF+HW	7.84	7.70	7.77
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	7.14	6.60	6.87
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	7.30	6.42	6.86
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	7.43	6.71	7.07
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	6.46	6.18	6.32
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	6.56	6.36	6.46
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	6.58	6.46	6.52
	<b>SE.m ±</b>	0.638	0.106	0.774
	<b>CD at 5%</b>	1.841	0.306	0.257



**Fig 4.7: Effect of weed and fertilizers management on neck thickness (cm)**

#### 4.4. Number of day taken to bulb formation:

Data of Table 4.8. & Figure 4.8 the analysis of variance of data on this attribute has been mentioned in Appendix- 8, showed the minimum number of day taken to bulb formation i.e. 65.15 days and 64.51 days were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 65.89 days and 65.58 days during 2015-16 and 2016-17, respectively and this improvement was significantly than rest of the treatment however, highest value i.e. 80.66 days and 80.35 days were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

During both the years, the mean value number of day taken to bulb formation was recorded noticed to be minimum 64.83 days in the treatment T<sub>5</sub> (weed free) followed by treatment T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 65.73 days and maximum 80.50 days was reported in treatment T<sub>6</sub> i.e. (Weedy check (Control)).

#### 4.5. Number of day taken to maturity:

Data of Table 4.9 & Figure 4.9 the analysis of variance of data on this attribute has been mentioned in Appendix- 9 showed the minimum Number of day taken to maturity i.e. 118.00 days and 118.66 days were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 120.00 days and 120.66 days during 2015-16 and 2016-17, respectively and this improvement was significantly than rest of the treatment however, highest value i.e. 142.00 days and 142.66 days were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

During both the years, the mean value Number of day taken to maturity was recorded noticed to be minimum 118.33 days in the treatment T<sub>5</sub> (weed free) followed by

treatment T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 120.33 days and maximum 142.33 days was reported in treatment T<sub>6</sub> i.e. (Weedy check (Control)).

#### 4.6.1. Weed Density (no. /m)<sup>2</sup> of monocot weeds at 30 DAT:

The data gathered in connection with Weed Density (no./m)<sup>2</sup> of monocot weeds at 30, days after transplanting due to influence of weed management have been displayed in table 4.10 and graphically represented in Figure 4.10 the analysis of variance of data on this attribute has been mentioned in Appendix- 10.

Critical analysis of data presented in above table revealed the expressive differences in Weed Density (no. /m)<sup>2</sup> of monocot weeds at 30, DAT due to various treatments of weed management. The maximum Weed Density (no./m)<sup>2</sup> of monocot weeds at 30 DAT i.e. 105.4 (no./m)<sup>2</sup> and 106.42 (no./m)<sup>2</sup> were noted by the application of T<sub>6</sub> (Weedy check (Control) closely followed by T<sub>9</sub> (Fluazipop-p-butyl +Weed check) i.e. 98.70 (no./m)<sup>2</sup> and 99.37 (no./m)<sup>2</sup> during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 0.00 (no. /m)<sup>2</sup> were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 57.36 And 58.37(no. /m)<sup>2</sup>.

During both the years, mean Weed Density (no./m)<sup>2</sup> of monocot weeds at 30 DAT was recorded noticed to be maximum 105.91 (no./m)<sup>2</sup> in the treatment T<sub>6</sub> (Weedy check (Control) followed by treatment T<sub>9</sub> (Fluazipop-p-butyl +Weed check) i.e. 99.03(no./m)<sup>2</sup> and minimum 0.00 (no./m)<sup>2</sup> was reported in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 57.86 (no./m)<sup>2</sup>.

#### 4.6.2. Weed Density (no./m)<sup>2</sup> of monocot weeds at 60 DAT:

The data gathered in connection with Weed Density (no. /m)<sup>2</sup> of monocot weeds at 60, days after transplanting due to influence of weed management have been displayed in Table 4.11 and graphically represented in Figure 4.11 the analysis of variance of data on this attribute has been mentioned in Appendix- 11.

Critical analysis of data presented in above table revealed the expressive differences in Weed Density (no. /m)<sup>2</sup> of monocot weeds at 60, DAT due to various treatments of weed management. The maximum Weed Density (no./m)<sup>2</sup> of monocot weeds at 60 DAT i.e. 188.84 (no./m)<sup>2</sup> and 188.16 (no./m)<sup>2</sup> were noted by the application of T<sub>6</sub> (Weedy check (Control)) closely followed by T<sub>9</sub> (Fluazipop-p-butyl + Weed check) i.e. 184.34 (no./m)<sup>2</sup> and 183.67 (no./m)<sup>2</sup> during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 0.00 (no./m)<sup>2</sup> were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 122.36 and 121.69 (no./m)<sup>2</sup>

During both the years, mean Weed Density (no./m)<sup>2</sup> of monocot weeds at 60 DAT was recorded noticed to be maximum 188.50 (no./m)<sup>2</sup> in the treatment T<sub>6</sub> (Weedy check (Control)) followed by treatment T<sub>9</sub> (Fluazipop-p-butyl + Weed check) i.e. 184.00 (no./m)<sup>2</sup> and minimum 0000 (no./m)<sup>2</sup> was reported in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 122.02 (no./m)<sup>2</sup>. Similar results were also obtained by **Pandey *et al.* (1992)**, parallel results were recorded by **Nandal and Ravinder Singh (2002)**.

Table 4.8: Effect of weed and fertilizers management on number of day taken to bulb formation

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	75.96	76.32	76.14
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	77.50	77.86	77.68
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	76.89	77.58	77.23
T <sub>4</sub>	Hand weeding at 30 DAP	77.81	77.17	77.49
T <sub>5</sub>	Weed free	65.15	64.51	64.83
T <sub>6</sub>	Weedy check (Control)	80.66	80.35	80.50
T <sub>7</sub>	Pendimethalin+HW	75.31	75.00	75.15
T <sub>8</sub>	Oxyfluorfen+Weed free	73.49	73.18	73.33
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	78.84	78.53	78.68
T <sub>10</sub>	Pendimethalin+75% RDF+HW	67.19	66.88	67.03
T <sub>11</sub>	Pendimethalin+100% RDF+HW	66.78	66.47	66.62
T <sub>12</sub>	Pendimethalin+125% RDF+HW	65.89	65.58	65.73
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	70.25	69.94	70.09
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	69.34	69.03	69.18
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	68.65	68.34	68.49
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	73.49	73.18	73.33
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	72.86	72.55	72.70
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	71.38	71.07	71.22
	<b>SE.m ±</b>	0.847	0.932	0.493
	<b>CD at 5%</b>	2.444	2.690	0.164

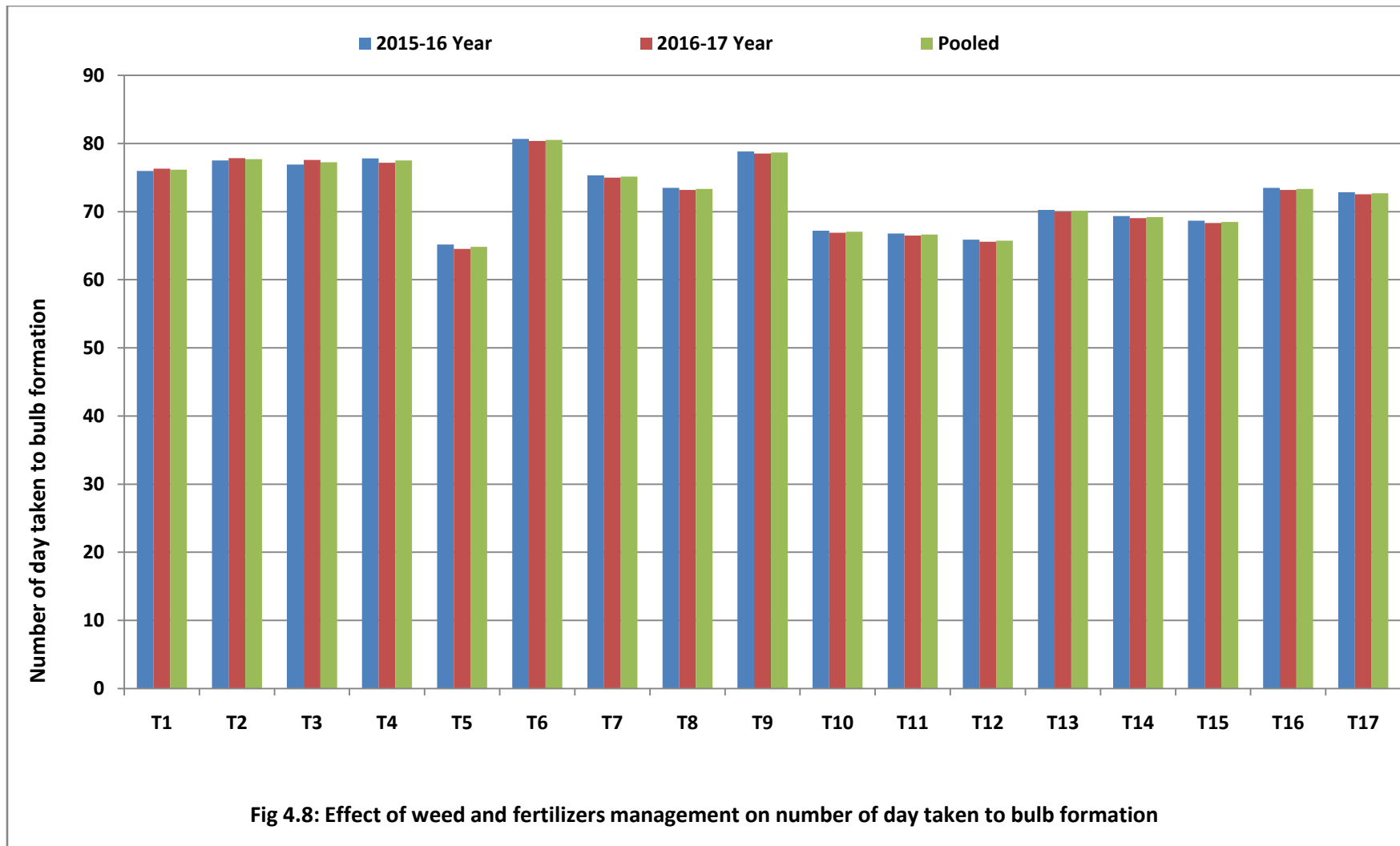
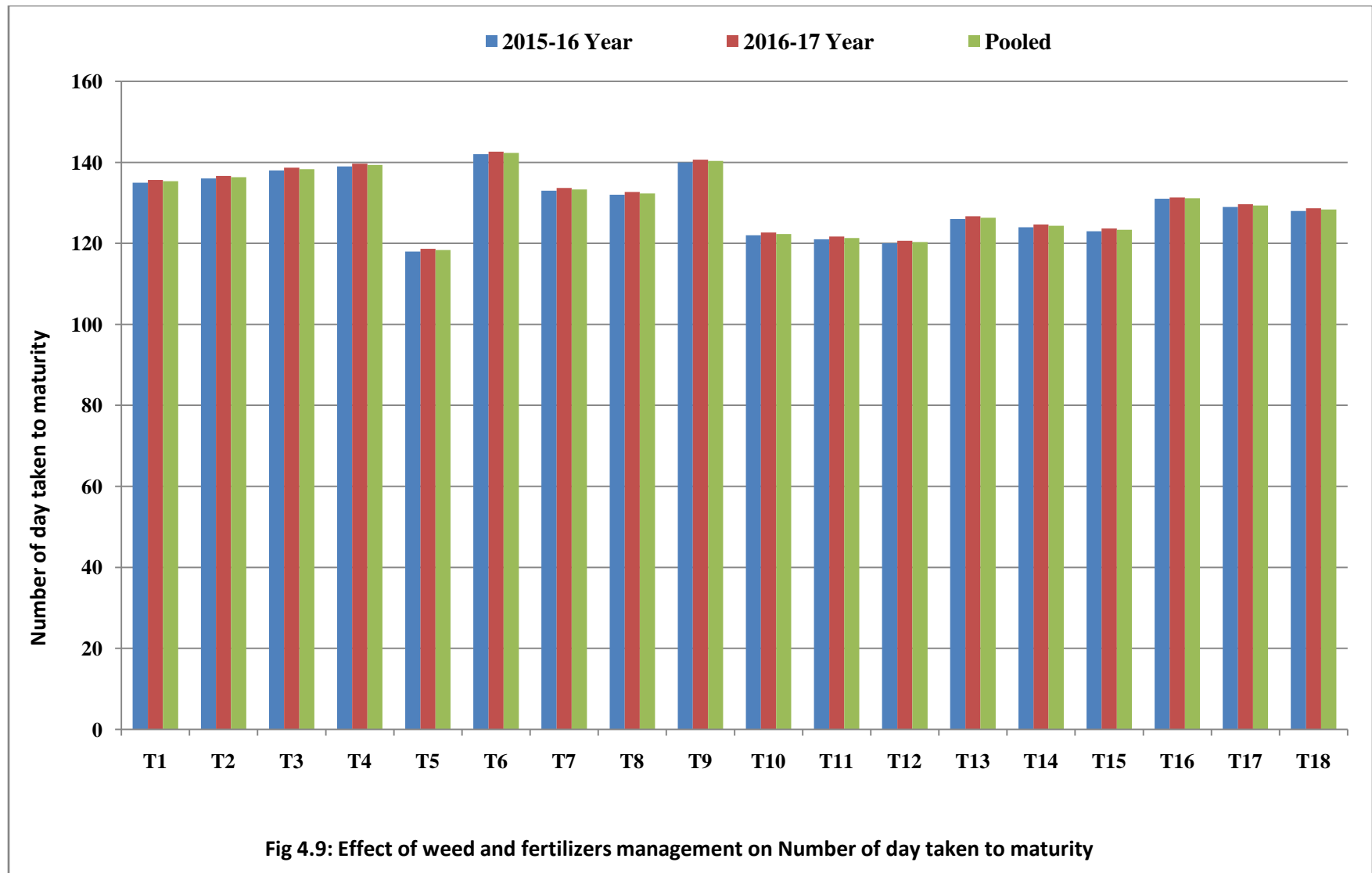


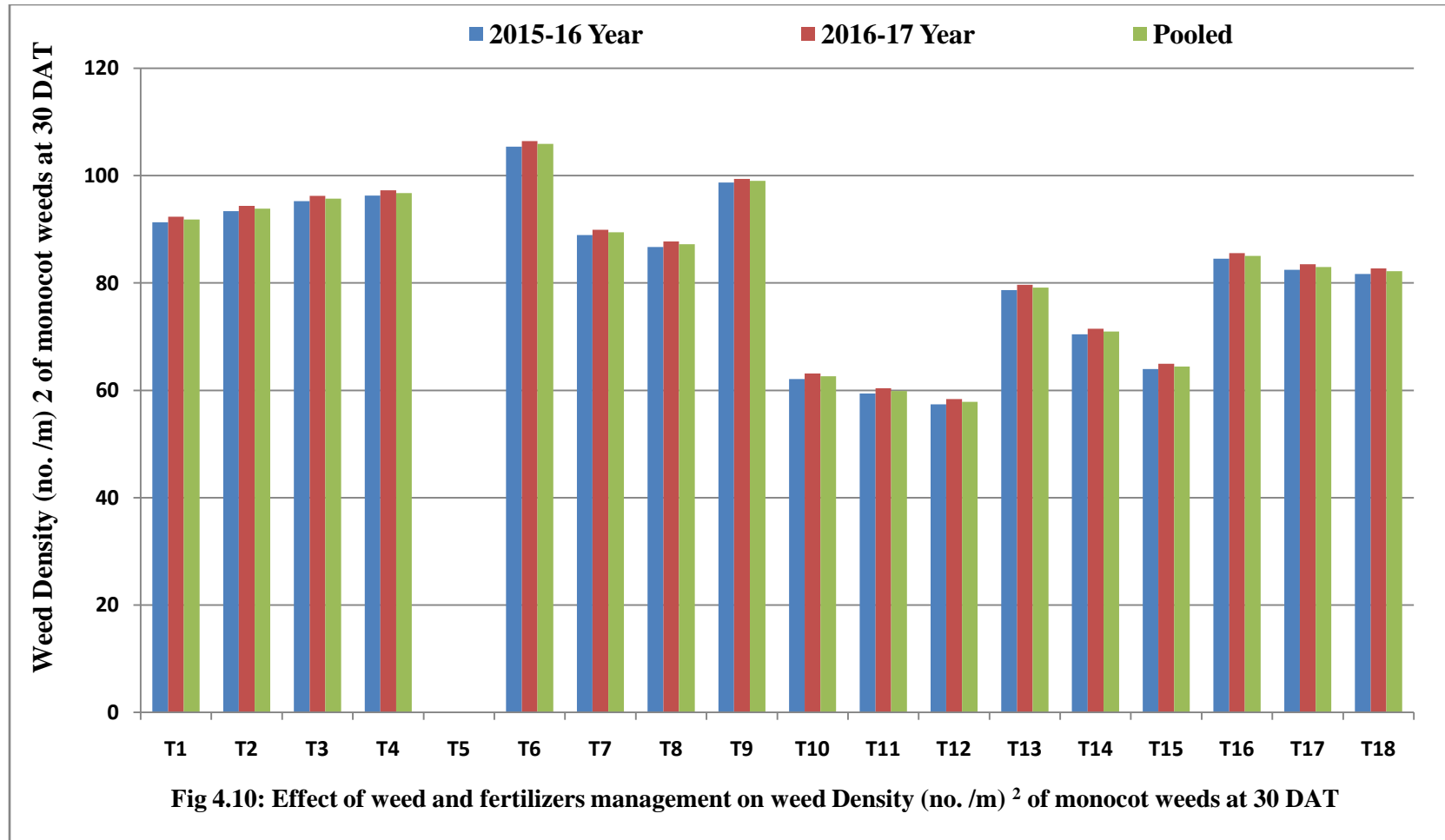
Table 4.9: Effect of weed and fertilizers management on Number of day taken to maturity.

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	135.00	135.66	135.33
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	136.00	136.66	136.33
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	138.00	138.66	138.33
T <sub>4</sub>	Hand weeding at 30 DAP	139.00	139.66	139.33
T <sub>5</sub>	Weed free	118.00	118.66	118.33
T <sub>6</sub>	Weedy check (Control)	142.00	142.66	142.33
T <sub>7</sub>	Pendimethalin+HW	133.00	133.66	133.33
T <sub>8</sub>	Oxyfluorfen+Weed free	132.00	132.66	132.33
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	140.00	140.66	140.33
T <sub>10</sub>	Pendimethalin+75% RDF+HW	122.00	122.66	122.33
T <sub>11</sub>	Pendimethalin+100% RDF+HW	121.00	121.66	121.33
T <sub>12</sub>	Pendimethalin+125% RDF+HW	120.00	120.66	120.33
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	126.00	126.66	126.33
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	124.00	124.66	124.33
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	123.00	123.66	123.33
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	131.00	131.33	131.16
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	129.00	129.66	129.33
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	128.00	128.66	128.33
	SE.m ±	0.804	0.782	0.166
	CD at 5%	2.320	2.258	0.055



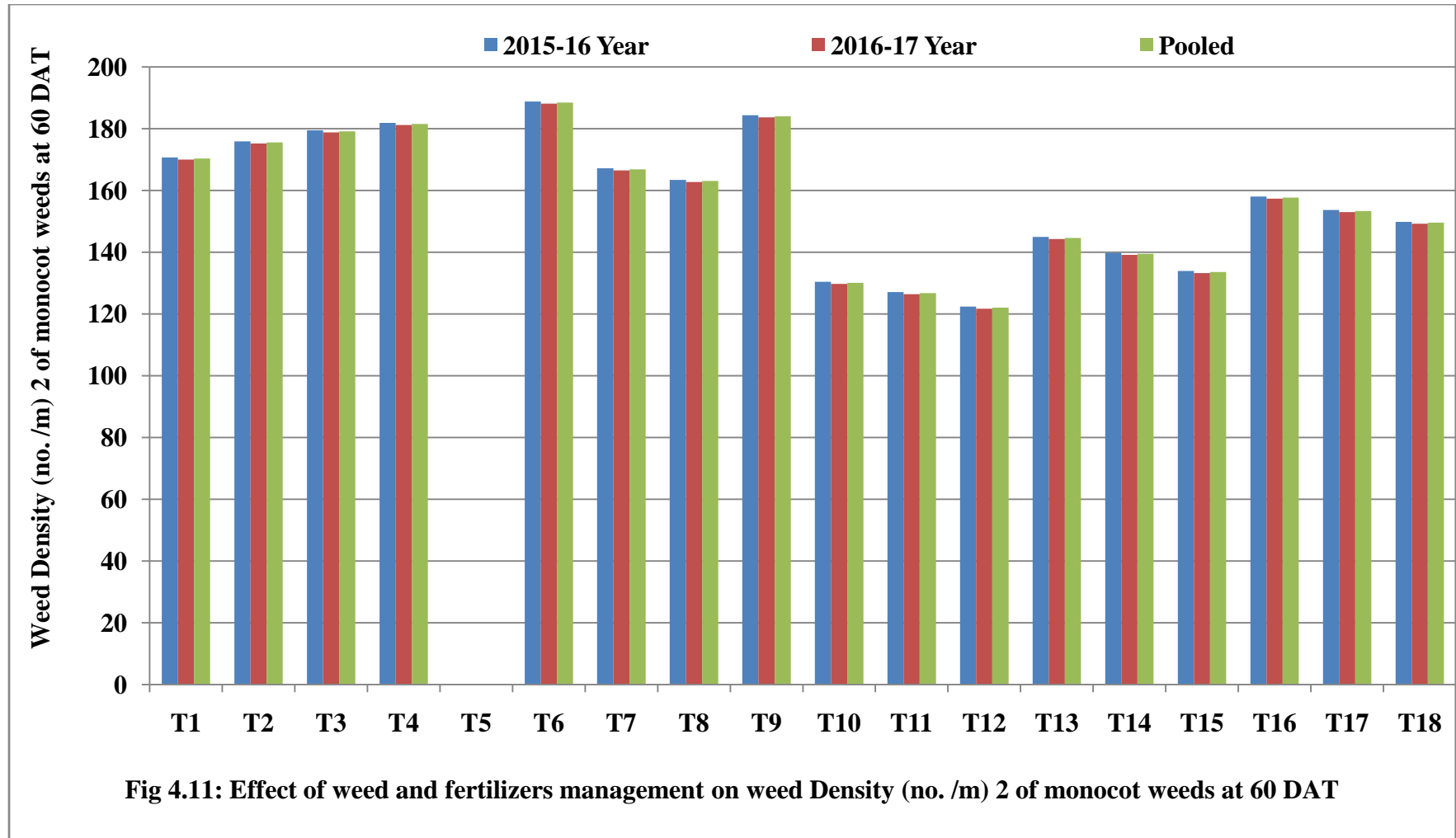
**Table 4.10: Effect of weed and fertilizers management on weed Density (no. /m)<sup>2</sup> of monocot weeds at 30 DAT.**

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	91.31	92.323	91.817
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	93.36	94.370	93.865
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	95.22	96.230	95.725
T <sub>4</sub>	Hand weeding at 30 DAP	96.26	97.273	96.767
T <sub>5</sub>	Weed free	0.00	0.000	0.000
T <sub>6</sub>	Weedy check (Control)	105.4	106.420	105.910
T <sub>7</sub>	Pendimethalin+HW	88.923	89.930	89.427
T <sub>8</sub>	Oxyfluorfen+Weed free	86.70	87.710	87.205
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	98.70	99.377	99.039
T <sub>10</sub>	Pendimethalin+75% RDF+HW	62.11	63.120	62.615
T <sub>11</sub>	Pendimethalin+100% RDF+HW	59.39	60.403	59.897
T <sub>12</sub>	Pendimethalin+125% RDF+HW	57.36	58.373	57.867
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	78.65	79.663	79.157
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	70.45	71.460	70.955
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	63.95	64.967	64.459
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	84.53	85.543	85.037
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	82.46	83.470	82.965
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	81.70	82.717	82.209
	SE.m ±	0.891	0.891	0.121
	CD at 5%	2.572	2.573	0.363



**Table 4.11: Effect of weed and fertilizers management on weed Density (no. /m)<sup>2</sup> of monocot weeds at 60 DAT.**

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	170.69	170.03	170.36
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	175.86	175.19	175.52
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	179.48	178.82	179.15
T <sub>4</sub>	Hand weeding at 30 DAP	181.87	181.20	181.53
T <sub>5</sub>	Weed free	0.00	0.00	0.00
T <sub>6</sub>	Weedy check (Control)	188.84	188.16	188.50
T <sub>7</sub>	Pendimethalin+HW	167.19	166.51	166.85
T <sub>8</sub>	Oxyfluorfen+Weed free	163.38	162.71	163.04
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	184.34	183.67	184.00
T <sub>10</sub>	Pendimethalin+75% RDF+HW	130.44	129.77	130.10
T <sub>11</sub>	Pendimethalin+100% RDF+HW	127.06	126.38	126.72
T <sub>12</sub>	Pendimethalin+125% RDF+HW	122.36	121.69	122.02
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	144.98	144.31	144.64
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	139.81	139.14	139.47
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	133.95	133.28	133.61
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	158.06	157.39	157.72
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	153.69	153.02	153.35
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	149.87	149.20	149.53
	SE.m ±	0.969	0.997	0.152
	CD at 5%	2.798	2.879	0.458



### 4.6.3. Weed Density (no. /m)<sup>2</sup> of monocot weeds at 90 DAT:

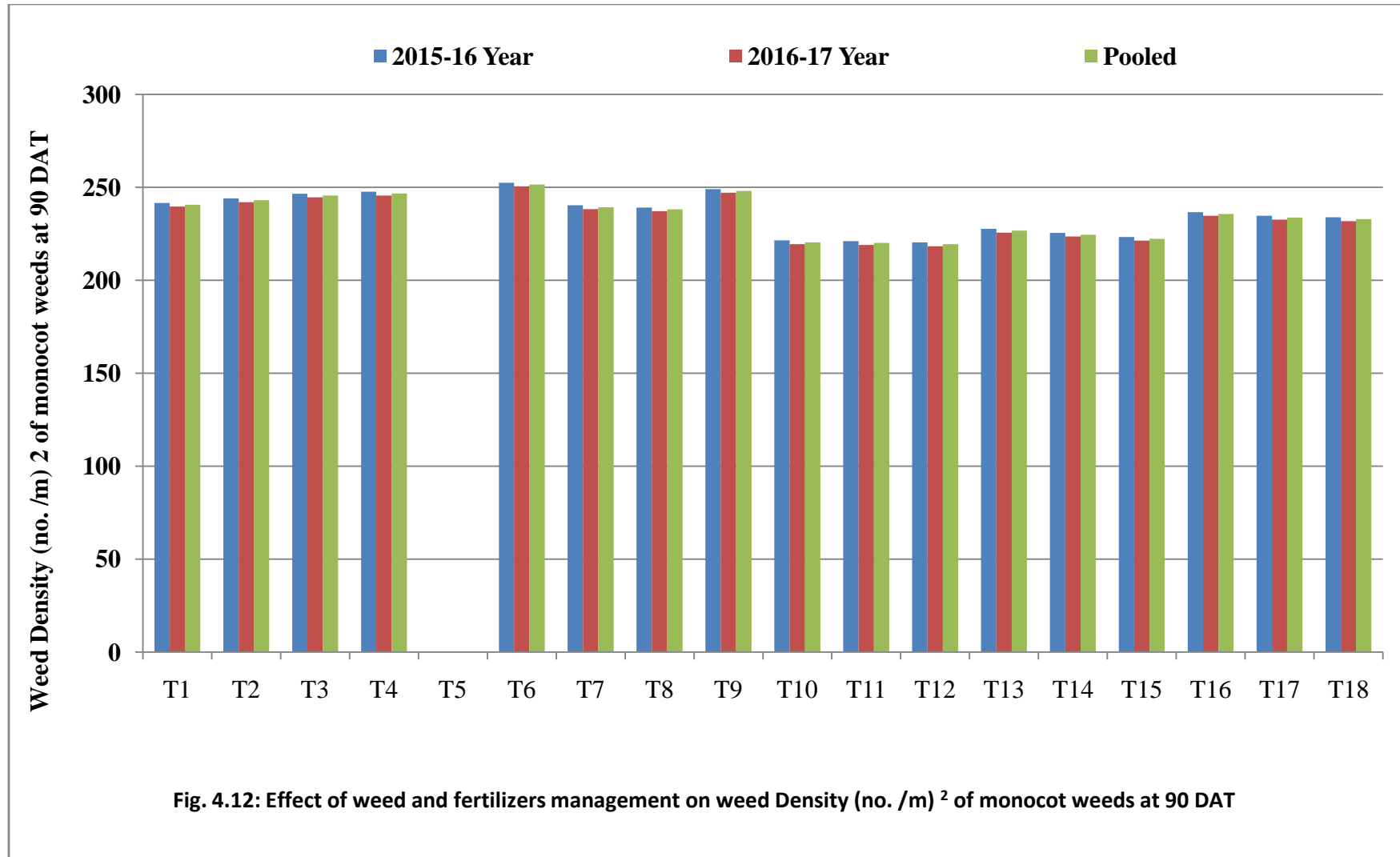
The data gathered in connection with Weed Density (no. /m)<sup>2</sup> of monocot weeds at 90, days after transplanting due to influence of weed management have been displayed in Table 4.12 and graphically represented in Figure 4.12 the analysis of variance of data on this attribute has been mentioned in Appendix- 12.

Critical analysis of data presented in above table revealed the expressive differences in Weed Density (no. /m)<sup>2</sup> of monocot weeds at 90, DAT due to various treatments of weed management. The maximum Weed Density (no./m)<sup>2</sup> of monocot weeds at 90 DAT i.e. 252.50 (no./m)<sup>2</sup> and 250.517 (no./m)<sup>2</sup> were noted by the application of T<sub>6</sub> (Weedy check (Control)) closely followed by T<sub>9</sub> (Fluazipop -p - butyl + Weed check) i.e. 249.07 (no./m)<sup>2</sup> and 247.083 (no./m)<sup>2</sup> during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 0.000 (no./m)<sup>2</sup> were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 220.36 And 218.373 (no. /m)<sup>2</sup>.

During both the years, mean Weed Density (no./m)<sup>2</sup> of monocot weeds at 90 DAT was recorded noticed to be maximum 251.509 (no./m)<sup>2</sup> in the treatment T<sub>6</sub> (Weedy check (Control)) followed by treatment T<sub>9</sub> (Fluazipop-p-butyl + Weed check) i.e. 248.077 (no./m)<sup>2</sup> and minimum 0000 (no./m)<sup>2</sup> was reported in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 219.367 (no./m)<sup>2</sup>. comparable results obtained by **Nadagouda (1995); Bhutia *et al.* (2005) and Khalid *et al.* (2006).**

**Table 4.12: Effect of weed and fertilizers management on weed Density (no. /m)<sup>2</sup> of monocot weeds at 90 DAT.**

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	241.59	239.607	240.599
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	244.06	242.073	243.067
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	246.58	244.597	245.589
T <sub>4</sub>	Hand weeding at 30 DAP	247.64	245.653	246.647
T <sub>5</sub>	Weed free	0.000	0.000	0.000
T <sub>6</sub>	Weedy check (Control)	252.50	250.517	251.509
T <sub>7</sub>	Pendimethalin+HW	240.29	238.300	239.295
T <sub>8</sub>	Oxyfluorfen+Weed free	239.11	237.127	238.119
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	249.07	247.083	248.077
T <sub>10</sub>	Pendimethalin+75% RDF+HW	221.44	219.453	220.447
T <sub>11</sub>	Pendimethalin+100% RDF+HW	221.06	219.070	220.065
T <sub>12</sub>	Pendimethalin+125% RDF+HW	220.36	218.373	219.367
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	227.65	225.663	226.657
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	225.48	223.493	224.487
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	223.29	221.300	222.295
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	236.67	234.677	235.674
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	234.69	232.707	233.699
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	233.87	231.883	232.877
	SE.m ±	1.181	1.182	0.227
	CD at 5%	3.408	3.413	0.684



#### 4.7.1. Fresh Weight of monocot weeds (g/m<sup>2</sup>) at 30 DAT:

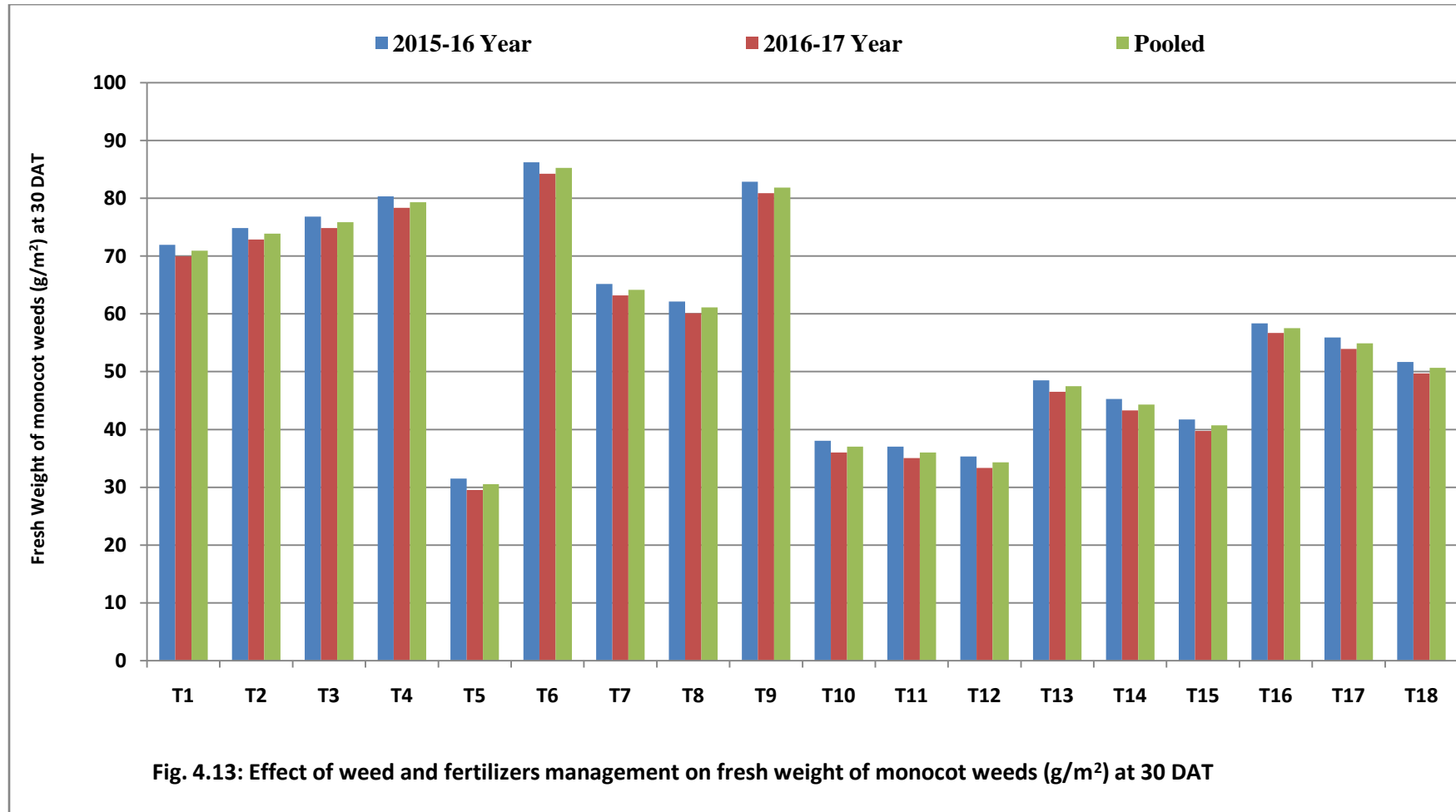
The data gathered in connection with Fresh Weight of monocot weeds (g/m<sup>2</sup>) at 30, days after transplanting due to influence of weed management have been displayed in Table 4.13 and graphically represented in Figure 4.13 the analysis of variance of data on this attribute has been mentioned in Appendix- 13.

Critical analysis of data presented in above table revealed the expressive differences in Fresh Weight of monocot weeds (g/m<sup>2</sup>) at 30, DAT due to various treatments of weed management. The maximum Fresh Weight of monocot weeds(g/m<sup>2</sup>) at 30 DAT i.e. 86.24 (no./m)<sup>2</sup> and 84.25 (no./m)<sup>2</sup> were noted by the application of T<sub>6</sub> (Weedy check (Control)) closely followed by T<sub>9</sub> (Fluazipop-p-butyl + Weed check) i.e. 82.86 (no./m)<sup>2</sup> and 80.87 (no./m)<sup>2</sup> during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 31.52 (no./m)<sup>2</sup> and 29.53 were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 35.32 and 33.33 (no./m)<sup>2</sup>.

During both the years, mean Fresh Weight of monocot weeds(g/m<sup>2</sup>) at 30 DAT was recorded noticed to be maximum 85.24 (no./m)<sup>2</sup> in the treatment T<sub>6</sub> (Weedy check (Control)) followed by treatment T<sub>9</sub> (Fluazipop - p- butyl + Weed check) i.e. 81.86 (no./m)<sup>2</sup> and minimum 30.52 (no./m)<sup>2</sup> was reported in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 34.32 (no./m)<sup>2</sup> **Chauhan et al. (1998).**

Table 4.13: Effect of weed and fertilizers management on Fresh Weight of monocot weeds (g/m<sup>2</sup>) at 30 DAT.

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	71.94	69.95	70.94
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	74.87	72.88	73.87
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	76.85	74.86	75.85
T <sub>4</sub>	Hand weeding at 30 DAP	80.33	78.34	79.33
T <sub>5</sub>	Weed free	31.52	29.53	30.52
T <sub>6</sub>	Weedy check (Control)	86.24	84.25	85.24
T <sub>7</sub>	Pendimethalin+HW	65.18	63.19	64.18
T <sub>8</sub>	Oxyfluorfen+Weed free	62.12	60.13	61.12
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	82.86	80.87	81.86
T <sub>10</sub>	Pendimethalin+75% RDF+HW	38.03	36.04	37.03
T <sub>11</sub>	Pendimethalin+100% RDF+HW	37.02	35.03	36.02
T <sub>12</sub>	Pendimethalin+125% RDF+HW	35.32	33.33	34.32
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	48.49	46.50	47.49
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	45.30	43.31	44.30
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	41.72	39.73	40.72
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	58.36	56.70	57.53
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	55.91	53.92	54.91
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	51.67	49.68	50.67
	SE.m ±	0.921	0.927	0.155
	CD at 5%	2.658	2.676	0.051



### 4.7.2. Fresh Weight of monocot weeds ( $\text{g/m}^2$ ) at 60 DAT:

The data gathered in connection with Fresh Weight of monocot weeds ( $\text{g/m}^2$ ) at 60, days after transplanting due to influence of weed management have been displayed in Table 4.14 and graphically represented in Figure 4.14 the analysis of variance of data on this attribute has been mentioned in Appendix- 14.

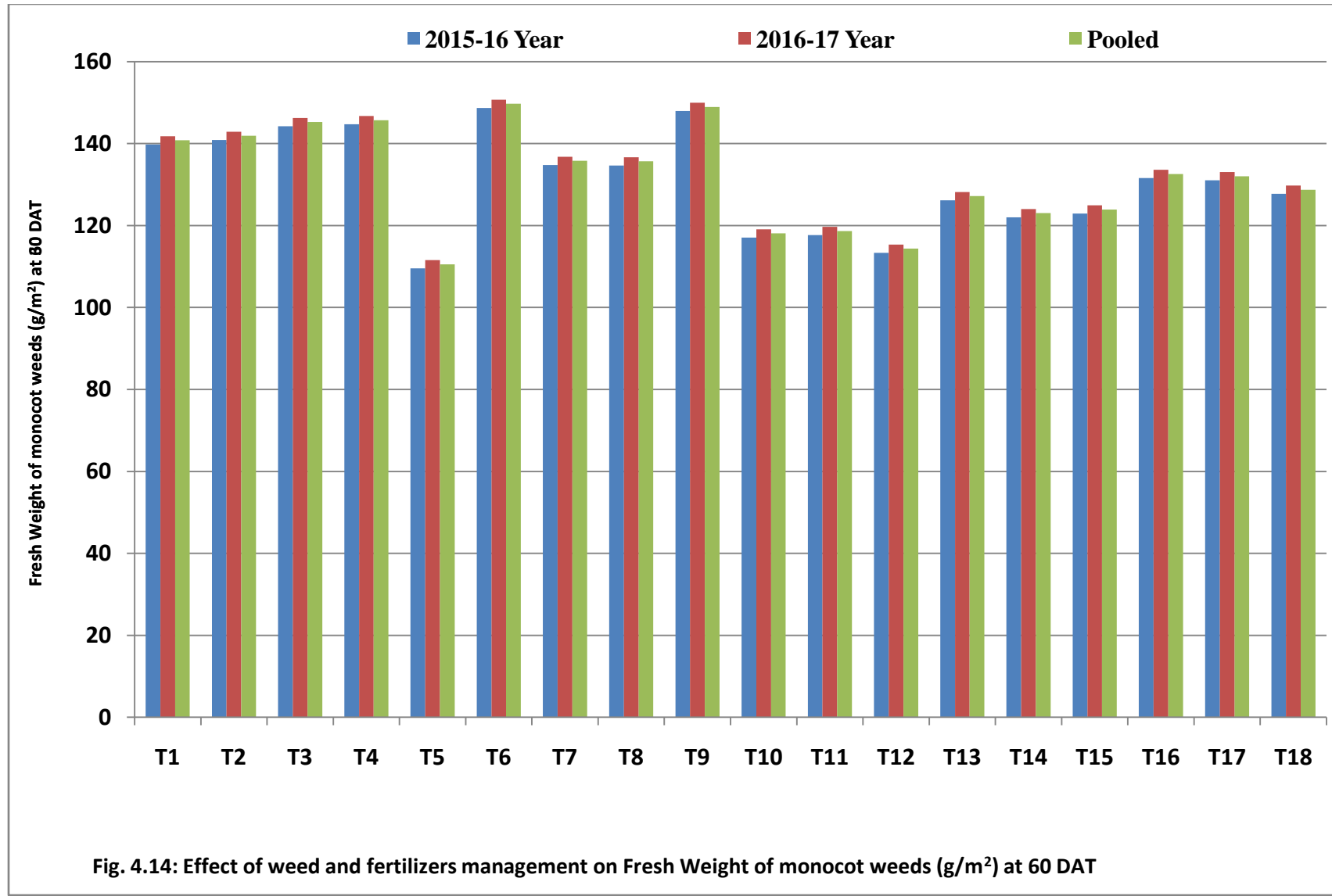
Critical analysis of data presented in above table revealed the expressive differences in Fresh Weight of monocot weeds ( $\text{g/m}^2$ ) at 60, DAT due to various treatments of weed management.

The maximum fresh weight of monocot weeds ( $\text{g/m}^2$ ) at 60 DAT i.e. 148.72 ( $\text{g/m}^2$ ) and 150.74 ( $\text{g/m}^2$ ) were noted by the application of T<sub>6</sub> (Weedy check (Control)) closely followed by T<sub>9</sub>(Fluazipop-p-butyl + Weed check) i.e. 147.74 ( $\text{g/m}^2$ ) and 149.96 ( $\text{g/m}^2$ ) during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 109.53 ( $\text{g/m}^2$ ) and 111.55 ( $\text{g/m}^2$ ) were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 113.36 And 115.38 ( $\text{g/m}^2$ )

During both the years, mean Fresh Weight of monocot weeds ( $\text{g/m}^2$ ) at 60 DAT was recorded noticed to be maximum 149.73 ( $\text{g/m}^2$ ) in the treatment T<sub>6</sub> (Weedy check (Control)) followed by treatment T<sub>9</sub> (Fluazipop-p-butyl + Weed check) i.e. 148.95 ( $\text{g/m}^2$ ) and minimum 110.54 ( $\text{g/m}^2$ ) was reported in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 114.37( $\text{g/m}^2$ ). Like consequences were reported by **Ved Prakash *et al.* (2000)**.

Table 4.14: Effect of weed and fertilizers management on fresh weight of monocot weeds (g/m<sup>2</sup>) at 60 DAT

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	139.81	141.83	140.82
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	140.91	142.92	141.91
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	144.26	146.27	145.27
T <sub>4</sub>	Hand weeding at 30 DAP	144.71	146.73	145.72
T <sub>5</sub>	Weed free	109.53	111.55	110.54
T <sub>6</sub>	Weedy check (Control)	148.72	150.74	149.73
T <sub>7</sub>	Pendimethalin+HW	134.80	136.81	135.80
T <sub>8</sub>	Oxyfluorfen+Weed free	134.67	136.68	135.68
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	147.95	149.96	148.95
T <sub>10</sub>	Pendimethalin+75% RDF+HW	117.09	119.10	118.10
T <sub>11</sub>	Pendimethalin+100% RDF+HW	117.67	119.68	118.67
T <sub>12</sub>	Pendimethalin+125% RDF+HW	113.36	115.38	114.37
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	126.18	128.19	127.19
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	122.02	124.04	123.03
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	122.91	124.92	123.92
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	131.58	133.60	132.59
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	131.03	133.04	132.03
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	127.74	129.75	128.74
	SE.m ±	0.825	0.826	0.218
	CD at 5%	2.381	2.385	0.073



### 4.7.3. Fresh Weight of monocot weeds ( $\text{g/m}^2$ ) at 90 DAT:

The data gathered in connection with Fresh Weight of monocot weeds ( $\text{g/m}^2$ ) at 90, days after transplanting due to influence of weed management have been displayed in Table 4.15 and graphically represented in Figure 4.15 the analysis of variance of data on this attribute has been mentioned in Appendix- 15.

Critical analysis of data presented in above table revealed the expressive differences in Fresh Weight of monocot weeds ( $\text{g/m}^2$ ) at 90, DAT due to various treatments of weed management. The maximum fresh weight of monocot weeds ( $\text{g/m}^2$ ) at 90 DAT i.e. 220.18 ( $\text{g/m}^2$ ) and 220.53 ( $\text{g/m}^2$ ) were noted by the application of T<sub>6</sub> (Weedy check (Control)) closely followed by T<sub>9</sub> (Fluazipop-p-butyl + Weed check) i.e. 209.46 ( $\text{g/m}^2$ ) and 209.48 ( $\text{g/m}^2$ ) during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 78.15 ( $\text{g/m}^2$ ) and 78.17 ( $\text{g/m}^2$ ) were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 81.11 And 81.13 ( $\text{g/m}^2$ ).

During both the years, mean fresh weight of monocot weeds ( $\text{g/m}^2$ ) at 90 DAT was recorded noticed to be maximum 220.36 ( $\text{g/m}^2$ ) in the treatment T<sub>6</sub> (Weedy check (Control)) followed by treatment T<sub>9</sub> (Fluazipop-p-butyl + Weed check) i.e. 209.47 ( $\text{g/m}^2$ ) and minimum 78.19 ( $\text{g/m}^2$ ) was reported in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 81.12 ( $\text{g/m}^2$ ).

Table 4.15: Effect of weed and fertilizers management on fresh weight of monocot weeds (g/m<sup>2</sup>) at 90 DAT.

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @ 1.0 kg a.i/ha	184.06	184.08	184.07
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	190.15	190.17	190.16
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	198.33	198.35	198.34
T <sub>4</sub>	Hand weeding at 30 DAP	206.42	206.44	206.43
T <sub>5</sub>	Weed free	78.15	78.17	78.16
T <sub>6</sub>	Weedy check (Control)	220.18	220.53	220.36
T <sub>7</sub>	Pendimethalin+HW	167.94	167.96	167.95
T <sub>8</sub>	Oxyfluorfen+Weed free	167.94	167.96	167.95
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	209.46	209.48	209.47
T <sub>10</sub>	Pendimethalin+75% RDF+HW	103.20	103.22	103.21
T <sub>11</sub>	Pendimethalin+100% RDF+HW	85.26	85.28	85.27
T <sub>12</sub>	Pendimethalin+125% RDF+HW	81.11	81.13	81.12
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	135.07	135.09	135.08
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	115.68	115.69	115.69
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	107.26	107.28	107.27
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	161.03	161.05	161.04
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	152.03	152.05	152.04
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	146.03	146.05	146.04
	SE.m ±	1.100	1.112	0.122
	CD at 5%	3.175	3.211	0.041

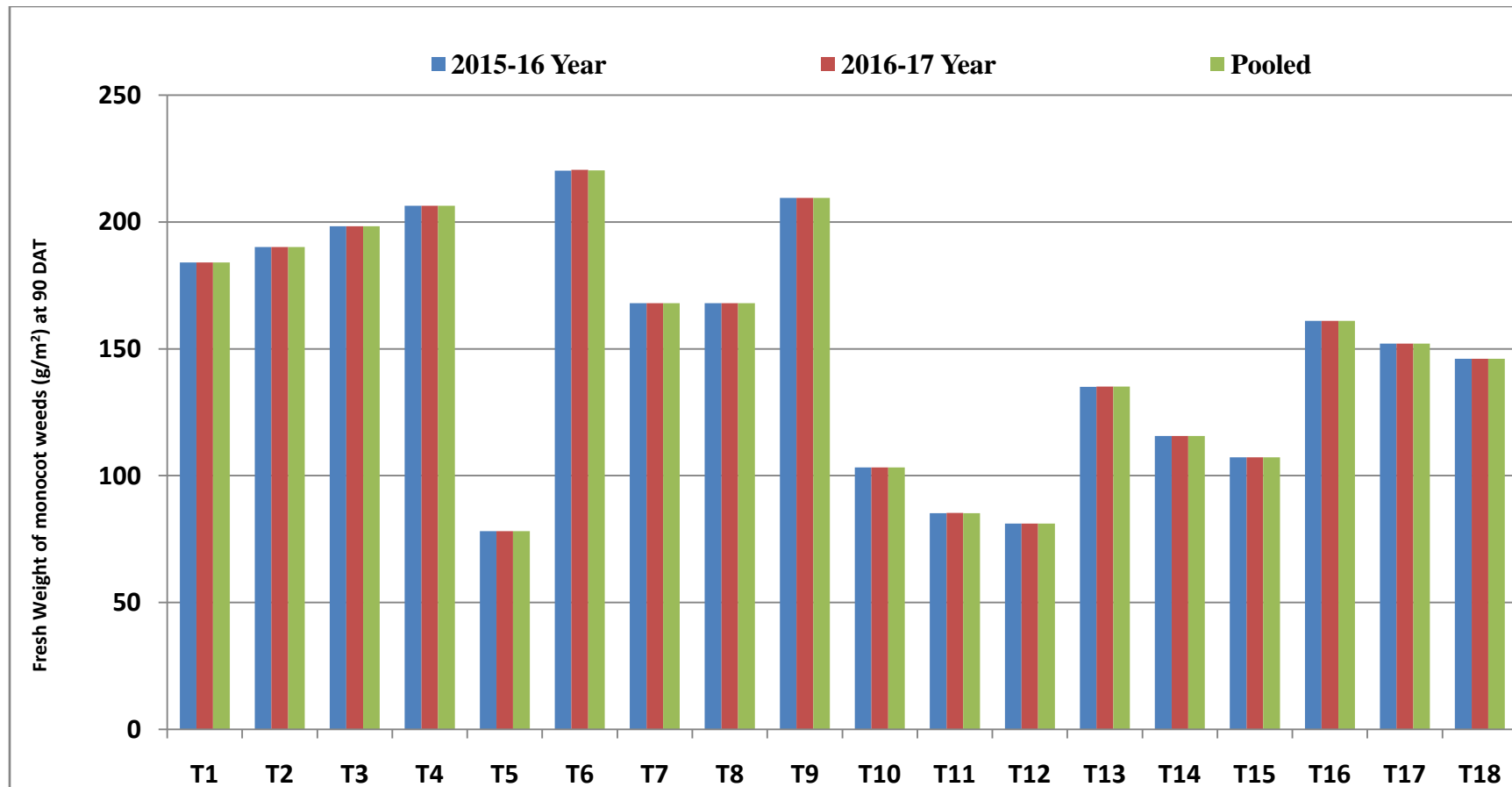


Fig. 4.15: Effect of weed and fertilizers management on Fresh Weight of monocot weeds (g/m<sup>2</sup>) at 90 DAT

#### 4.8.1. Weed Density (no./m)<sup>2</sup> of Dicot weeds at 30 DAT:

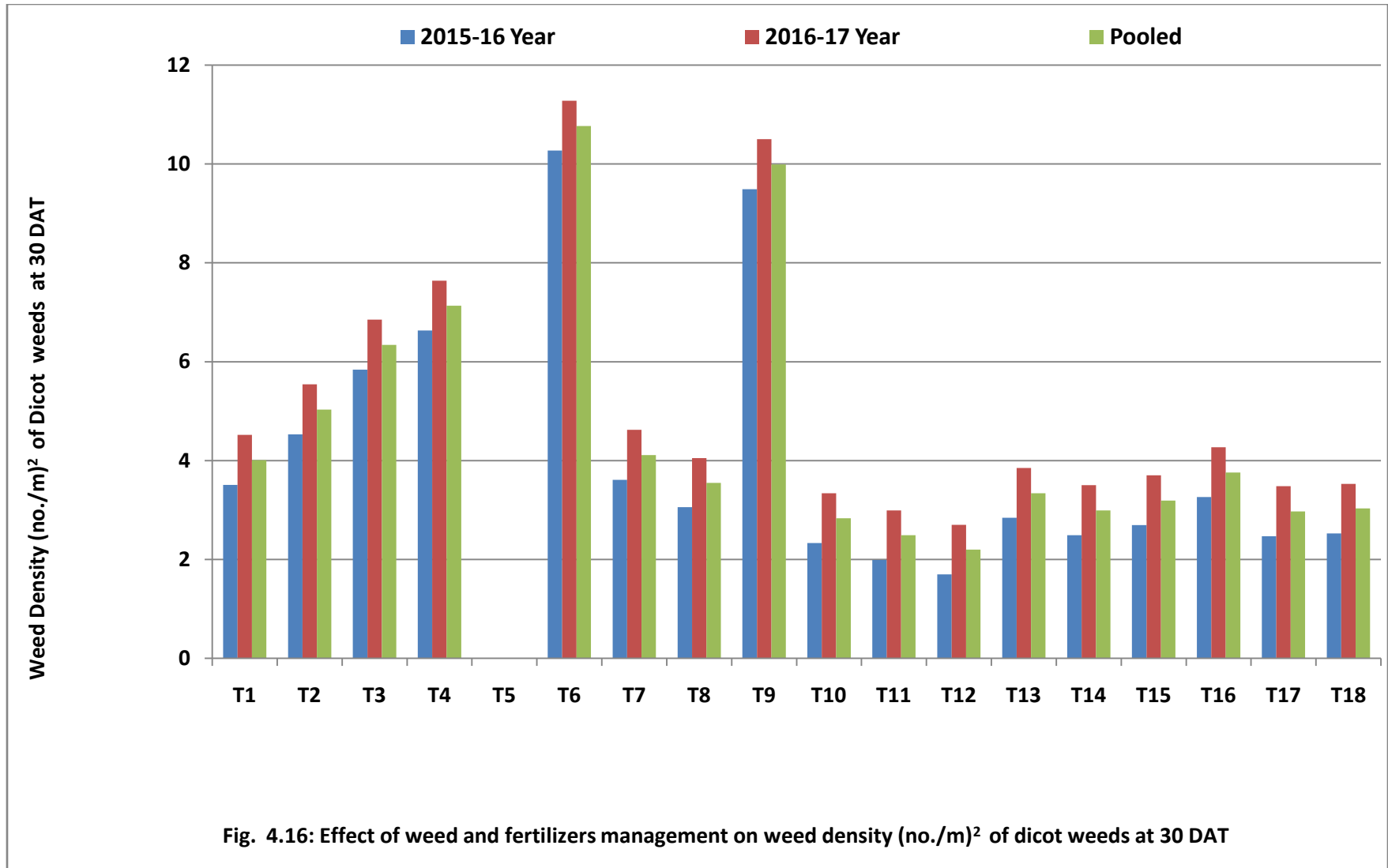
The data gathered in connection with weed density (no./m)<sup>2</sup> of dicot weeds at 30, days after transplanting due to influence of weed management have been displayed in Table 4.16 and graphically represented in Figure 4.16 the analysis of variance of data on this attribute has been mentioned in Appendix- 16.

Critical analysis of data presented in above table revealed the expressive differences in weed density (no./m)<sup>2</sup> of dicot weeds at 30, DAT due to various treatments of weed management. The maximum weed density (no./m)<sup>2</sup> of dicot weeds at 30 DAT i.e. 10.27 (no./m)<sup>2</sup> and 11.28 (g/m<sup>2</sup>) were noted by the application of T<sub>6</sub> (Weedy check (Control)) closely followed by T<sub>9</sub> (Fluazipop-p-butyl + Weed check) i.e. 9.49 (no./m)<sup>2</sup> and 10.50 (no./m)<sup>2</sup> during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 0.00 (no./m)<sup>2</sup> and 0.00 (no./m)<sup>2</sup> were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 1.697 And 2.70 (no./m)<sup>2</sup>

During both the years, mean weed density (no./m)<sup>2</sup> of dicot weeds at 30 DAT was recorded noticed to be maximum 10.77 (no./m)<sup>2</sup> in the treatment T<sub>6</sub> (Weedy check (Control)) followed by treatment T<sub>9</sub>(Fluazipop-p-butyl+ Weed check)i.e. 9.99 (no./m)<sup>2</sup> and minimum 0.00 (no./m)<sup>2</sup> was reported in treatment T<sub>5</sub>(weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 2.20 (no./m)<sup>2</sup>. Similar results found by **Elamin and Tom (1991)**

Table 4.16: Effect of weed and fertilizers management on weed density (no./m)<sup>2</sup> of dicot weeds at 30 DAT.

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	3.51	4.52	4.01
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	4.53	5.54	5.03
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	5.84	6.85	6.34
T <sub>4</sub>	Hand weeding at 30 DAP	6.63	7.64	7.13
T <sub>5</sub>	Weed free	0.00	0.00	0.00
T <sub>6</sub>	Weedy check (Control)	10.27	11.28	10.77
T <sub>7</sub>	Pendimethalin+HW	3.61	4.62	4.11
T <sub>8</sub>	Oxyfluorfen+Weed free	3.06	4.05	3.55
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	9.49	10.50	9.99
T <sub>10</sub>	Pendimethalin+75% RDF+HW	2.333	3.34	2.83
T <sub>11</sub>	Pendimethalin+100% RDF+HW	1.987	2.99	2.49
T <sub>12</sub>	Pendimethalin+125% RDF+HW	1.697	2.70	2.20
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	2.843	3.85	3.34
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	2.490	3.50	2.99
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	2.693	3.70	3.19
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	3.263	4.27	3.76
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	2.470	3.48	2.97
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	2.527	3.53	3.03
	SE.m ±	0.417	0.417	0.358
	CD at 5%	1.204	1.203	0.119



#### 4.8.2. Weed Density (no. /m)<sup>2</sup> of Dicot weeds at 60 DAT:

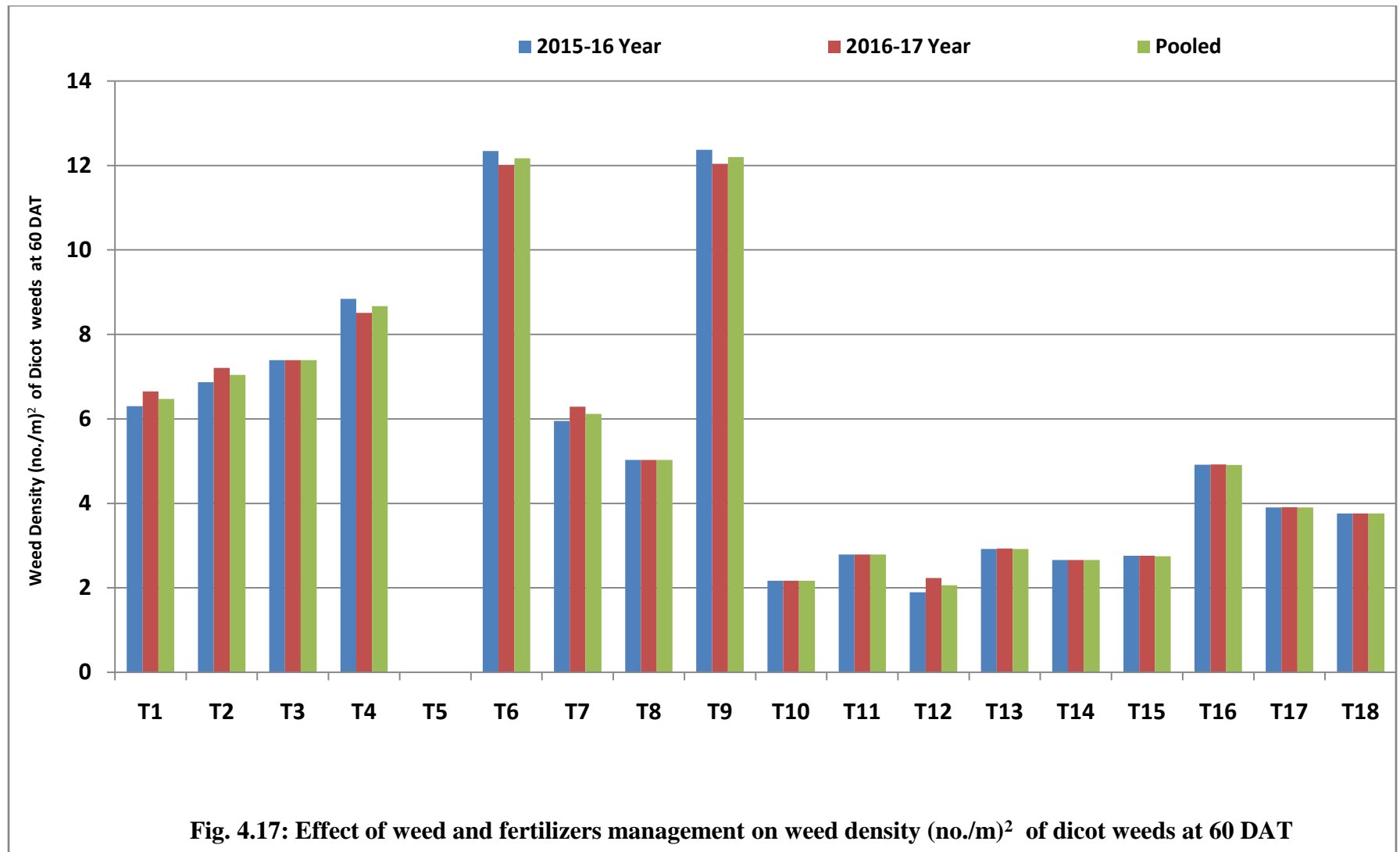
The data gathered in connection with Weed Density (no./m)<sup>2</sup> of dicot weeds at 60, days after transplanting due to influence of weed management have been displayed in Table 4.17 and graphically represented in Figure 4.17 the analysis of variance of data on this attribute has been mentioned in Appendix- 17.

Critical analysis of data presented in above table revealed the expressive differences in Weed Density (no./m)<sup>2</sup> of dicot weeds at 60, DAT due to various treatments of weed management. The maximum Weed Density (no./m)<sup>2</sup> of dicot weeds at 60 DAT i.e. 12.34 (no./m)<sup>2</sup> and 12.04 (no./m)<sup>2</sup> were noted by the application of T<sub>6</sub> (Weedy check (Control)) closely followed by T<sub>9</sub> (Fluazipop-p-butyl + Weed check) i.e. 12.37 (no./m)<sup>2</sup> and 12.01 (no./m)<sup>2</sup> during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 0.00 (no./m)<sup>2</sup> and 0.00 (no./m)<sup>2</sup> were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 1.897 and 2.23 (no. /m)<sup>2</sup>

During both the years, mean Weed Density (no./m)<sup>2</sup> of dicot weeds at 60 DAT was recorded noticed to be maximum 12.20 (no./m)<sup>2</sup> in the treatment T<sub>6</sub> (Weedy check (Control)) followed by treatment T<sub>9</sub> (Fluazipop-p-butyl + Weed check) i.e. 12.17 (no./m)<sup>2</sup> and minimum 0.00 (no./m)<sup>2</sup> was reported in treatment T<sub>5</sub>(weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 2.06 (no. /m)<sup>2</sup>.

**Table 4.17: Effect of weed and fertilizers management on weed density (no./m)<sup>2</sup> of dicot weeds at 60 DAT.**

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	6.3	6.65	6.47
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	6.87	7.21	7.04
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	7.39	7.39	7.39
T <sub>4</sub>	Hand weeding at 30 DAP	8.84	8.51	8.67
T <sub>5</sub>	Weed free	0.00	0.00	0.00
T <sub>6</sub>	Weedy check (Control)	12.34	12.01	12.17
T <sub>7</sub>	Pendimethalin+HW	5.950	6.29	6.12
T <sub>8</sub>	Oxyfluorfen+Weed free	5.03	5.03	5.03
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	12.37	12.04	12.20
T <sub>10</sub>	Pendimethalin+75% RDF+HW	2.167	2.17	2.17
T <sub>11</sub>	Pendimethalin+100% RDF+HW	2.787	2.79	2.79
T <sub>12</sub>	Pendimethalin+125% RDF+HW	1.897	2.23	2.06
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	2.920	2.93	2.92
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	2.657	2.66	2.66
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	2.757	2.76	2.75
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	4.917	4.92	4.91
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	3.903	3.91	3.90
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	3.760	3.76	3.76
	SE.m ±	0.398	0.466	0.321
	CD at 5%	1.149	1.344	0.107



### 4.8.3. Weed Density (no./m)<sup>2</sup> of Dicot weeds at 90 DAT:

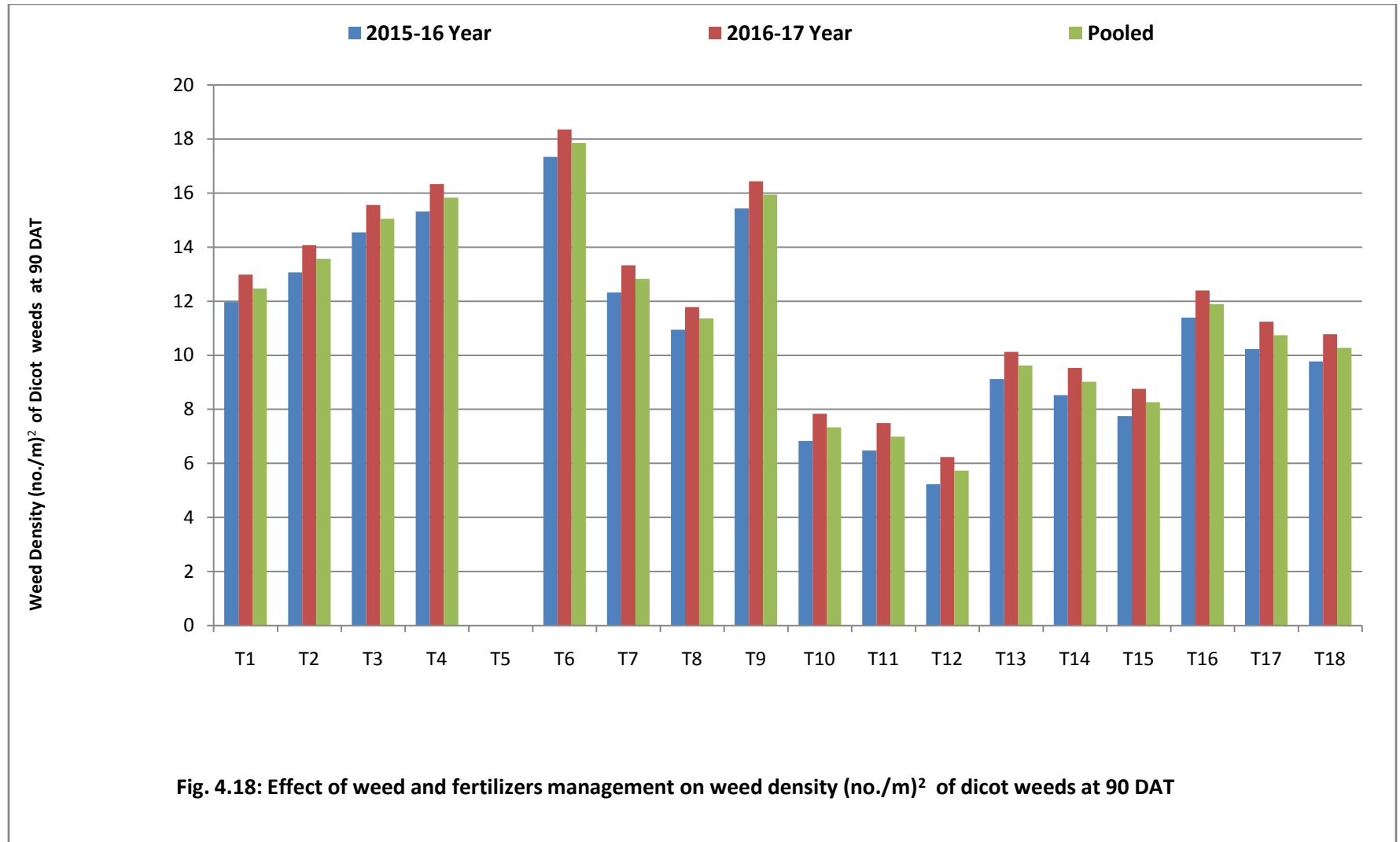
The data gathered in connection with Weed Density (no./m)<sup>2</sup> of dicot weeds at 90, days after transplanting due to influence of weed management have been displayed in Table 4.18 and graphically represented in Figure 4.18 the analysis of variance of data on this attribute has been mentioned in Appendix- 18.

Critical analysis of data presented in above table revealed the expressive differences in Weed Density (no./m)<sup>2</sup> of dicot weeds at 90, DAT due to various treatments of weed management. The maximum weed density (no./m)<sup>2</sup> of dicot weeds at 90 DAT i.e. 17.34 (no./m)<sup>2</sup> and 18.35 (no./m)<sup>2</sup> were noted by the application of T<sub>6</sub> (Weedy check (Control)) closely followed by T<sub>9</sub> (Fluazipop-p-butyl + Weed check) i.e. 15.43 (no./m)<sup>2</sup> and 16.44 (no./m)<sup>2</sup> during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 0.00 (no./m)<sup>2</sup> and 0.00 (no./m)<sup>2</sup> were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 5.23 and 6.24 (no./m)<sup>2</sup>.

During both the years, mean weed density (no./m)<sup>2</sup> of dicot weeds at 90 DAT was recorded noticed to be maximum 17.85 (no./m)<sup>2</sup> in the treatment T<sub>6</sub> (Weedy check (Control)) followed by treatment T<sub>9</sub> (Fluazipop-p-butyl + Weed check) i.e. 15.94 (no./m)<sup>2</sup> and minimum 0.00 (no./m)<sup>2</sup> was reported in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 5.73 (no./m)<sup>2</sup>.

Table 4.18: Effect of weed and fertilizers management on weed density (no./m)<sup>2</sup> of dicot weeds at 90 DAT.

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	11.97	12.98	12.47
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	13.07	14.07	13.57
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	14.55	15.56	15.05
T <sub>4</sub>	Hand weeding at 30 DAP	15.32	16.33	15.83
T <sub>5</sub>	Weed free	0.008	0.000	0.00
T <sub>6</sub>	Weedy check (Control)	17.34	18.35	17.85
T <sub>7</sub>	Pendimethalin+HW	12.32	13.33	12.82
T <sub>8</sub>	Oxyfluorfen+Weed free	10.94	11.78	11.36
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	15.43	16.44	15.94
T <sub>10</sub>	Pendimethalin+75% RDF+HW	6.83	7.84	7.33
T <sub>11</sub>	Pendimethalin+100% RDF+HW	6.48	7.49	6.99
T <sub>12</sub>	Pendimethalin+125% RDF+HW	5.23	6.24	5.73
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	9.12	10.13	9.62
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	8.52	9.53	9.02
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	7.75	8.76	8.26
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	11.39	12.40	11.89
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	10.23	11.24	10.74
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	9.77	10.78	10.27
	SE.m ±	0.346	0.348	0.362
	CD at 5%	0.999	1.003	0.120



#### 4.9.1. Fresh Weight of Dicot weeds ( $\text{g/m}^2$ ) at 30 DAT:

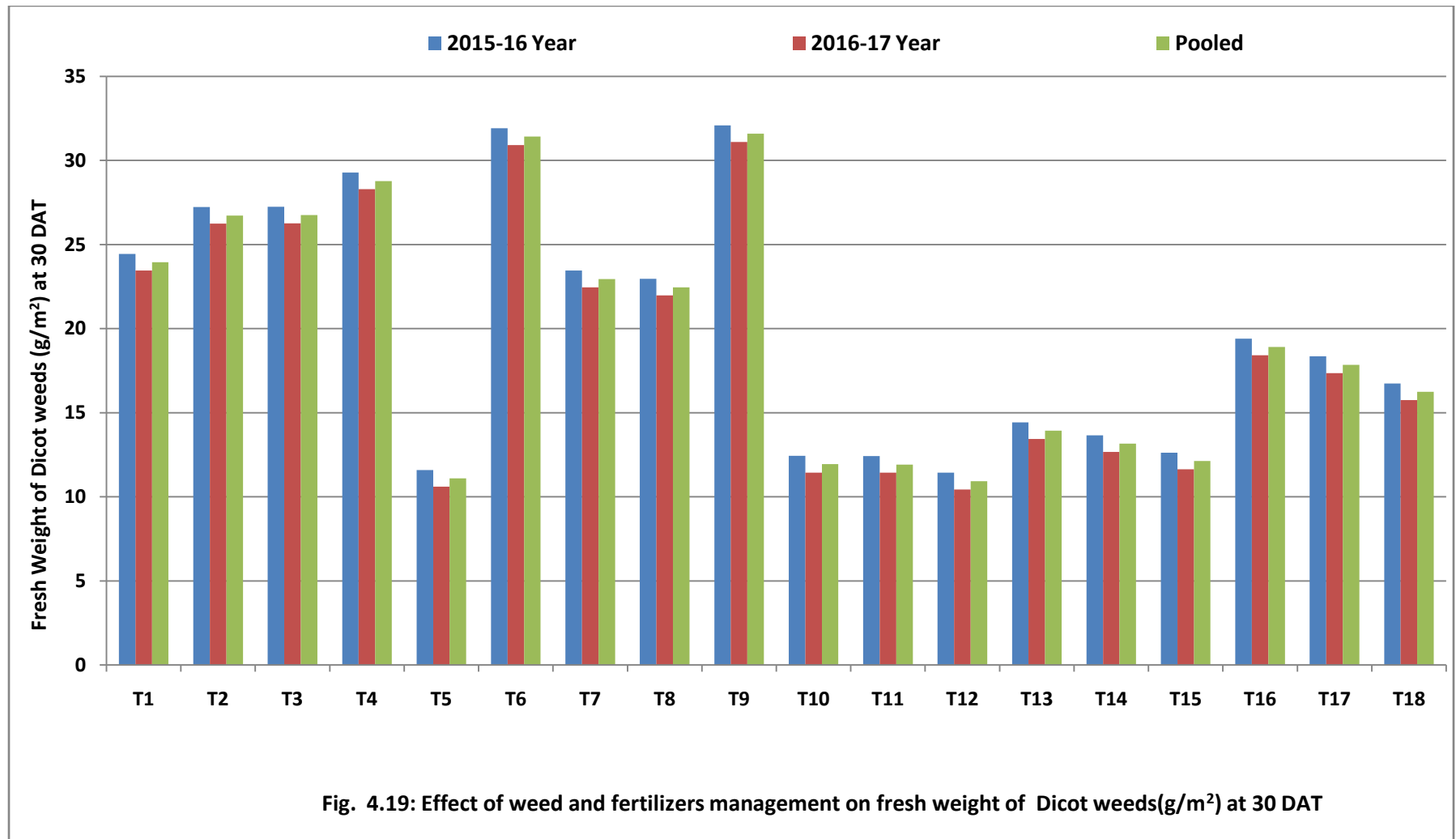
The data gathered in connection with Fresh Weight of Dicot weeds ( $\text{g/m}^2$ ) at 30, days after transplanting due to influence of weed management have been displayed in Table 4.19 and graphically represented in Figure 4.19 the analysis of variance of data on this attribute has been mentioned in Appendix- 19.

Critical analysis of data presented in above table revealed the expressive differences in Fresh Weight of Dicot weeds ( $\text{g/m}^2$ ) at 30, DAT due to various treatments of weed management. The maximum fresh weight of dicot weeds ( $\text{g/m}^2$ ) at 30 DAT i.e. 31.91 ( $\text{g/m}^2$ ) and 30.92 ( $\text{g/m}^2$ ) were noted by the application of T<sub>6</sub> (Weedy check (Control) closely followed by T<sub>9</sub> (Fluazipop-p-butyl + Weed check) i.e. 32.09 ( $\text{g/m}^2$ ) and 32.10 ( $\text{g/m}^2$ ) during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 11.59 ( $\text{g/m}^2$ ) and 10.60 ( $\text{g/m}^2$ ) were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 11.43 And 10.44 ( $\text{g/m}^2$ ).

During both the years, mean fresh weight of dicot weeds ( $\text{g/m}^2$ ) at 30 DAT was recorded noticed to be maximum 31.42 ( $\text{g/m}^2$ ) in the treatment T<sub>6</sub> (Weedy check (Control) followed by treatment T<sub>9</sub> (Fluazipop-p-butyl Weed check) i.e. 31.59 ( $\text{g/m}^2$ ) and minimum 11.09 ( $\text{g/m}^2$ ) was reported in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 10.93( $\text{g/m}^2$ ).

Table 4.19: Effect of weed and fertilizers management on fresh weight of dicot weeds (g/m<sup>2</sup>) at 30 DAT.

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	24.44	23.45	23.95
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	27.23	26.24	26.73
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	27.25	26.26	26.76
T <sub>4</sub>	Hand weeding at 30 DAP	29.28	28.29	28.78
T <sub>5</sub>	Weed free Number	11.59	10.60	11.09
T <sub>6</sub>	Weedy check (Control)	31.91	30.92	31.42
T <sub>7</sub>	Pendimethalin+HW	23.45	22.46	22.95
T <sub>8</sub>	Oxyfluorfen+Weed free	22.96	21.97	22.46
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	32.09	31.10	31.59
T <sub>10</sub>	Pendimethalin+75% RDF+HW	12.43	11.44	11.94
T <sub>11</sub>	Pendimethalin+100% RDF+HW	12.42	11.43	11.92
T <sub>12</sub>	Pendimethalin+125% RDF+HW	11.43	10.44	10.93
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	14.43	13.44	13.93
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	13.66	12.67	13.16
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	12.62	11.63	12.13
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	19.40	18.41	18.91
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	18.35	17.36	17.85
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	16.74	15.75	16.24
	SE.m ±	0.439	0.439	0.004
	CD at 5%	1.268	1.268	0.001



#### 4.9.2. Fresh Weight of Dicot weeds ( $\text{g/m}^2$ ) at 60 DAT:

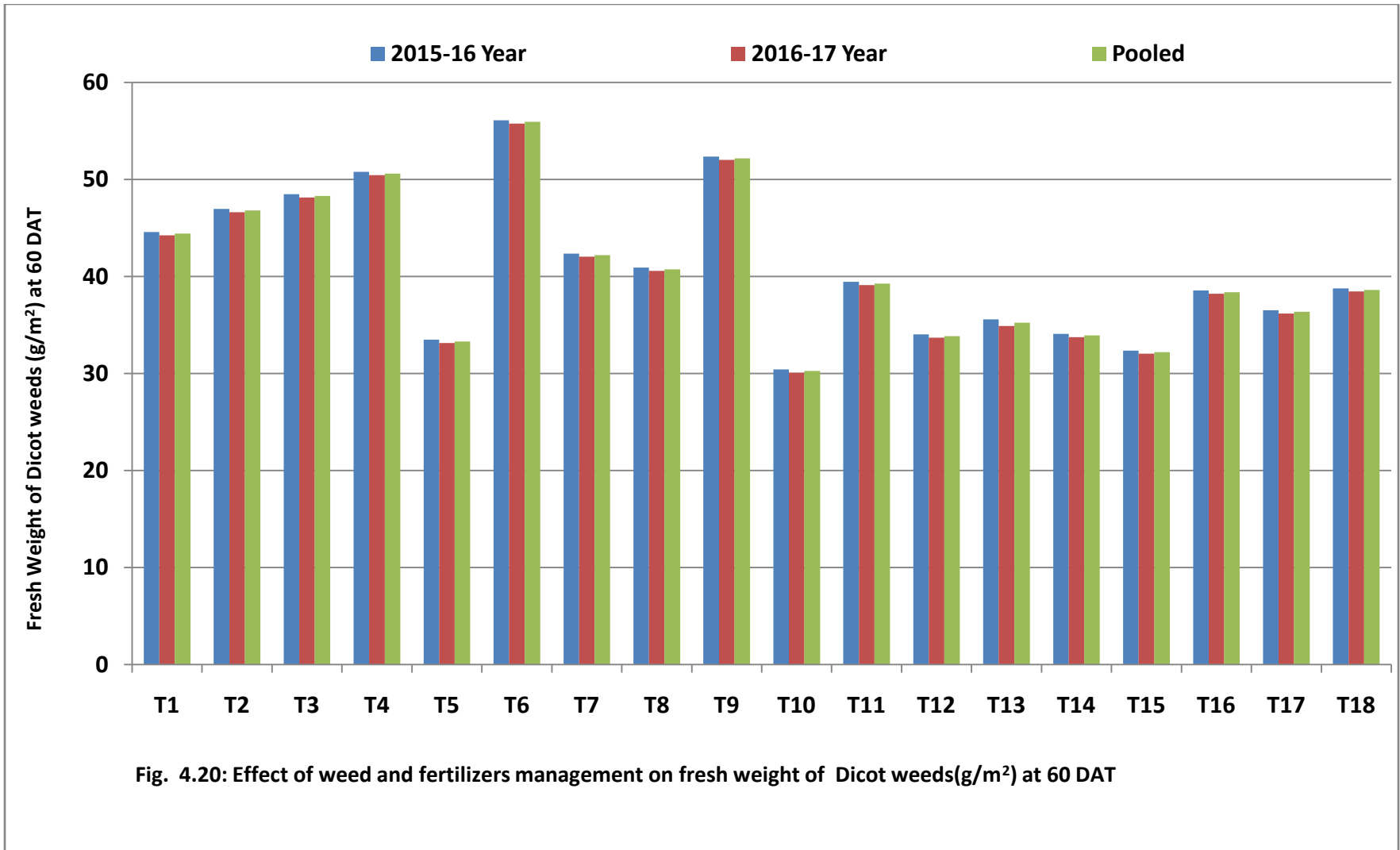
The data gathered in connection with fresh weight of dicot weeds ( $\text{g/m}^2$ ) at 60, days after transplanting due to influence of weed management have been displayed in Table 4.20 and graphically represented in Figure 4.20 the analysis of variance of data on this attribute has been mentioned in Appendix- 20.

Critical analysis of data presented in above table revealed the expressive differences in Fresh Weight of Dicot weeds ( $\text{g/m}^2$ ) at 60, DAT due to various treatments of weed management. The maximum fresh weight of dicot weeds ( $\text{g/m}^2$ ) at 60 DAT i.e. 56.11 ( $\text{g/m}^2$ ) and 55.77 ( $\text{g/m}^2$ ) were noted by the application of T<sub>6</sub> (Weedy check (Control) closely followed by T<sub>9</sub> (Fluazipop-p-butyl + Weed check) i.e. 52.35 ( $\text{g/m}^2$ ) and 52.01 ( $\text{g/m}^2$ ) during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 33.47 ( $\text{g/m}^2$ ) and 33.13 ( $\text{g/m}^2$ ) were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 34.03 And 33.70 ( $\text{g/m}^2$ ).

During both the years, mean fresh weight of dicot weeds ( $\text{g/m}^2$ ) at 60 DAT was recorded noticed to be maximum 55.94 ( $\text{g/m}^2$ ) in the treatment T<sub>6</sub> (Weedy check (Control) followed by treatment T<sub>9</sub> (Fluazipop-p-butyl Weed check) i.e. 52.18 ( $\text{g/m}^2$ ) and minimum 33.30 ( $\text{g/m}^2$ ) was reported in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 33.86 ( $\text{g/m}^2$ ).

Table 4.20: Effect of weed and fertilizers management on fresh weight of dicot weeds (g/m<sup>2</sup>) at 60 DAT.

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	44.59	44.25	44.42
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	46.97	46.63	46.80
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	48.48	48.15	48.31
T <sub>4</sub>	Hand weeding at 30 DAP	50.78	50.44	50.61
T <sub>5</sub>	Weed free	33.47	33.13	33.30
T <sub>6</sub>	Weedy check (Control)	56.11	55.77	55.94
T <sub>7</sub>	Pendimethalin+HW	42.36	42.03	42.19
T <sub>8</sub>	Oxyfluorfen+Weed free	40.91	40.58	40.74
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	52.35	52.01	52.18
T <sub>10</sub>	Pendimethalin+75% RDF+HW	30.43	30.09	30.26
T <sub>11</sub>	Pendimethalin+100% RDF+HW	39.45	39.12	39.28
T <sub>12</sub>	Pendimethalin+125% RDF+HW	34.03	33.70	33.86
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	35.57	34.90	35.23
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	34.09	33.75	33.92
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	32.36	32.03	32.19
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	38.56	38.22	38.39
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	36.52	36.19	36.35
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	38.78	38.45	38.61
	SE.m ±	0.742	0.741	0.121
	CD at 5%	2.142	2.138	0.040



### 4.9.3. Fresh Weight of Dicot weeds ( $\text{g/m}^2$ ) at 90 DAT:

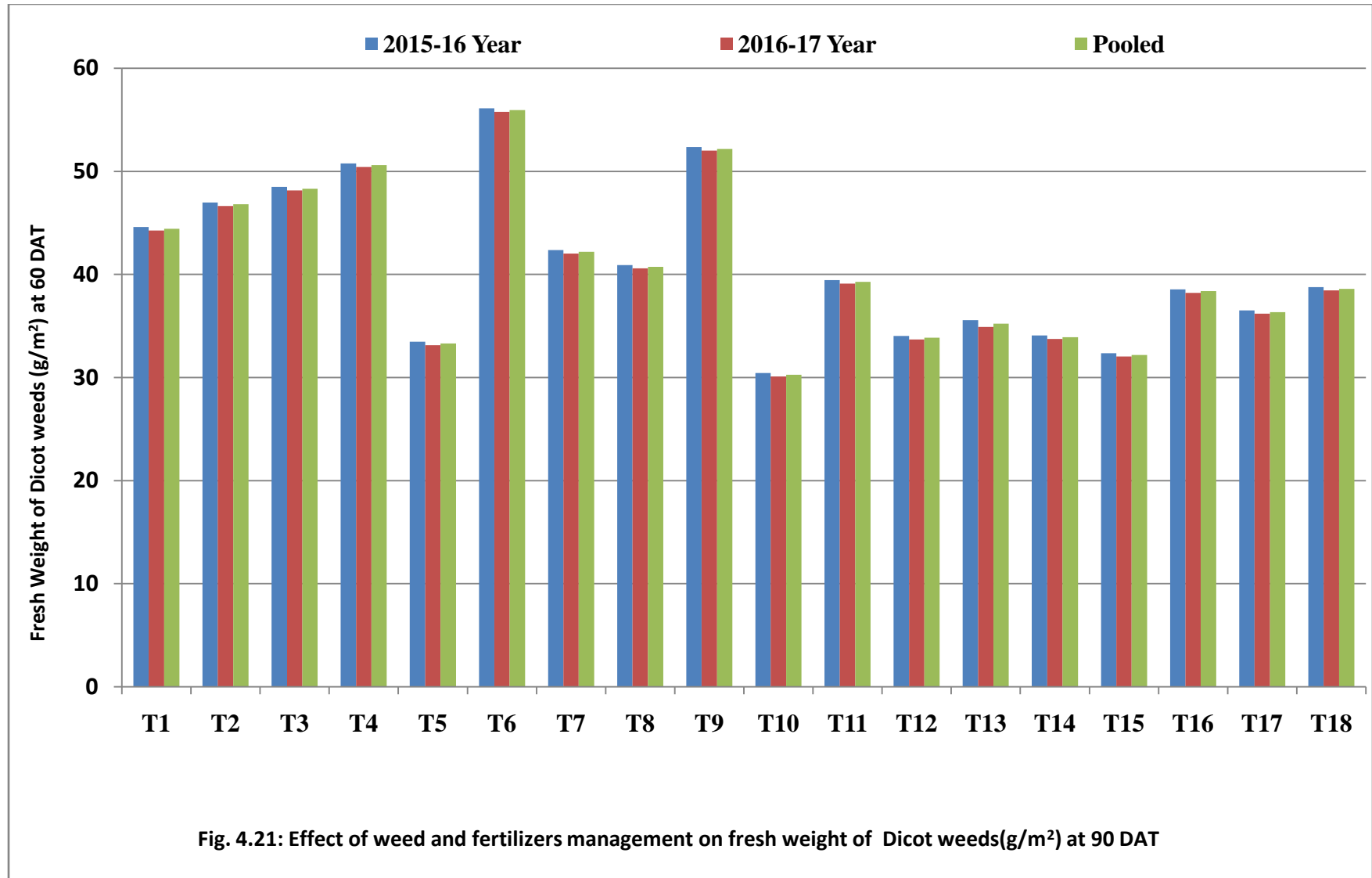
The data gathered in connection with Fresh Weight of Dicot weeds ( $\text{g/m}^2$ ) at 90, days after transplanting due to influence of weed management have been displayed in Table 4.21 and graphically represented in Figure 4.21 the analysis of variance of data on this attribute has been mentioned in Appendix- 21.

Critical analysis of data presented in above table revealed the expressive differences in fresh weight of dicot weeds ( $\text{g/m}^2$ ) at 90, DAT due to various treatments of weed management. The maximum fresh weight of dicot weeds ( $\text{g/m}^2$ ) at 90 DAT i.e. 94.06 ( $\text{g/m}^2$ ) and 94.73 ( $\text{g/m}^2$ ) were noted by the application of T<sub>6</sub> (Weedy check (Control)) closely followed by T<sub>9</sub> (Fluazipop-p-butyl + Weed check) i.e. 92.25 ( $\text{g/m}^2$ ) and 92.93 ( $\text{g/m}^2$ ) during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 55.45 ( $\text{g/m}^2$ ) and 56.12 ( $\text{g/m}^2$ ) were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 59.73 And 60.40 ( $\text{g/m}^2$ ).

During both the years, mean fresh weight of dicot weeds ( $\text{g/m}^2$ ) at 90 DAT was recorded noticed to be maximum 94.40 ( $\text{g/m}^2$ ) in the treatment T<sub>6</sub> (Weedy check (Control)) followed by treatment T<sub>9</sub> (Fluazipop-p-butyl Weed check) i.e. 92.59 ( $\text{g/m}^2$ ) and minimum 55.79 ( $\text{g/m}^2$ ) was reported in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 60.07 ( $\text{g/m}^2$ ).

Table 4.21: Effect of weed and fertilizers management on fresh weight of Dicot weeds (g/m<sup>2</sup>) at 90 DAT.

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	85.20	85.87	85.53
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	87.59	88.27	87.93
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	90.37	91.38	90.87
T <sub>4</sub>	Hand weeding at 30 DAP	90.31	90.99	90.65
T <sub>5</sub>	Weed free	55.45	56.12	55.79
T <sub>6</sub>	Weedy check (Control)	94.06	94.73	94.40
T <sub>7</sub>	Pendimethalin+HW	84.32	84.99	84.65
T <sub>8</sub>	Oxyfluorfen+Weed free	79.92	80.59	80.25
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	92.25	92.93	92.59
T <sub>10</sub>	Pendimethalin+75% RDF+HW	63.34	64.01	63.68
T <sub>11</sub>	Pendimethalin+100% RDF+HW	61.17	61.84	61.51
T <sub>12</sub>	Pendimethalin+125% RDF+HW	59.73	60.40	60.07
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	70.59	67.93	69.26
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	66.99	67.66	67.33
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	66.64	67.31	66.97
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	79.78	80.45	80.11
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	75.14	75.81	75.47
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	71.38	72.05	71.72
	SE.m ±	0.774	1.137	1.193
	CD at 5%	2.234	3.282	0.396



#### 4.10. Dry weight of weeds ( $\text{g/m}^2$ ):

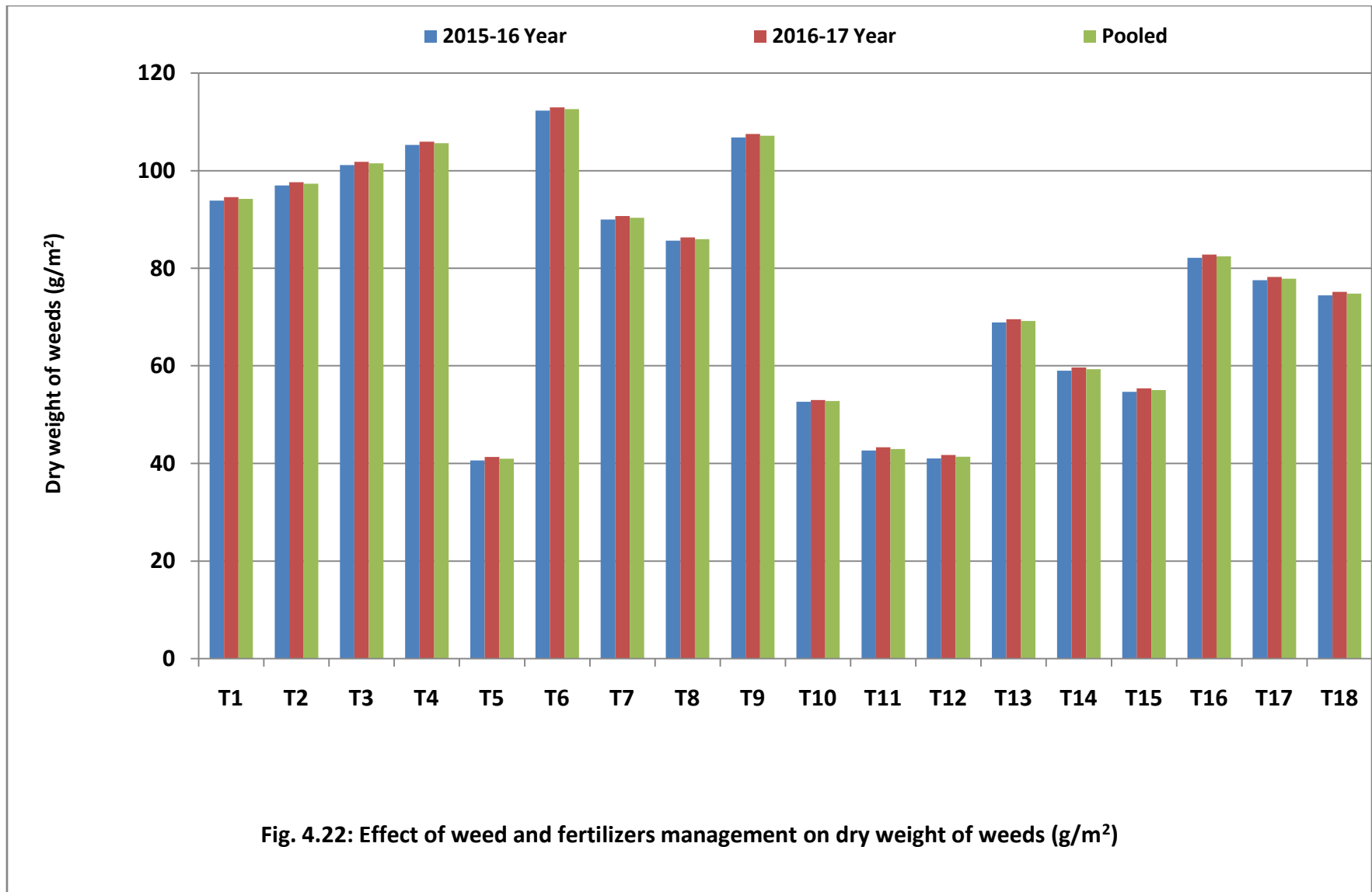
The data gathered in connection with Dry weight of weeds ( $\text{g/m}^2$ ) ( $\text{g/m}^2$ ) at 90, days after transplanting due to influence of weed management have been displayed in Table 4.22 and graphically represented in Figure 4.22 the analysis of variance of data on this attribute has been mentioned in Appendix- 22.

Critical analysis of data presented in above table revealed the expressive differences in Dry weight of weeds ( $\text{g/m}^2$ ) ( $\text{g/m}^2$ ) at 90, DAT due to various treatments of weed management. The maximum dry weight of weeds ( $\text{g/m}^2$ ) ( $\text{g/m}^2$ ) at 90 DAT i.e. 112.29 ( $\text{g/m}^2$ ) and 112.97 ( $\text{g/m}^2$ ) were noted by the application of T<sub>6</sub> (Weedy check (Control)) closely followed by T<sub>9</sub>(Fluazipop-p-butyl + Weed check) i.e. 106.82 ( $\text{g/m}^2$ ) and 107.50 ( $\text{g/m}^2$ ) during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 40.63 ( $\text{g/m}^2$ ) and 41.31 ( $\text{g/m}^2$ ) were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 41.03 And 41.71 ( $\text{g/m}^2$ ).

During both the years, mean dry weight of weeds ( $\text{g/m}^2$ ) at 90 DAT was recorded noticed to be maximum 112.63 ( $\text{g/m}^2$ ) in the treatment T<sub>6</sub> (Weedy check (Control)) followed by treatment T<sub>9</sub>(Fluazipop-p-butyl Weed check) i.e. 107.16 ( $\text{g/m}^2$ ) and minimum 40.97 ( $\text{g/m}^2$ ) was reported in treatment T<sub>5</sub>(weed free) followed by T<sub>12</sub> (Pendimethalin+125%RDF+HW) i.e.41.37( $\text{g/m}^2$ ).

Table 4.22: Effect of weed and fertilizers management on dry weight of weeds (g/m<sup>2</sup>).

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	93.87	94.55	94.21
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	96.97	97.65	97.31
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	101.14	101.82	101.48
T <sub>4</sub>	Hand weeding at 30 DAP	105.27	105.95	105.61
T <sub>5</sub>	Weed free	40.63	41.31	40.97
T <sub>6</sub>	Weedy check (Control)	112.29	112.97	112.63
T <sub>7</sub>	Pendimethalin+HW	90.01	90.69	90.35
T <sub>8</sub>	Oxyfluorfen+Weed free	85.64	86.32	85.98
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	106.82	107.50	107.16
T <sub>10</sub>	Pendimethalin+75% RDF+HW	52.63	52.98	52.80
T <sub>11</sub>	Pendimethalin+100% RDF+HW	42.63	43.31	42.97
T <sub>12</sub>	Pendimethalin+125% RDF+HW	41.03	41.71	41.37
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	68.88	69.56	69.22
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	58.99	59.67	59.33
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	54.70	55.38	55.04
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	82.12	82.80	82.46
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	77.53	78.21	77.87
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	74.47	75.15	74.81
	SE.m ±	1.075	1.081	0.091
	CD at 5%	3.103	3.121	0.030



#### 4.11. Weed control efficiency (%):

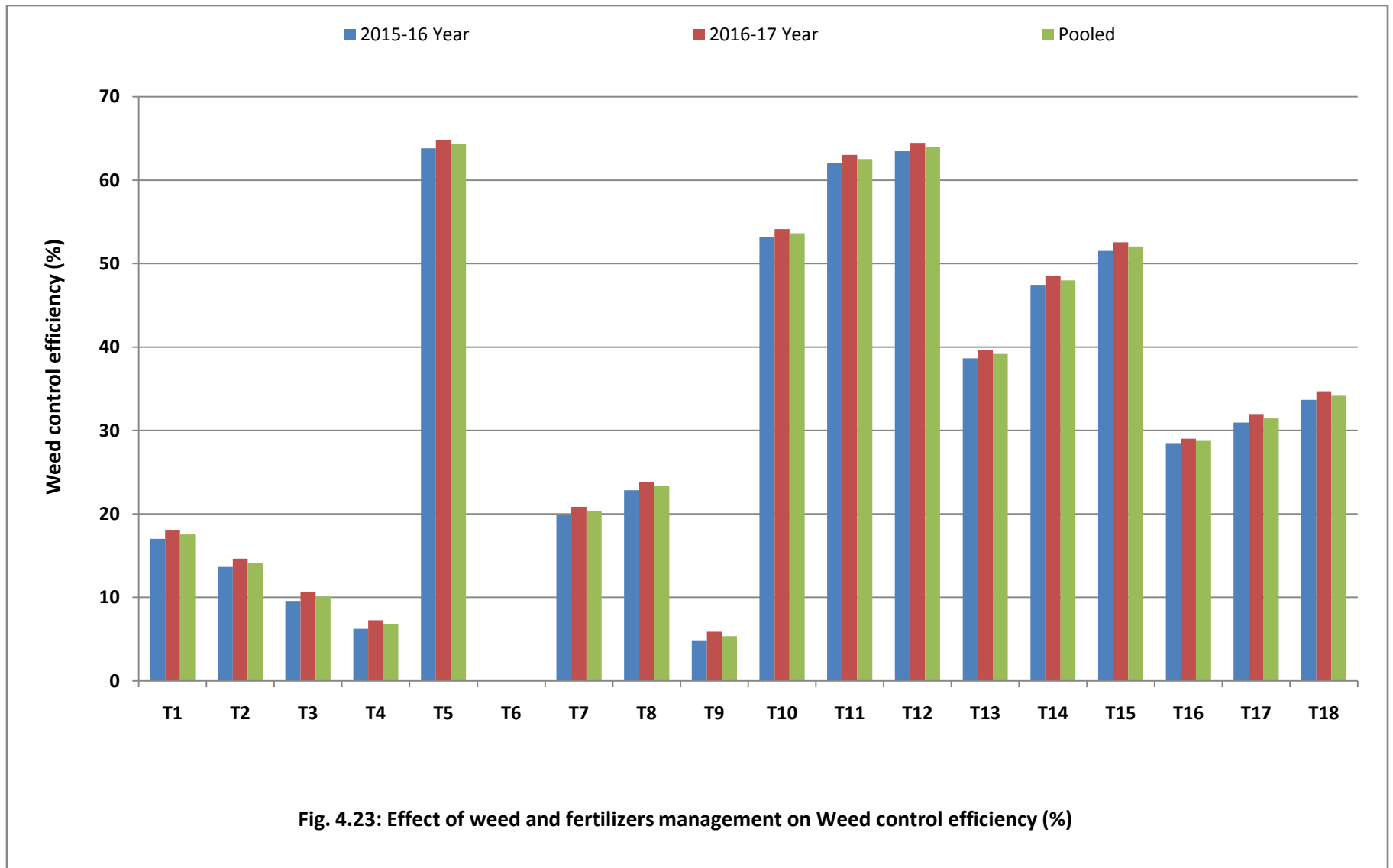
The data gathered in connection with weed control efficiency (%) ( $\text{g/m}^2$ ) as influenced by different treatment at harvest are presented in Table 4.23 and graphically represented in Figure 4.23 efficiency the analysis of variance of data on this attribute has been mentioned in Appendix- 23.

Among the herbicide treatment, the maximum weed control efficiency(%) recorded in T<sub>5</sub>(Weed free) 64.31% and T<sub>12</sub> application of Pendimethalin + 125% RDF + HW 63.96% at 30 DAT Recorded significantly higher weed control efficiency application of Pendimethalin + 100% RDF + HW at 45 DAT found third rank in respect of weed control efficiency (62.53%).Significantly lower weed control efficiency was noticed in a T<sub>6</sub> (Weedy check (Control).followed by T<sub>9</sub> (Fluazipop-p-butyl + Weed check) and T<sub>4</sub> (Hand weeding at 20 DAP) The weed free treatment was found significantly superior by recording 100% weed control efficiency.

The higher WCE in this treatment might be due to the significant reduction in weed dry matter because effective weed control practices through application of pre-emergence and post emergence herbicides. Related results were also reported by **Singh et al. (1997), Tewari et al. (1998) and Kathiresan et al. (2004).**

Table 4.23: Effect of weed and fertilizers management on Weed control efficiency (%).

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	17.00	18.10	17.55
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	13.64	14.65	14.14
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	9.58	10.59	10.09
T <sub>4</sub>	Hand weeding at 30 DAP	6.25	7.26	6.75
T <sub>5</sub>	Weed free	63.81	64.82	64.31
T <sub>6</sub>	Weedy check (Control)	0.00	0.00	0.00
T <sub>7</sub>	Pendimethalin+HW	19.84	20.85	20.34
T <sub>8</sub>	Oxyfluorfen+Weed free	22.84	23.85	23.34
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	4.87	5.88	5.37
T <sub>10</sub>	Pendimethalin+75% RDF+HW	53.13	54.14	53.63
T <sub>11</sub>	Pendimethalin+100% RDF+HW	62.03	63.04	62.53
T <sub>12</sub>	Pendimethalin+125% RDF+HW	63.46	64.47	63.96
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	38.65	39.66	39.16
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	47.46	48.47	47.97
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	51.53	52.54	52.04
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	28.50	29.00	28.75
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	30.95	31.96	31.45
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	33.68	34.69	34.18
	SE.m ±	1.684	1.692	0.390
	CD at 5%	4.861	4.883	0.130



#### 4.12. Bulb weight (g):

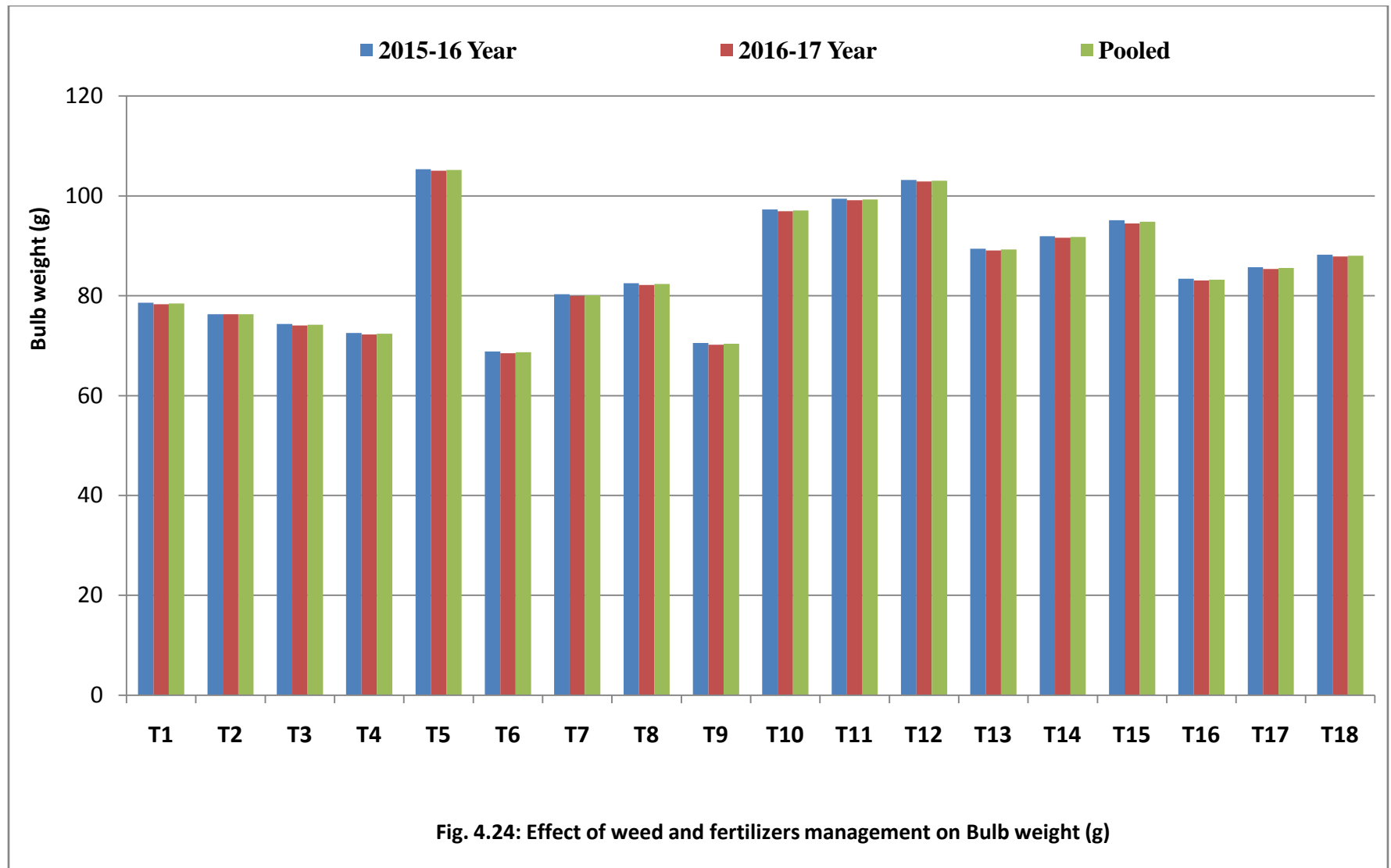
The data in respect of fresh weight of bulb at harvest as influenced by different weed control treatment are presented in Table 4.24 and graphically represented in Figure 4.24 efficiency the analysis of variance of data on this attribute has been mentioned in Appendix- 24.

Critical analysis of data presented in above table revealed the expressive differences in fresh weight of bulb after harvest due to various treatments of weed management. The maximum fresh weight of bulb at 90 DAT i.e. 105.35 g. and 105.03 g. were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 103.20 g. and 102.87 g. during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 68.84 g. and 68.51 g. were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

It was revealed that there were differences in fresh weight of bulb due to various weed management treatments. Among the different treatments, the T<sub>5</sub>(Weed free) treatment recorded the highest average fresh weight of bulb (105.19 g. bulb) and it was at par with the integrated weed management treatment of Pendimethalin + 125% RDF + HW(103.04) + Pendimethalin + 100%RD F+ HW(99.27g.bulb) + Pendimethalin + 75%RDF+HW(97.08g.bulb) + Oxyfluorfen + 125%RDF + WF(94.81 g. bulb) + Oxyfluorfen + 100%RDF + WF(91.75 g. bulb) at 45 DAT these treatment were superior as compared to other treatment. The treatment of T<sub>6</sub> (Weedy check (Control)), recorded significantly lowest average fresh weight of bulb (68.68 g. bulb) as compared to rest of the treatment.

Table 4.24: Effect of weed and fertilizers management on Bulb weight (g).

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	78.62	78.29	78.45
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	76.29	76.30	76.29
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	74.36	74.03	74.20
T <sub>4</sub>	Hand weeding at 30 DAP	72.56	72.23	72.40
T <sub>5</sub>	Weed free	105.35	105.03	105.19
T <sub>6</sub>	Weedy check (Control)	68.84	68.51	68.68
T <sub>7</sub>	Pendimethalin+HW	80.28	79.95	80.11
T <sub>8</sub>	Oxyfluorfen+Weed free	82.51	82.17	82.34
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	70.54	70.21	70.38
T <sub>10</sub>	Pendimethalin+75% RDF+HW	97.25	96.92	97.08
T <sub>11</sub>	Pendimethalin+100% RDF+HW	99.44	99.11	99.27
T <sub>12</sub>	Pendimethalin+125% RDF+HW	103.20	102.87	103.04
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	89.40	89.08	89.24
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	91.91	91.59	91.75
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	95.14	94.48	94.81
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	83.38	83.05	83.21
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	85.70	85.38	85.54
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	88.19	87.86	88.03
	SE.m ±	0.350	0.358	0.185
	CD at 5%	1.009	1.032	0.061



#### 4.14. Bulb diameter (cm):

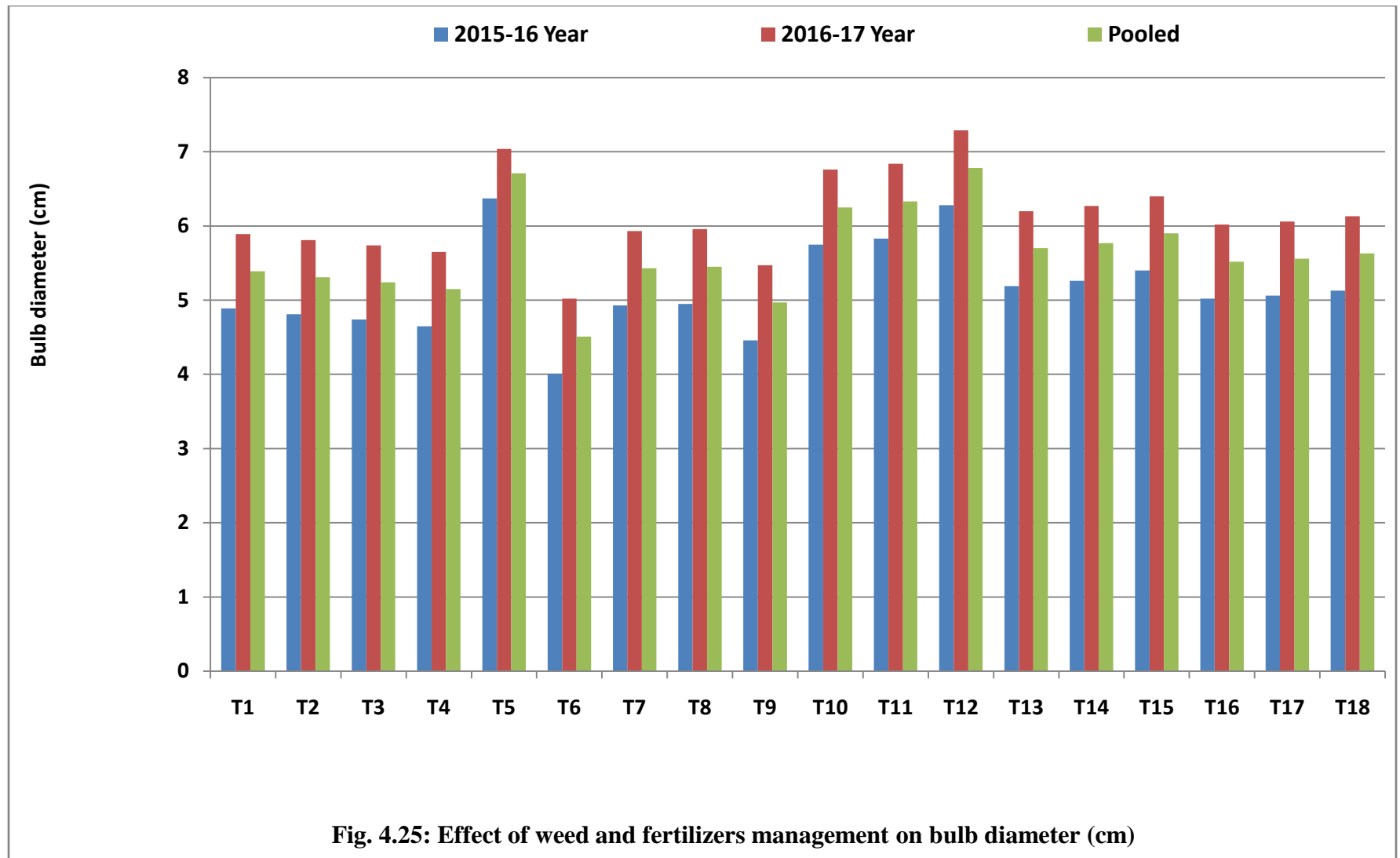
The data in respect of bulb diameter at harvest as influenced by different weed control treatment are presented in Table 4.25 and graphically represented in Figure 4.25 efficiency the analysis of variance of data on this attribute has been mentioned in Appendix- 25.

Critical analysis of data presented in above table revealed the expressive differences in Bulb diameter after harvest due to various treatments of weed management. The maximum bulb diameter at 90 DAT i.e. 6.37 cm and 7.04 cm were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 6.28 cm and 7.29 cm during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 4.01 cm and 5.02 cm were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

It was revealed that there were differences in Bulb diameter due to various weed management treatments. Among the different treatments, the T<sub>5</sub> (Weed free) treatment recorded the highest average Bulb diameter (6.71 cm.) and it was at par with the integrated weed management treatment of Pendimethalin + 125% RDF + HW (6.78cm) + Pendimethalin + 100% RDF + HW (6.33) + Pendimethalin + 75% RDF + HW (6.25cm) + Oxyfluorfen + 125% RDF + WF (5.90 cm) + Oxyfluorfen + 100% RDF + WF (5.77cm) at 90 DAT these treatment were superior as compared to other treatment. The treatment of T<sub>6</sub> (Weedy check (Control)). recorded significantly lowest average Bulb diameter (4.51cm) as compared to rest of the treatment.

Table 4.25: Effect of weed and fertilizers management on bulb diameter (cm)

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	4.89	5.89	5.39
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	4.81	5.81	5.31
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	4.74	5.74	5.24
T <sub>4</sub>	Hand weeding at 30 DAP	4.65	5.65	5.15
T <sub>5</sub>	Weed free	6.37	7.04	6.71
T <sub>6</sub>	Weedy check (Control)	4.01	5.02	4.51
T <sub>7</sub>	Pendimethalin+HW	4.93	5.93	5.43
T <sub>8</sub>	Oxyfluorfen+Weed free	4.95	5.96	5.45
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	4.46	5.47	4.97
T <sub>10</sub>	Pendimethalin+75% RDF+HW	5.75	6.76	6.25
T <sub>11</sub>	Pendimethalin+100% RDF+HW	5.83	6.84	6.33
T <sub>12</sub>	Pendimethalin+125% RDF+HW	6.28	7.29	6.78
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	5.19	6.20	5.70
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	5.26	6.27	5.77
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	5.40	6.40	5.90
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	5.02	6.02	5.52
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	5.06	6.06	5.56
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	5.13	6.13	5.63
	SE.m ±	0.104	0.153	0.118
	CD at 5%	0.299	0.442	0.039



#### 4.15. Number of scales/bulb:

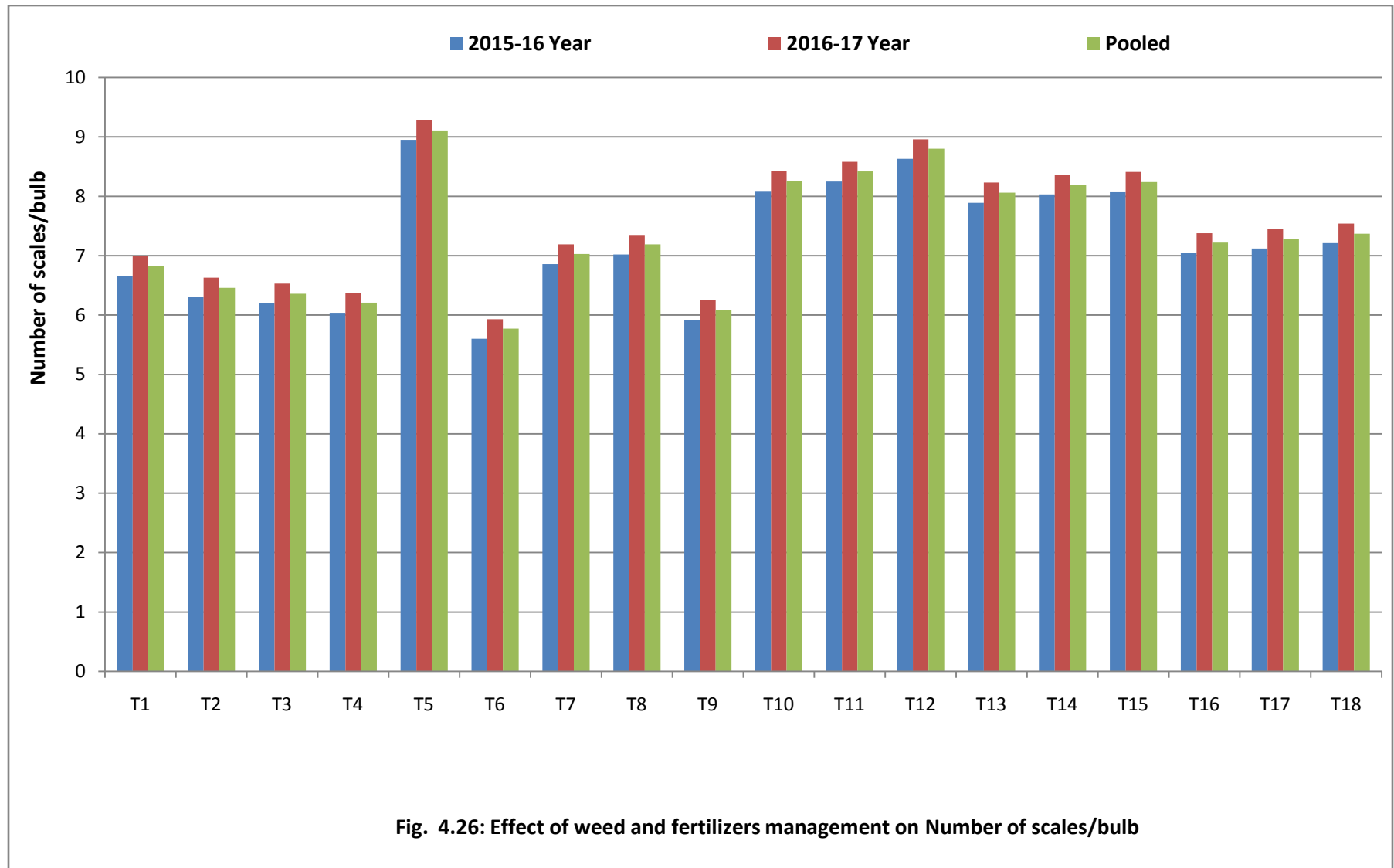
The data in respect of number of scales/bulb after harvest as influenced by different weed control treatment are presented in Table 4.26 and graphically represented in Figure 4.26 efficiency the analysis of variance of data on this attribute has been mentioned in Appendix- 26.

Critical analysis of data presented in above Table revealed the expressive differences in number of scales/bulb after harvest due to various treatments of weed management. The maximum number of scales/bulb after harvest i.e. 8.95 and 9.28 were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 8.63 and 8.96 during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 5.60 and 5.93 were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

It was revealed that there were differences in number of scales/bulb due to various weed management treatments. Among the different treatments, the T<sub>5</sub> (Weed free) treatment recorded the highest average Number of scales/bulb 9.11. and it was at par with the integrated weed management treatment of Pendimethalin + 125% RDF + HW (8.80)+ Pendimethalin + 100% RDF + HW(8.42) + Pendimethalin + 75% RDF + HW (8.26) + Oxyfluorfen + 125% RDF + WF(8.24) + Oxyfluorfen + 100% RDF + WF(8.20) after harvest these treatment were superior as compared to other treatment. The treatment of T<sub>6</sub> (Weedy check (Control)). recorded significantly lowest average Number of scales/bulb (5.77) as compared to rest of the treatment.

Table 4.26: Effect of weed and fertilizers management on Number of scales/bulb.

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	6.66	6.99	6.82
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	6.30	6.63	6.46
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	6.20	6.53	6.36
T <sub>4</sub>	Hand weeding at 30 DAP	6.04	6.37	6.21
T <sub>5</sub>	Weed free	8.95	9.28	9.11
T <sub>6</sub>	Weedy check (Control)	5.60	5.93	5.77
T <sub>7</sub>	Pendimethalin+HW	6.86	7.19	7.03
T <sub>8</sub>	Oxyfluorfen+Weed free	7.02	7.35	7.19
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	5.92	6.25	6.09
T <sub>10</sub>	Pendimethalin+75% RDF+HW	8.09	8.43	8.26
T <sub>11</sub>	Pendimethalin+100% RDF+HW	8.25	8.58	8.42
T <sub>12</sub>	Pendimethalin+125% RDF+HW	8.63	8.96	8.80
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	7.89	8.23	8.06
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	8.03	8.36	8.20
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	8.08	8.41	8.24
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	7.05	7.38	7.22
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	7.12	7.45	7.28
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	7.21	7.54	7.37
	SE.m ±	0.059	0.059	0.007
	CD at 5%	0.170	0.169	0.002



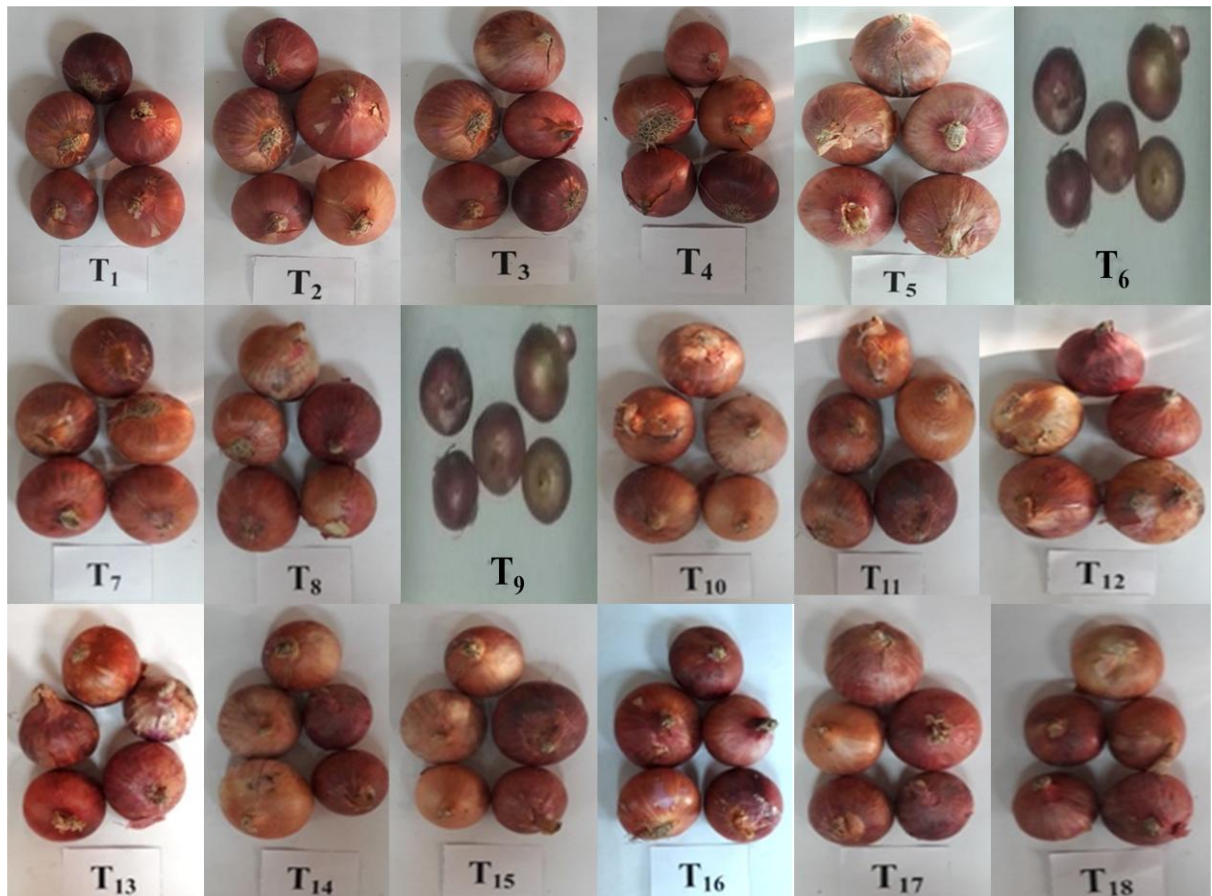
#### 4.16. Bulb yield/plot (kg):

The data in respect of bulb yield/plot (kg) after harvest as influenced by different weed control treatment are presented in Table 4.27 and graphically represented in Figure 4.27 efficiency the analysis of variance of data on this attribute has been mentioned in Appendix- 27.

Critical analysis of data presented in above Table revealed the expressive differences in bulb yield/plot (kg) after harvest due to various treatments of weed management. The maximum bulb yield/plot (kg) after harvest i.e. 5.48 and 4.45 were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 5.24 and 4.21 during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 2.83 and 1.80 were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

It was revealed that there were differences in bulb yield/plot (kg) due to various weed management treatments. Among the different treatments, the T<sub>5</sub> (Weed free) treatment recorded the highest average Bulb yield/plot (kg) 4.97. and it was at par with the integrated weed management treatment of Pendimethalin+125% RDF+HW(4.73)+ Pendimethalin + 100% RDF + HW (4.60) + Pendimethalin + 75% RDF + HW (4.56) + Oxyfluorfen + 125% RDF + WF (4.44) + Oxyfluorfen + 100% RDF + WF (4.31) after harvest these treatment were superior as compared to other treatment. The treatment of T<sub>6</sub> (Weedy check (Control)). recorded significantly lowest average Bulb yield/plot (kg) (2.31) as compared to rest of the treatment.

These findings are in close compliance with those reported by **Singh *et al.* (1982)**, **Singh and Singh (1994)**, **Nandal and Singh (2002)**, **Bhutia, *et al.* (2005)**, **Warade *et al.* (2006)** and **Patel *et al.* (2011)**.



**Plate 4. Effect of weed and fertilizers management on size and quality analysis of bulb**

Table 4.27: Effect of weed and fertilizers management on bulb yield/plot (kg).

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	3.75	2.72	3.24
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	3.70	2.67	3.18
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	3.52	2.49	3.00
T <sub>4</sub>	Hand weeding at 30 DAP	3.23	2.20	2.72
T <sub>5</sub>	Weed free	5.48	4.45	4.97
T <sub>6</sub>	Weedy check (Control)	2.83	1.80	2.31
T <sub>7</sub>	Pendimethalin+HW	3.94	2.91	3.43
T <sub>8</sub>	Oxyfluorfen+Weed free	4.06	3.03	3.55
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	3.14	2.11	2.63
T <sub>10</sub>	Pendimethalin+75% RDF+HW	5.07	4.04	4.56
T <sub>11</sub>	Pendimethalin+100% RDF+HW	5.11	4.08	4.60
T <sub>12</sub>	Pendimethalin+125% RDF+HW	5.24	4.21	4.73
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	4.73	3.70	4.22
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	4.82	3.79	4.31
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	4.95	3.92	4.44
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	4.25	3.22	3.73
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	4.32	3.29	3.81
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	4.52	3.49	4.00
	SE.m ±	0.014	0.014	0.004
	CD at 5%	0.040	0.039	0.001

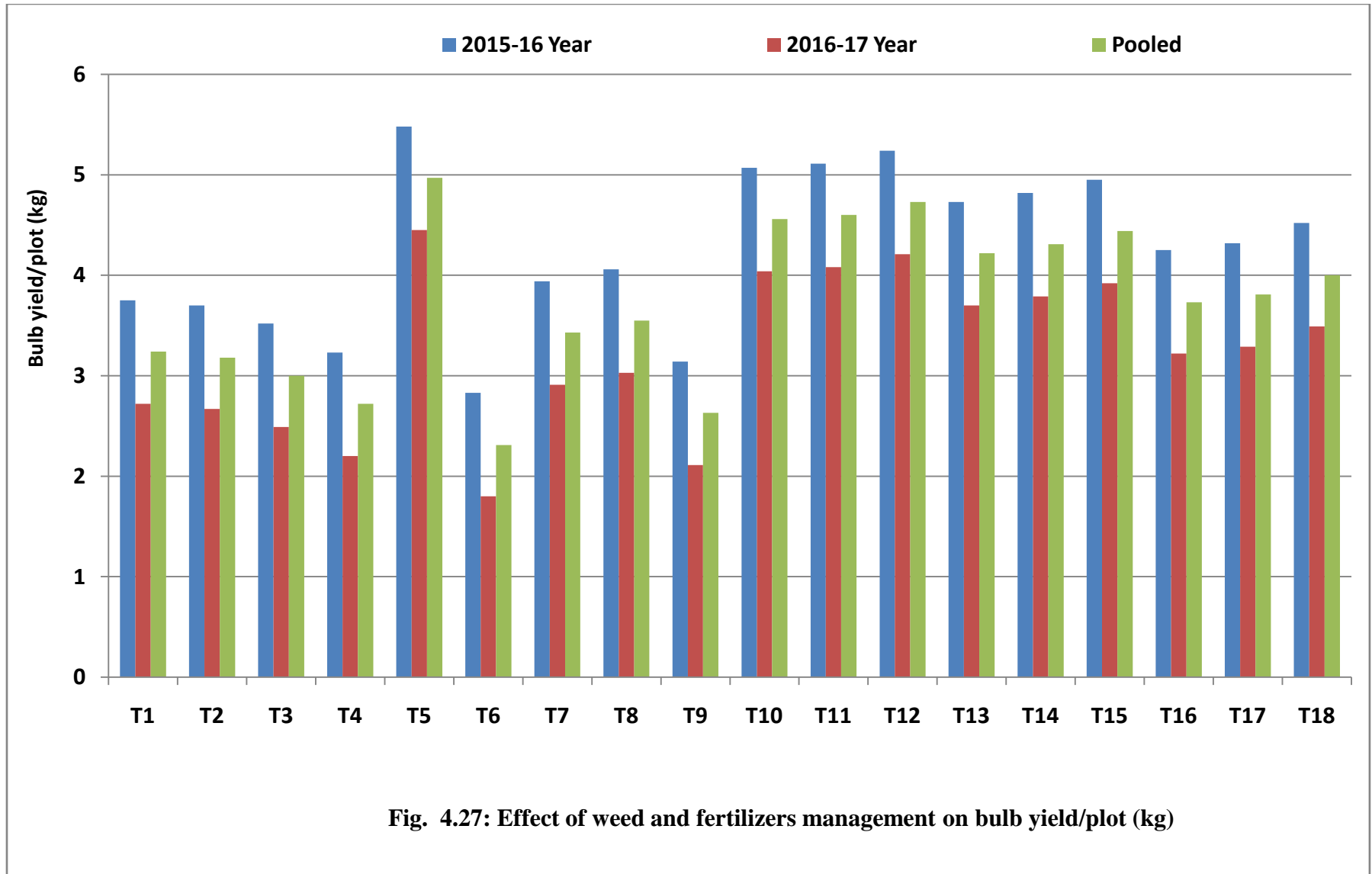


Fig. 4.27: Effect of weed and fertilizers management on bulb yield/plot (kg)

#### 4.17. Total bulb yield (q/ha):

The data in respect of total bulb yield (q/ha) after harvest as influenced by different weed control treatment are presented in Table 4.28 and graphically represented in Figure 4.28 efficiency the analysis of variance of data on this attribute has been mentioned in Appendix- 28.

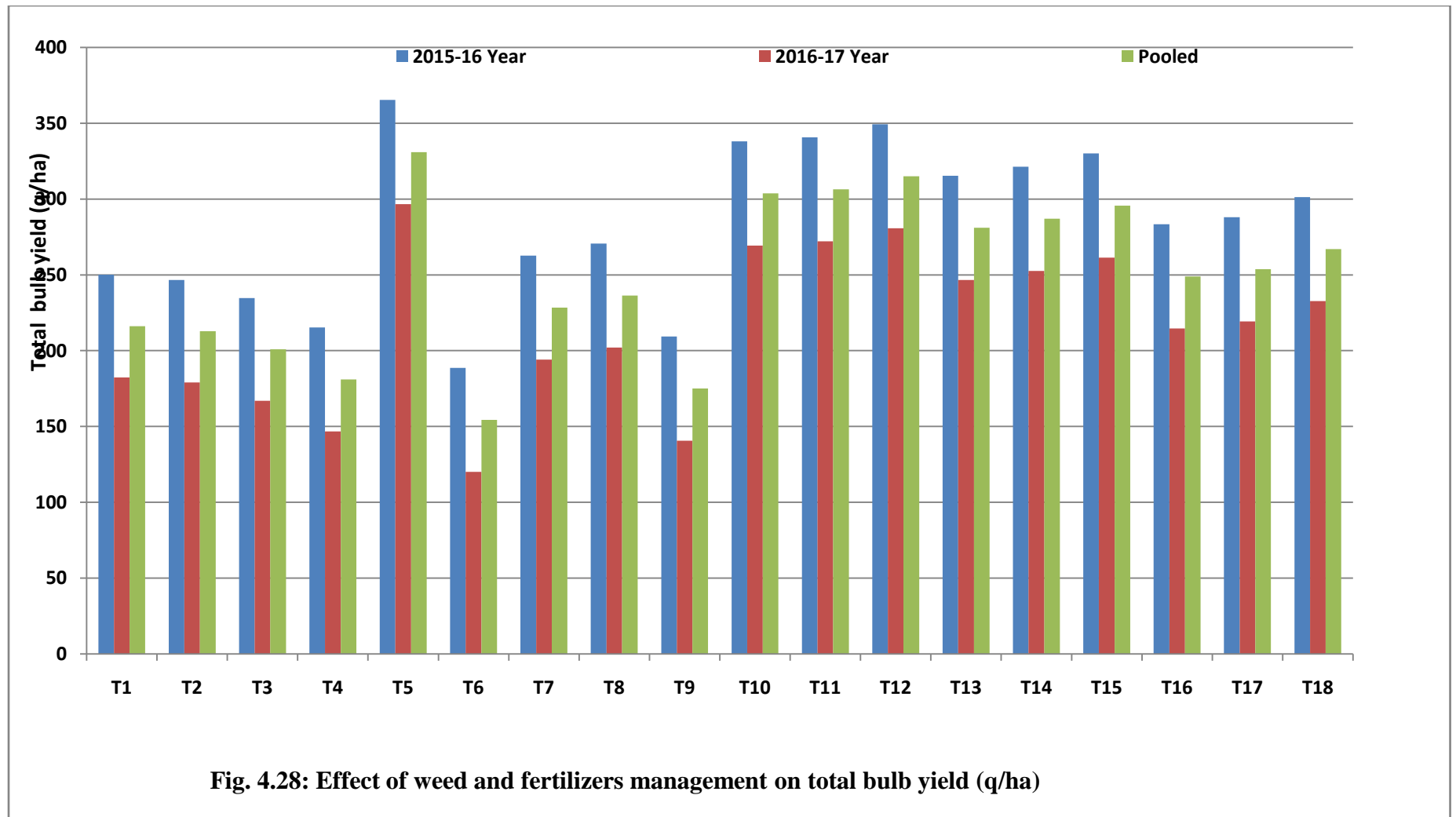
Critical analysis of data presented in above Table revealed the expressive differences in total bulb yield (q/ha) after harvest due to various treatments of weed management.

The maximum total bulb yield (q/ha) after harvest i.e. 365.33 and 296.67 were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 349.33 and 280.67 during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 188.67 and 120.08 were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

It was revealed that there were differences in total bulb yield (q/ha) due to various weed management treatments. Among the different treatments, the T<sub>5</sub> (Weed free) treatment recorded the highest average total bulb yield (q/ha) 331.00. and it was at par with the integrated weed management treatment of Pendimethalin + 125% RDF + HW (315.00) + Pendimethalin+100% RDF + HW (306.36) + Pendimethalin + 75% RDF + HW (303.70) + Oxyfluorfen + 125% RDF + WF (295.69) + Oxyfluorfen + 100% RDF + WF (287.00) after harvest these treatment were superior as compared to other treatment. The treatment of T<sub>6</sub> (Weedy check (Control)). recorded significantly lowest average total bulb yield (q/ha) (154.37) as compared to rest of the treatment.

Table 4.28: Effect of weed and fertilizers management on total bulb yield (q/ha).

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	250.09	182.33	216.21
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	246.67	179.04	212.85
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	234.67	167.02	200.84
T <sub>4</sub>	Hand weeding at 30 DAP	215.33	146.67	181.00
T <sub>5</sub>	Weed free	365.33	296.67	331.00
T <sub>6</sub>	Weedy check (Control)	188.67	120.08	154.37
T <sub>7</sub>	Pendimethalin+HW	262.67	194.06	228.36
T <sub>8</sub>	Oxyfluorfen+Weed free	270.67	202.08	236.37
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	209.33	140.67	175.00
T <sub>10</sub>	Pendimethalin+75% RDF+HW	338.07	269.33	303.70
T <sub>11</sub>	Pendimethalin+100% RDF+HW	340.67	272.05	306.36
T <sub>12</sub>	Pendimethalin+125% RDF+HW	349.33	280.67	315.00
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	315.33	246.67	281.00
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	321.33	252.67	287.00
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	330.05	261.34	295.69
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	283.33	214.67	249.00
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	288.02	219.33	253.67
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	301.33	232.67	267.00
	SE.m ±	0.799	1.165	0.403
	CD at 5%	2.306	3.363	0.134



#### 4.18. Calcium (mg/100g):

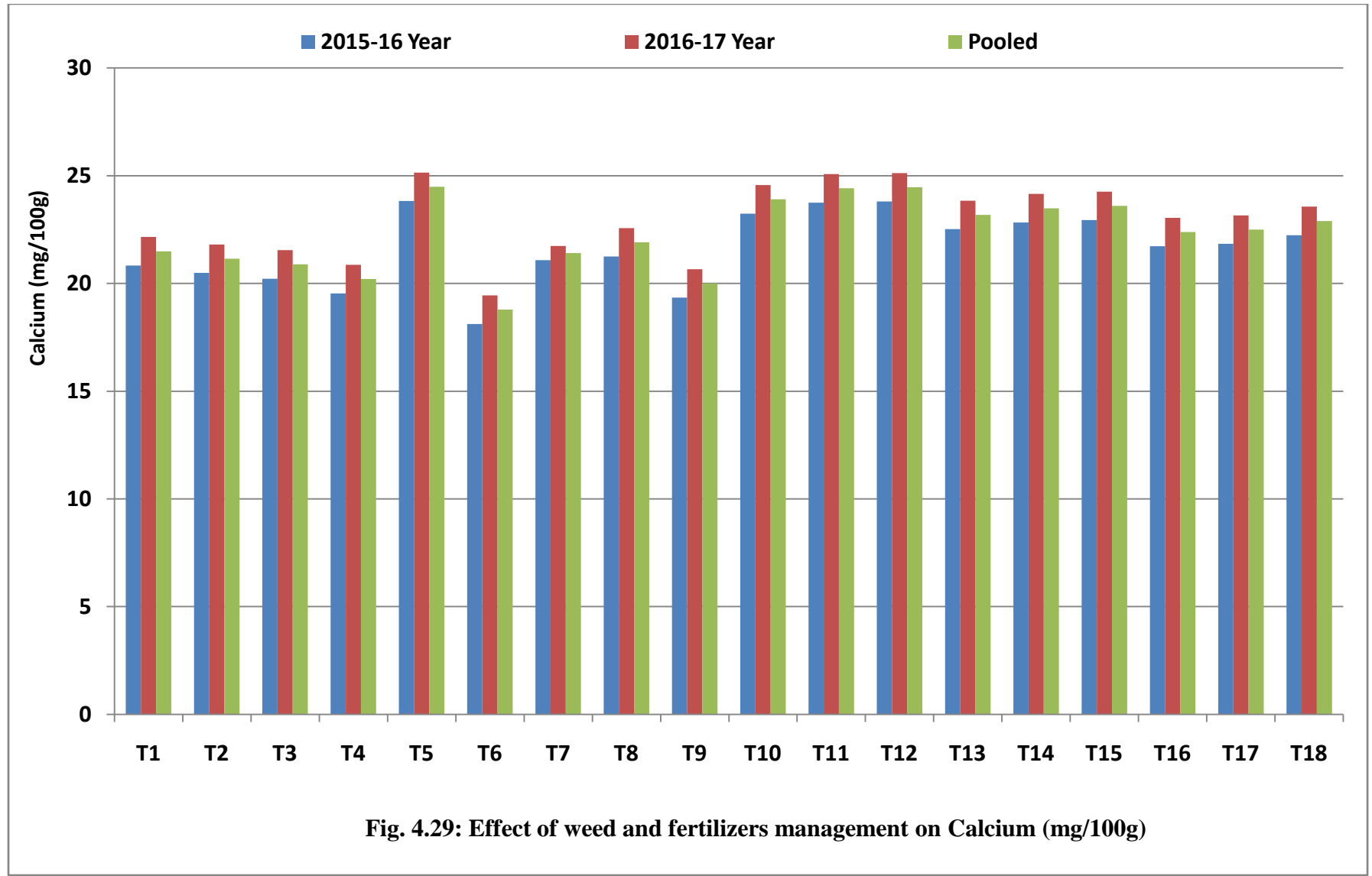
The data in respect of Calcium (mg/100g) as influenced by different weed control treatment are presented in Table 4.29 and graphically represented in Figure 4.29 efficiency the analysis of variance of data on this attribute has been mentioned in Appendix- 29.

Critical analysis of data presented in above table revealed the expressive differences in Calcium (mg/100g) due to various treatments of weed management. The maximum Calcium (mg/100g) i.e. 23.82 mg and 25.14 mg were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 23.80 mg and 25.12 mg during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 18.12 mg and 19.44 mg were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

It was revealed that there were differences in Calcium (mg/100g) due to various weed management treatments. Among the different treatments, the T<sub>5</sub>(Weed free) treatment recorded the highest average Calcium (mg/100g) 24.48 mg and it was at par with the integrated weed management treatment of Pendimethalin+125% RDF+HW(24.46 mg)+ Pendimethalin+100%RDF+HW(24.41mg)+Pendimethalin+75%RDF+HW(23.90mg)+Oxyfluorfen+125%RDF+WF(23.60 mg)+ Oxyfluorfen+100%RDF+WF(23.49mg) these treatment were superior as compared to other treatment. The treatment of T<sub>6</sub> (Weedy check (Control). recorded significantly lowest average Calcium (mg/100g) (18.78 mg) as compared to rest of the treatment.

Table 4.29: Effect of weed and fertilizers management on Calcium (mg/100g).

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	20.83	22.16	21.49
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	20.49	21.81	21.15
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	20.22	21.54	20.88
T <sub>4</sub>	Hand weeding at 30 DAP	19.54	20.86	20.20
T <sub>5</sub>	Weed free	23.82	25.14	24.48
T <sub>6</sub>	Weedy check (Control)	18.12	19.44	18.78
T <sub>7</sub>	Pendimethalin+HW	21.08	21.74	21.41
T <sub>8</sub>	Oxyfluorfen+Weed free	21.25	22.57	21.91
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	19.34	20.66	20.00
T <sub>10</sub>	Pendimethalin+75% RDF+HW	23.24	24.56	23.90
T <sub>11</sub>	Pendimethalin+100% RDF+HW	23.75	25.07	24.41
T <sub>12</sub>	Pendimethalin+125% RDF+HW	23.80	25.12	24.46
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	22.52	23.84	23.18
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	22.83	24.15	23.49
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	22.94	24.26	23.60
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	21.72	23.04	22.38
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	21.84	23.16	22.50
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	22.24	23.56	22.90
	SE.m ±	0.010	0.157	0.234
	CD at 5%	0.028	0.452	0.078



#### 4.19. Phosphorus (mg/100g):

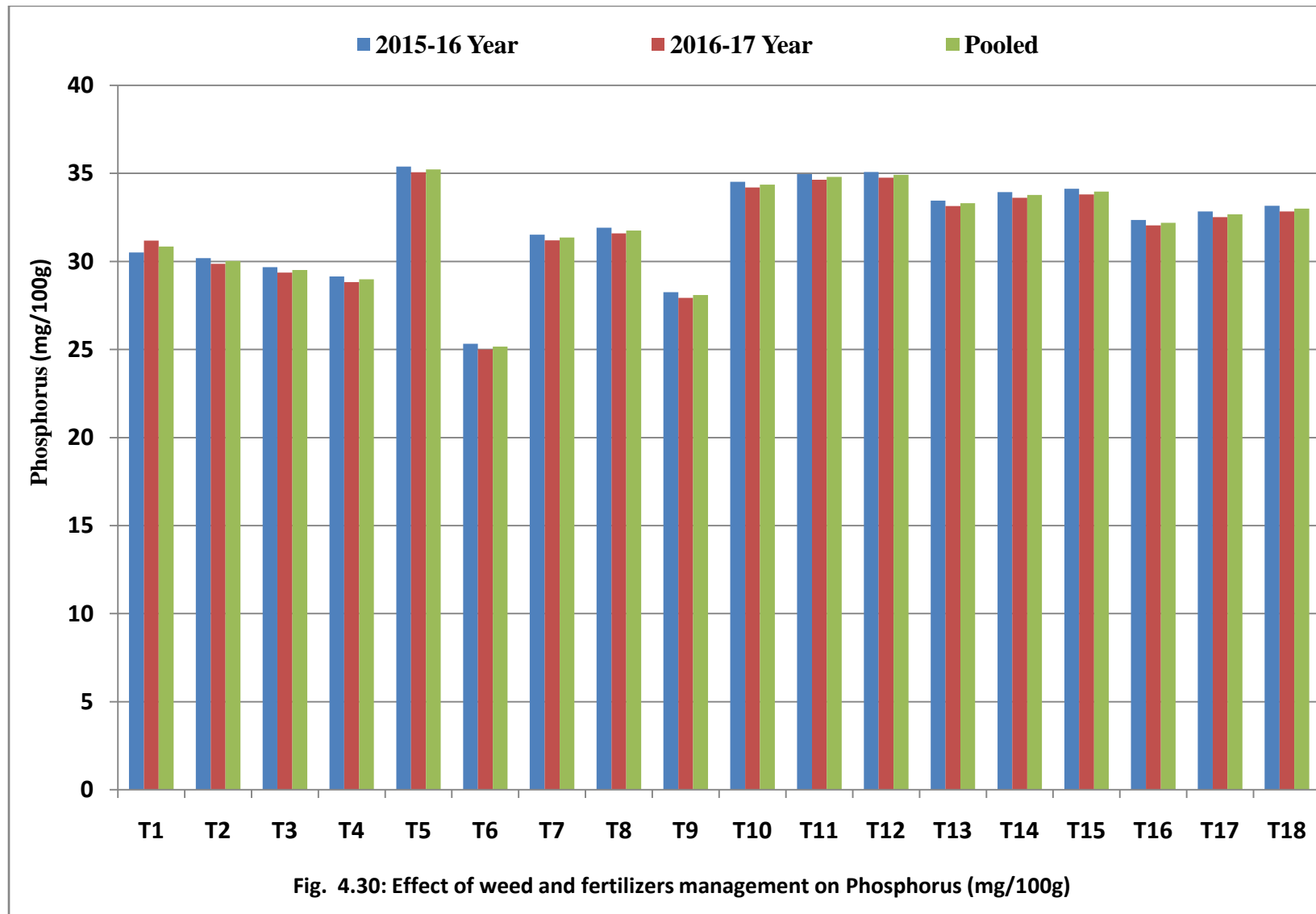
The data in respect of Phosphorus (mg/100g) as influenced by different weed control treatment are presented in Table 4.30 and graphically represented in Figure 4.30 efficiency the analysis of variance of data on this attribute has been mentioned in Appendix- 30.

Critical analysis of data presented in above table revealed the expressive differences in Phosphorus (mg/100g) due to various treatments of weed management. The maximum Phosphorus (mg/100g) i.e. 35.38mg and 35.06 mg were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e.35.08 mg and 34.76mg during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 25.32mg and 25.00 mg were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

It was revealed that. There were differences in Phosphorus (mg/100g) due to various weed management treatments. Among the different treatments, the T<sub>5</sub>(Weed free) treatment recorded the highest average Phosphorus (mg/100g) 35.22 mg and it was at par with the integrated weed management treatment of Pendimethalin+125% RDF+HW(34.92mg)+Pendimethalin+100%RDF+HW(34.80mg)+Pendimethalin+75%RDF+HW(34.36mg)+Oxyfluorfen+125%RDF+WF(23.60mg)+Oxyfluorfen+100%RDF+WF(33.96 mg) these treatment were superior as compared to other treatment. The treatment of T<sub>6</sub> (Weedy check (Control)). recorded significantly lowest average Phosphorus (mg/100g) (25.16 mg) as compared to rest of the treatment.

Table 4.30: Effect of weed and fertilizers management on phosphorus (mg/100g).

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	30.51	31.19	30.85
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	30.18	29.86	30.02
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	29.68	29.36	29.52
T <sub>4</sub>	Hand weeding at 30 DAP	29.14	28.82	28.98
T <sub>5</sub>	Weed free	35.38	35.06	35.22
T <sub>6</sub>	Weedy check (Control)	25.32	25.00	25.16
T <sub>7</sub>	Pendimethalin+HW	31.52	31.20	31.36
T <sub>8</sub>	Oxyfluorfen+Weed free	31.92	31.60	31.76
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	28.25	27.93	28.09
T <sub>10</sub>	Pendimethalin+75% RDF+HW	34.52	34.20	34.36
T <sub>11</sub>	Pendimethalin+100% RDF+HW	34.96	34.64	34.80
T <sub>12</sub>	Pendimethalin+125% RDF+HW	35.08	34.76	34.92
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	33.46	33.14	33.30
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	33.94	33.62	33.78
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	34.12	33.80	33.96
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	32.36	32.04	32.20
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	32.84	32.52	32.68
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	33.16	32.84	33.00
	SE.m ±	0.017	0.020	0.0354
	CD at 5%	0.050	0.058	0.118



#### 4.20. Sulphur (mg/100g):

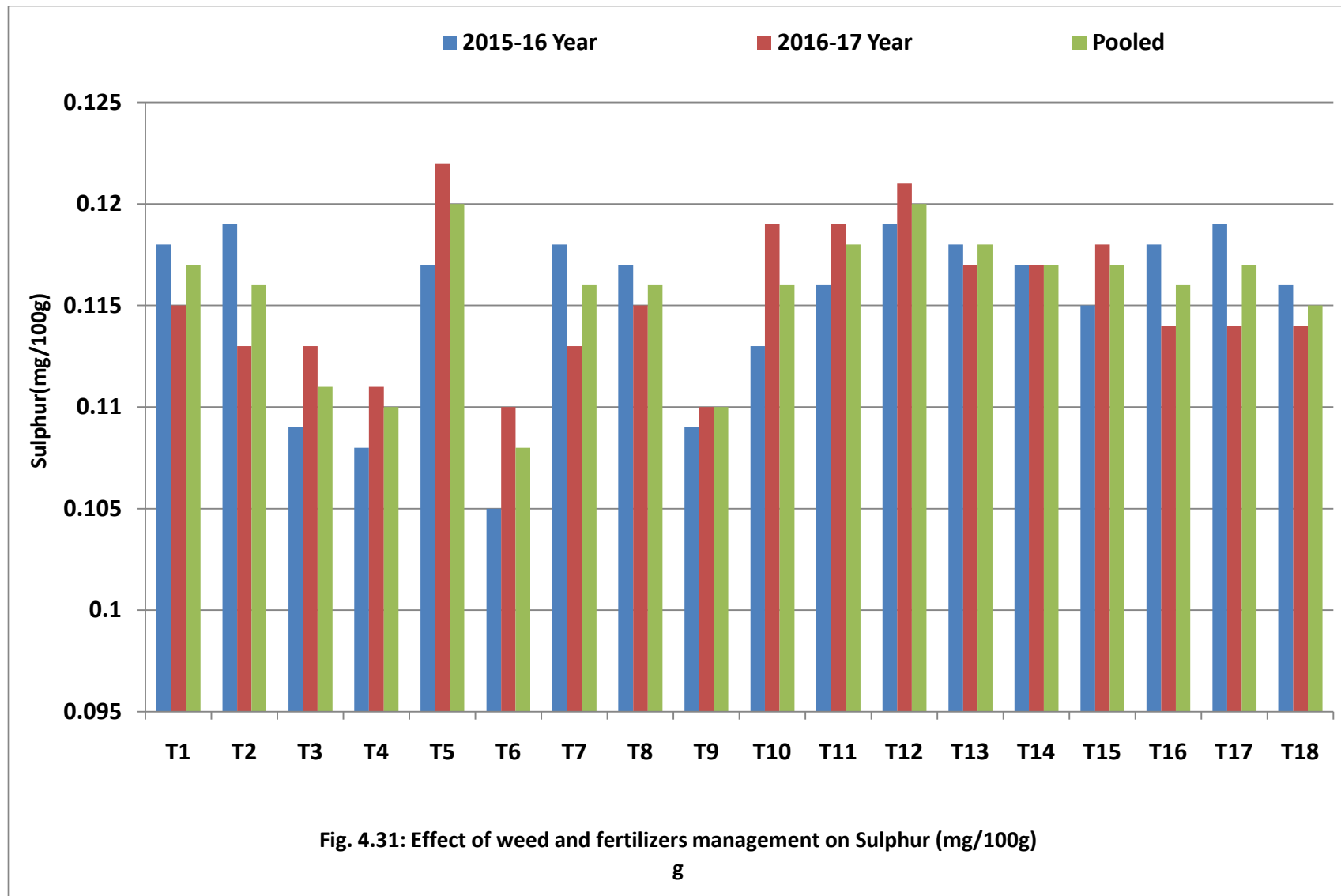
The data in respect of sulphur (mg/100g) as influenced by different weed control treatment are presented in Table 4.31 and graphically represented in Figure 4.31 efficiency the analysis of variance of data on this attribute has been mentioned in Appendix- 31.

Critical analysis of data presented in above table revealed the expressive differences in sulphur (mg/100g) due to various treatments of weed management .The maximum sulphur (mg/100g)i.e. 0.117mg and 0.122 mg were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 0.119mg and 0.121 mg during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 0.105 mg and 0.110 mg were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

It was revealed that. There were differences in Sulphur (mg/100g) due to various weed management treatments. Among the different treatments, the T<sub>5</sub>(Weed free) treatment recorded the highest average sulphur(mg/100g) 0.120mg and it was at par with the integrated weed management treatment of Pendimethalin+125% RDF+HW(0.120mg)+Pendimethalin+100%RDF+HW(0.118mg)+Pendimethalin+75%RDF+HW(0.116mg)+Oxyfluorfen+125%RDF+WF(0.117mg)+Oxyfluorfen+100%RDF WF(0.117mg) these treatment were superior as compared to other treatment. The treatment of T<sub>6</sub> (Weedy check (Control)). recorded significantly lowest average Sulphur (mg/100g) (0.108 mg) as compared to rest of the treatment.

Table 4.31: Effect of weed and fertilizers management on Sulphur (mg/100g).

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	0.118	0.115	0.117
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	0.119	0.113	0.116
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	0.109	0.113	0.111
T <sub>4</sub>	Hand weeding at 30 DAP	0.108	0.111	0.110
T <sub>5</sub>	Weed free	0.117	0.122	0.120
T <sub>6</sub>	Weedy check (Control)	0.105	0.110	0.108
T <sub>7</sub>	Pendimethalin+HW	0.118	0.113	0.116
T <sub>8</sub>	Oxyfluorfen+Weed free	0.117	0.115	0.116
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	0.109	0.110	0.110
T <sub>10</sub>	Pendimethalin+75% RDF+HW	0.113	0.119	0.116
T <sub>11</sub>	Pendimethalin+100% RDF+HW	0.116	0.119	0.118
T <sub>12</sub>	Pendimethalin+125% RDF+HW	0.119	0.121	0.120
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	0.118	0.117	0.118
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	0.117	0.117	0.117
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	0.115	0.118	0.117
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	0.118	0.114	0.116
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	0.119	0.114	0.117
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	0.116	0.114	0.115
	SE.m ±	0.001	0.001	0.006
	CD at 5%	0.002	0.002	0.002



#### 4.21. Total soluble solids (<sup>0</sup>Brix):

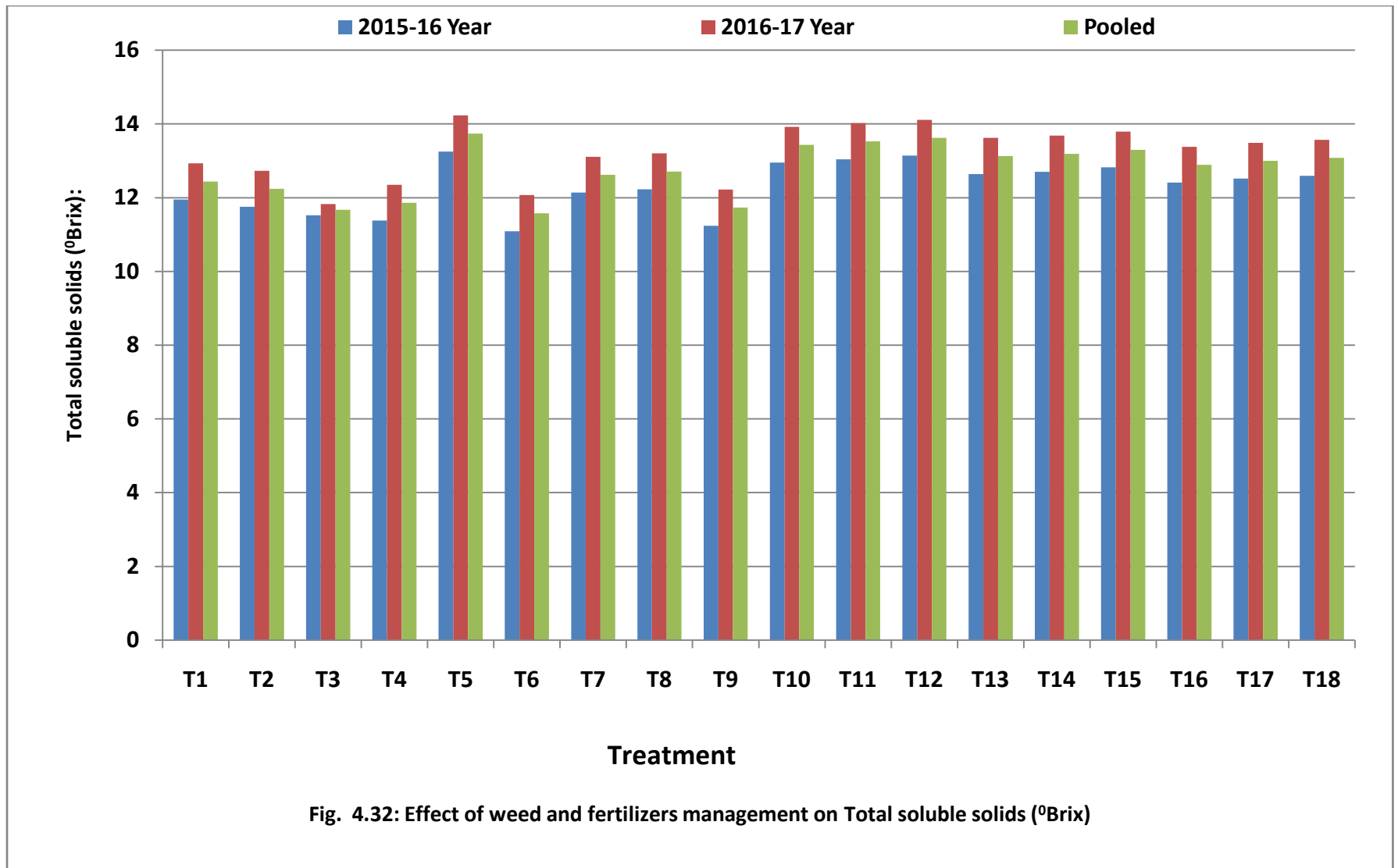
The data in respect of total soluble solids (<sup>0</sup>Brix) as influenced by different weed control treatment are presented in Table 4.32 and graphically represented in Figure 4.32. The analysis of variance of data on this attribute has been mentioned in Appendix- 32.

Critical analysis of data presented in above table revealed the expressive differences in Total soluble solids (<sup>0</sup>Brix) due to various treatments of weed management. The maximum Total soluble solids (<sup>0</sup>Brix) i.e. 13.25<sup>0</sup>Brix and 14.23<sup>0</sup>Brix were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 13.14<sup>0</sup>Brix and 14.11<sup>0</sup>Brix during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 11.09<sup>0</sup>Brix and 12.07<sup>0</sup>Brix were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

It was revealed that. There were differences in Total soluble solids (<sup>0</sup>Brix) due to various weed management treatments. Among the different treatments, the T<sub>5</sub>(Weed free) treatment recorded the highest average Total soluble solids (<sup>0</sup>Brix) 13.74<sup>0</sup>Brix and it was at par with the integrated weed management treatment of Pendimethalin + 125% RDF + HW(13.62<sup>0</sup>Brix) + Pendimethalin+ 100% RDF + HW(13.53<sup>0</sup>Brix) + Pendimethalin + 75%RDF + HW (13.43<sup>0</sup>Brix) + Oxyfluorfen + 125%RDF + WF (13.30<sup>0</sup>Brix) + Oxyfluorfen + 100% RDF + WF(13.19<sup>0</sup>Brix) these treatment were superior as compared to other treatment. The treatment of T<sub>6</sub> (Weedy check (Control)) recorded significantly lowest average Total soluble solids (<sup>0</sup>Brix) (11.58<sup>0</sup>Brix) as compared to rest of the treatment

Table 4.32: Effect of weed and fertilizers management on Total soluble solids (<sup>0</sup>Brix).

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	11.95	12.93	12.44
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	11.75	12.73	12.24
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	11.52	11.83	11.67
T <sub>4</sub>	Hand weeding at 30 DAP	11.38	12.35	11.86
T <sub>5</sub>	Weed free	13.25	14.23	13.74
T <sub>6</sub>	Weedy check (Control)	11.09	12.07	11.58
T <sub>7</sub>	Pendimethalin+HW	12.14	13.11	12.62
T <sub>8</sub>	Oxyfluorfen+Weed free	12.23	13.20	12.71
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	11.24	12.22	11.73
T <sub>10</sub>	Pendimethalin+75% RDF+HW	12.95	13.92	13.43
T <sub>11</sub>	Pendimethalin+100% RDF+HW	13.04	14.02	13.53
T <sub>12</sub>	Pendimethalin+125% RDF+HW	13.14	14.11	13.62
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	12.64	13.62	13.13
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	12.70	13.68	13.19
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	12.82	13.79	13.30
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	12.41	13.38	12.89
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	12.52	13.49	13.00
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	12.59	13.57	13.08
	SE.m ±	0.013	0.155	0.238
	CD at 5%	0.037	0.446	0.079



#### 4.22. Ascorbic acid (Vitamin C mg/100g):

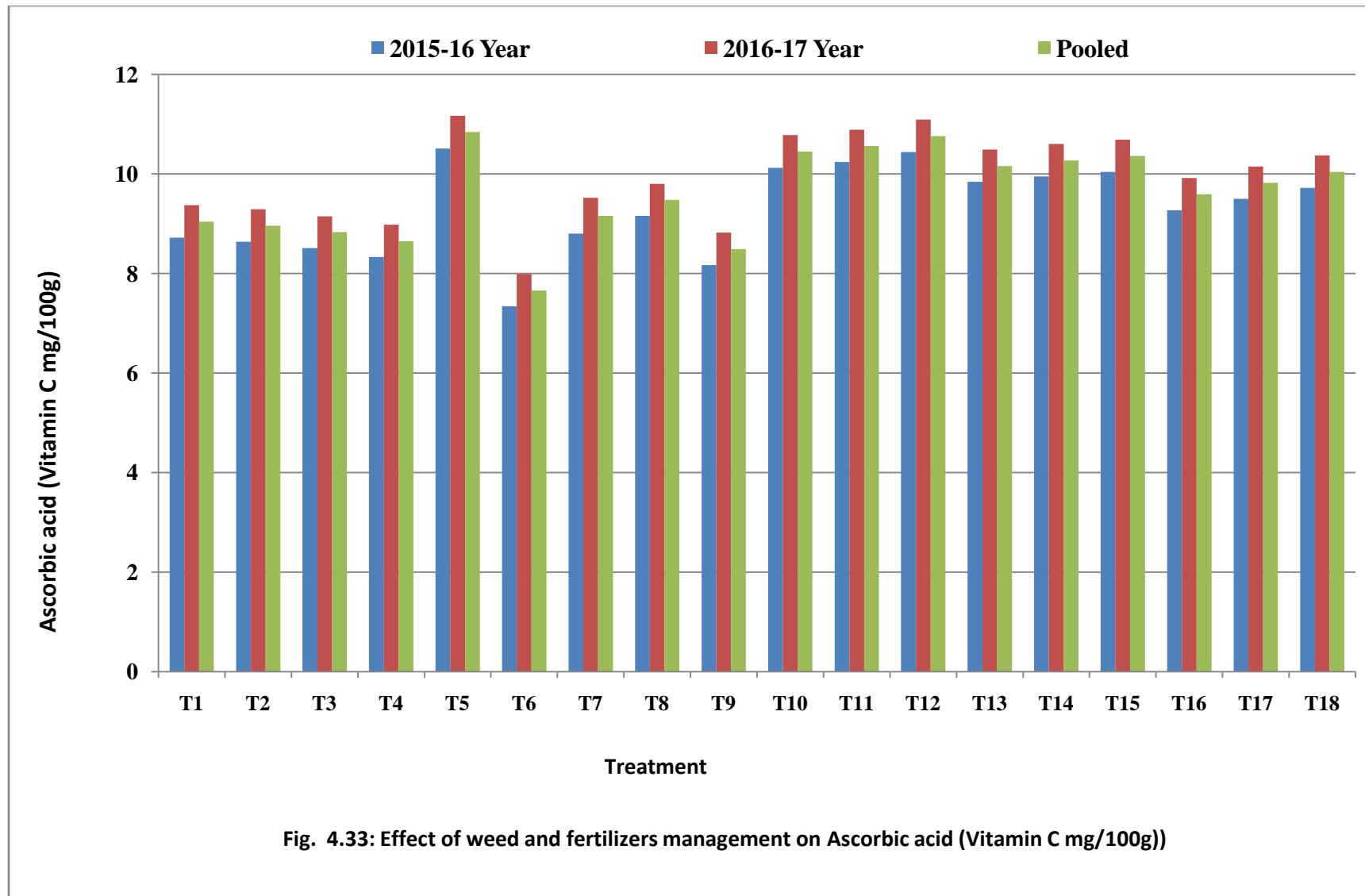
The data in respect of Ascorbic acid (Vitamin C mg/100g) as influenced by different weed control treatment are presented in Table 4.33 and graphically represented in Figure 4.33 efficiency the analysis of variance of data on this attribute has been mentioned in Appendix- 33.

Critical analysis of data presented in above table revealed the expressive differences in Ascorbic acid (Vitamin C mg/100g) due to various treatments of weed management. The maximum Ascorbic acid (Vitamin C mg/100g) i.e. 10.51 mg and 11.17 mg were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 10.44 mg and 11.09 mg during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 7.34 mg and 7.99 mg were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

It was revealed that there were differences in Ascorbic acid (Vitamin C mg/100g) due to various weed management treatments. Among the different treatments, the T<sub>5</sub> (Weed free) treatment recorded the highest average Ascorbic acid (Vitamin C mg/100g) 10.84 mg and it was at par with the integrated weed management treatment of Pendimethalin+125%RDF+HW(10.76mg)+Pendimethalin+100%RDF+HW(10.56mg)+Pendimethalin+75%RDF+HW(10.45mg)+Oxyfluorfen+125%RDF+WF(10.36mg)+Oxyfluorfen+100%RDF+WF(10.27mg) these treatment were superior as compared to other treatment. The treatment of T<sub>6</sub> (Weedy check (Control)). recorded significantly lowest average Ascorbic acid (Vitamin C mg/100g) (7.66mg) as compared to rest of the treatment.

Table 4.33: Effect of weed and fertilizers management on Ascorbic acid (Vitamin C mg/100g).

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	8.72	9.37	9.04
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	8.64	9.29	8.96
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	8.51	9.15	8.83
T <sub>4</sub>	Hand weeding at 30 DAP	8.33	8.98	8.65
T <sub>5</sub>	Weed free	10.51	11.17	10.84
T <sub>6</sub>	Weedy check (Control)	7.34	7.99	7.66
T <sub>7</sub>	Pendimethalin+HW	8.80	9.52	9.16
T <sub>8</sub>	Oxyfluorfen+Weed free	9.16	9.80	9.48
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	8.17	8.82	8.49
T <sub>10</sub>	Pendimethalin+75% RDF+HW	10.12	10.78	10.45
T <sub>11</sub>	Pendimethalin+100% RDF+HW	10.24	10.89	10.56
T <sub>12</sub>	Pendimethalin+125% RDF+HW	10.44	11.09	10.76
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	9.843	10.49	10.16
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	9.947	10.60	10.27
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	10.04	10.69	10.36
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	9.27	9.92	9.59
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	9.50	10.15	9.82
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	9.72	10.37	10.04
	SE.m ±	0.008	0.008	0.029
	CD at 5%	0.023	0.022	0.010



### 4.23. Reducing sugar (%):

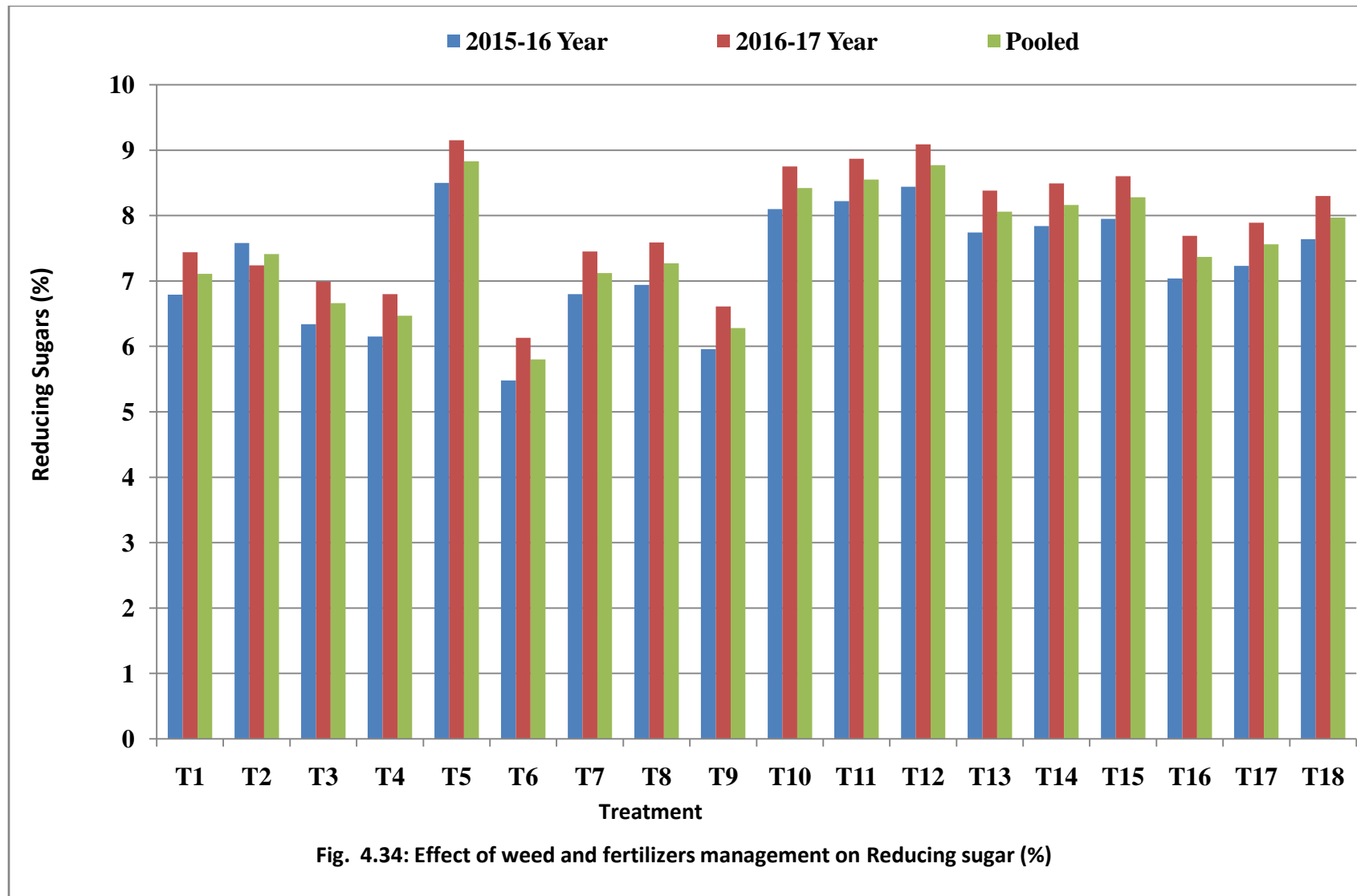
The data in respect of reducing sugar (%) as influenced by different weed control treatment are presented in Table 4.34 and graphically represented in Figure 4.34 efficiency the analysis of variance of data on this attribute has been mentioned in Appendix- 34.

Critical analysis of data presented in above table revealed the expressive differences in reducing sugar (%) due to various treatments of weed management. The maximum reducing sugar (%) i.e. 8.50% and 9.15% were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 8.44% and 9.09% during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 5.48% and 6.13% were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

It was revealed that there were differences in reducing sugar (%) due to various weed management treatments. Among the different treatments, the T<sub>5</sub>(Weed free) treatment recorded the highest average reducing sugars (%) 8.83% and it was at par with the integrated weed management treatment of Pendimethalin + 125% RDF + HW (8.77%) + Pendimethalin + 100% RDF + HW (8.55%) + Pendimethalin + 75% RDF + HW (8.42%) + Oxyfluorfen + 125% RDF + WF (8.28%) + Oxyfluorfen + 100% RDF + WF (8.16%) these treatment were superior as compared to other treatment. The treatment of T<sub>6</sub> (Weedy check (Control)). recorded significantly lowest average Reducing sugar (%) (5.80%) as compared to rest of the treatment.

Table 4.34: Effect of weed and fertilizers management on reducing sugar (%).

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	6.79	7.44	7.11
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	7.58	7.24	7.41
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	6.34	6.99	6.66
T <sub>4</sub>	Hand weeding at 30 DAP	6.15	6.80	6.47
T <sub>5</sub>	Weed free	8.50	9.15	8.83
T <sub>6</sub>	Weedy check (Control)	5.48	6.13	5.80
T <sub>7</sub>	Pendimethalin+HW	6.80	7.45	7.12
T <sub>8</sub>	Oxyfluorfen+Weed free	6.94	7.59	7.27
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	5.96	6.61	6.28
T <sub>10</sub>	Pendimethalin+75% RDF+HW	8.10	8.75	8.42
T <sub>11</sub>	Pendimethalin+100% RDF+HW	8.22	8.87	8.55
T <sub>12</sub>	Pendimethalin+125% RDF+HW	8.44	9.09	8.77
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	7.74	8.38	8.06
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	7.84	8.49	8.16
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	7.95	8.60	8.28
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	7.04	7.69	7.37
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	7.23	7.89	7.56
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	7.64	8.30	7.97
	SE.m ±	0.016	0.016	0.0354
	CD at 5%	0.046	0.047	0.118



#### 4.24. Non reducing sugar (%):

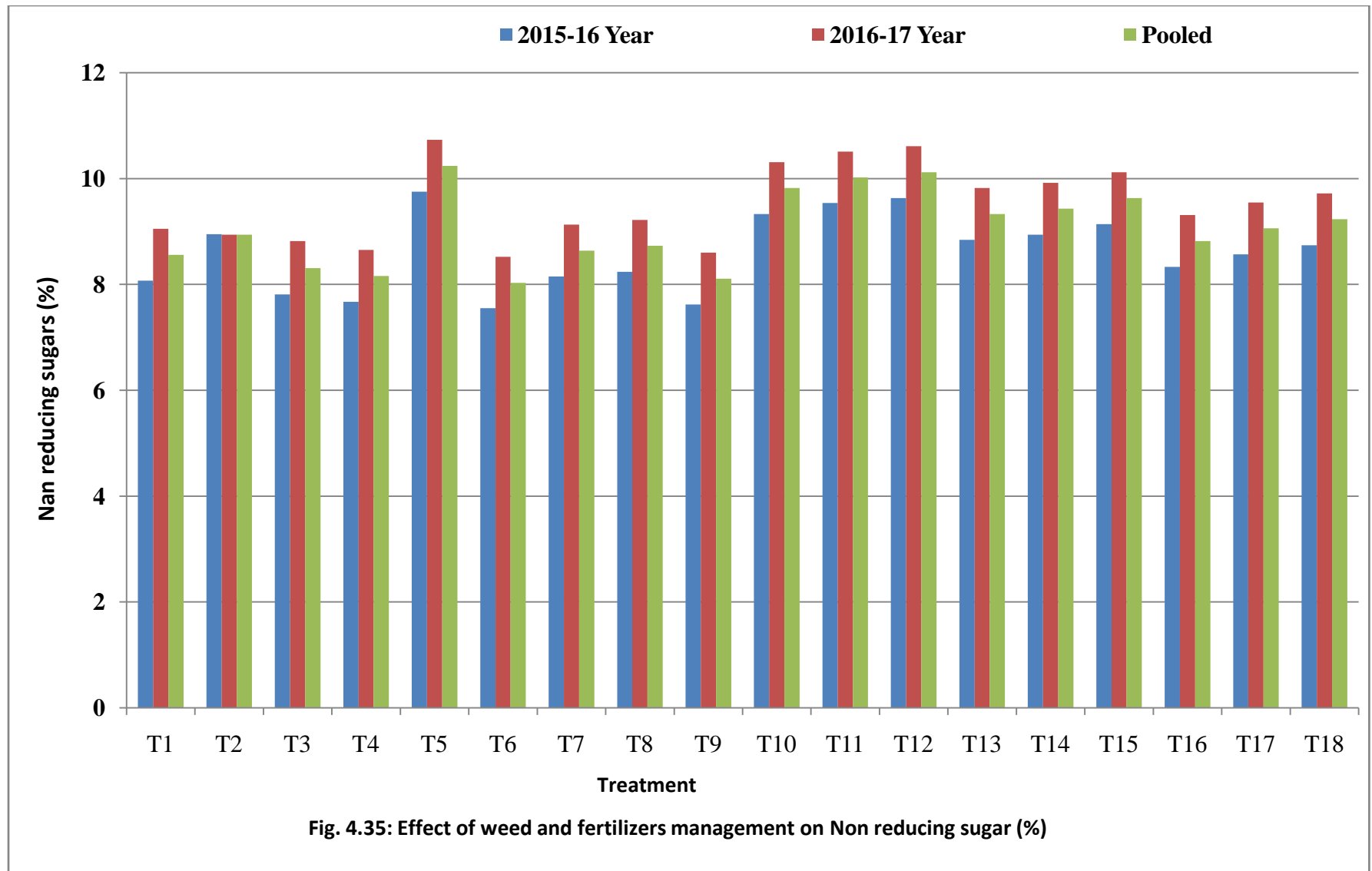
The data in respect of non- reducing sugar (%) as influenced by different weed control treatment are presented in Table 4.35 and graphically represented in Figure 4.35 efficiency the analysis of variance of data on this attribute has been mentioned in Appendix- 35.

Critical analysis of data presented in above table revealed the expressive differences in Non Reducing sugars (%) due to various treatments of weed management. The maximum non- reducing sugars (%) i.e. 9.75% and 10.73% were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 9.63% and 10.61% during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 7.55% and 8.52% were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

It was revealed that there were differences in Non Reducing sugars (%) due to various weed management treatments. Among the different treatments, the T<sub>5</sub>(Weed free) treatment recorded the highest average non- reducing sugar (%) 10.24% and it was at par with the integrated weed management treatment of Pendimethalin + 125% RDF + HW (10.12%) + Pendimethalin + 100% RDF + HW (10.02%) + Pendimethalin + 75% RDF + HW (9.82%) + Oxyfluorfen + 125% RDF + WF (9.63%) + Oxyfluorfen + 100% RDF + WF (9.43%) these treatment were superior as compared to other treatment. The treatment of T<sub>6</sub> (Weedy check (Control)). recorded significantly lowest average non - reducing sugar (%) (8.03%) as compared to rest of the treatment.

Table 4.35: Effect of weed and fertilizers management on non reducing sugar (%)

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	8.07	9.05	8.56
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	8.95	8.94	8.94
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	7.81	8.82	8.31
T <sub>4</sub>	Hand weeding at 30 DAP	7.67	8.65	8.16
T <sub>5</sub>	Weed free	9.75	10.73	10.24
T <sub>6</sub>	Weedy check (Control)	7.55	8.52	8.03
T <sub>7</sub>	Pendimethalin+HW	8.15	9.13	8.64
T <sub>8</sub>	Oxyfluorfen+Weed free	8.24	9.22	8.73
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	7.62	8.60	8.11
T <sub>10</sub>	Pendimethalin+75% RDF+HW	9.33	10.31	9.82
T <sub>11</sub>	Pendimethalin+100% RDF+HW	9.54	10.51	10.02
T <sub>12</sub>	Pendimethalin+125% RDF+HW	9.63	10.61	10.12
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	8.84	9.82	9.33
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	8.94	9.92	9.43
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	9.14	10.12	9.63
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	8.33	9.31	8.82
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	8.57	9.55	9.06
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	8.74	9.72	9.23
	SE.m ±	0.011	0.010	0.351
	CD at 5%	0.031	0.030	0.117



#### 4.25. Total sugars (%):

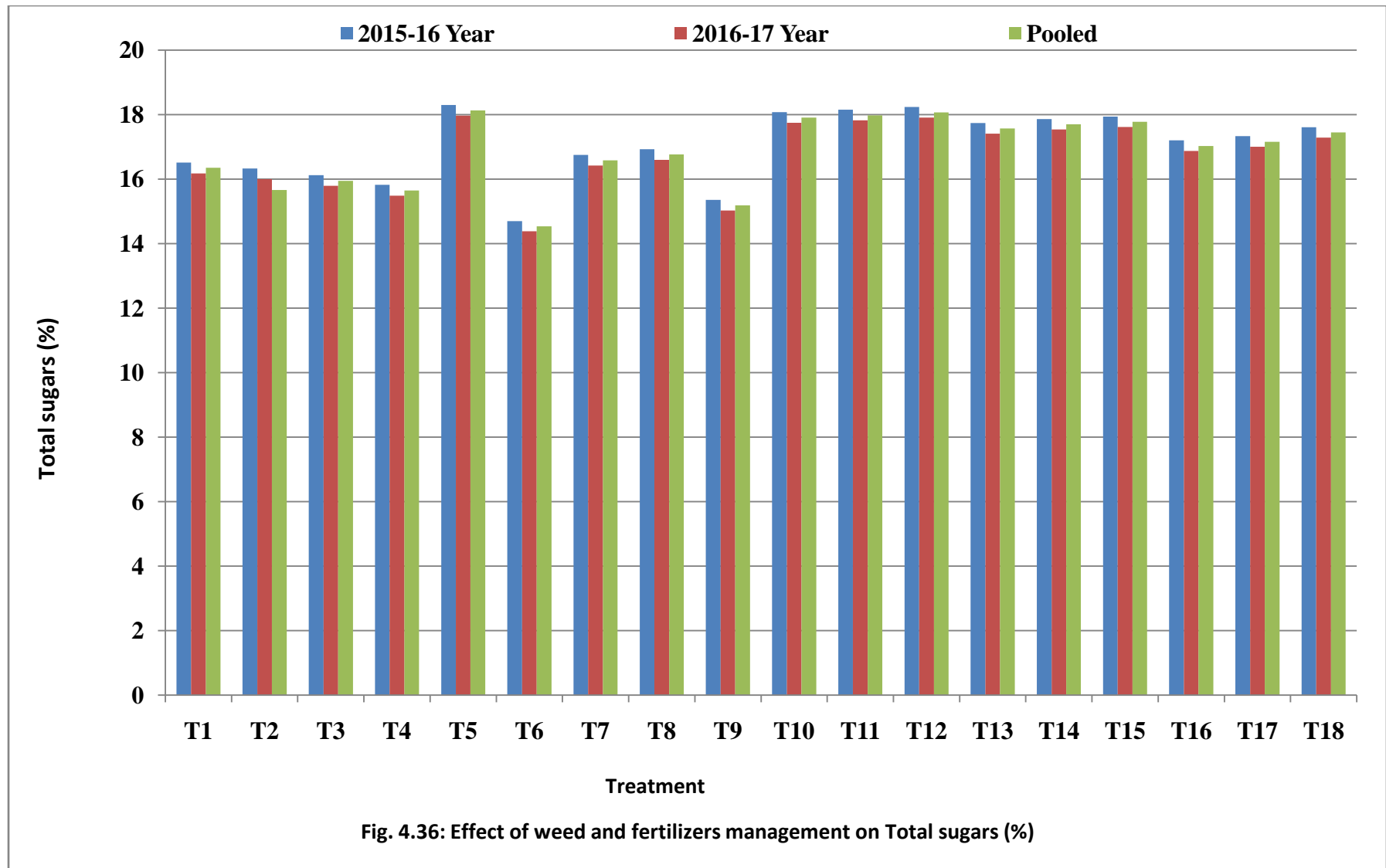
The data in respect of Total sugars (%) as influenced by different weed control treatment are presented in Table 4.36 and graphically represented in Figure 4.36 efficiency the analysis of variance of data on this attribute has been mentioned in Appendix- 36.

Critical analysis of data presented in above table revealed the expressive differences in Total sugars (%) due to various treatments of weed management. The maximum Total sugars (%) i.e. 18.30% and 17.97% were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) i.e. 18.24% and 17.91% during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 14.70% and 14.38% were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

It was revealed that there were differences in total sugars (%) due to various weed management treatments. Among the different treatments, the T<sub>5</sub>(Weed free) treatment recorded the highest average total sugars (%)18.13% and it was at par with the integrated weed management treatment of Pendimethalin + 125% RDF + HW (18.07%) + Pendimethalin + 100% RDF + HW (17.98%) + Pendimethalin + 75% RDF + HW (17.91%) + Oxyfluorfen + 125% RDF + WF (17.78%) + Oxyfluorfen + 100% RDF + WF (17.70%) these treatment were superior as compared to other treatment. The treatment of T<sub>6</sub> (Weedy check (Control)). recorded significantly lowest average Total sugars (%) (14.54%) as compared to rest of the treatment.

Table 4.36: Effect of weed and fertilizers management on Total sugars (%).

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	16.51	16.18	16.35
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	16.33	16.00	15.66
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	16.12	15.79	15.95
T <sub>4</sub>	Hand weeding at 30 DAP	15.82	15.49	15.65
T <sub>5</sub>	Weed free	18.30	17.97	18.13
T <sub>6</sub>	Weedy check (Control)	14.70	14.38	14.54
T <sub>7</sub>	Pendimethalin+HW	16.75	16.42	16.58
T <sub>8</sub>	Oxyfluorfen+ Weed free	16.93	16.60	16.77
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	15.36	15.03	15.19
T <sub>10</sub>	Pendimethalin+75% RDF+HW	18.08	17.75	17.91
T <sub>11</sub>	Pendimethalin+100% RDF+HW	18.15	17.82	17.98
T <sub>12</sub>	Pendimethalin+125% RDF+HW	18.24	17.91	18.07
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	17.74	17.41	17.57
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	17.86	17.54	17.70
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	17.94	17.62	17.78
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	17.20	16.87	17.03
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	17.33	17.00	17.16
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	17.61	17.29	17.45
	SE.m ±	0.009	0.009	0.353
	CD at 5%	0.026	0.025	0.117



### 4.37. Economics studies:

The data in respect of cost of cultivation, gross and net monetary returns and B: C ratio is presented in table. 4.37.2 And graphically represented in Figure 4.37.2 efficiency the analysis of variance of data on this attribute has been mentioned in Appendix- 37.

#### 4.26.1. Gross monetary returns:

The data in respect of cost of cultivation, gross and net monetary returns is presented in Table. 4.37.1 And graphically represented in Figure 4.37.1 efficiency the analysis of variance of data on this attribute has been mentioned in Appendix- 38. The gross monetary returns were recorded significantly higher in weed free treatment (Rs 199792 ha<sup>-1</sup>) and it was at par with the application of Pendimethalin + 125% RDF + HW (Rs 199368 ha<sup>-1</sup>) at 25 DAT and Pendimethalin + 100% RDF + HW (Rs 189590 ha<sup>-1</sup>) and Pendimethalin + 75% RDF + HW (Rs 182630 ha<sup>-1</sup>) and Oxyfluorfen + 125% RDF + WF (Rs 161054 ha<sup>-1</sup>) and Oxyfluorfen + 100% RDF + WF (Rs 145630 ha<sup>-1</sup>) at 45 DAT. The lowest gross monetary returns (Rs 50230) was recorded in weedy check due to the lowest onion bulb yield in this treatment. The results are in comparison with (Singh *et al.*, 1997).

#### 4.26.2. Cost of cultivation:

The cost of cultivation was highest in weed free treatment (Rs 40950 ha<sup>-1</sup>). This could be due to repeated manual weeding which needed more labor and time than other weed control treatment. It was followed by Pendimethalin + 125% RDF + HW (Rs 41350 ha<sup>-1</sup>) at 25 DAT and Pendimethalin + 100% RDF + HW (Rs 40980 ha<sup>-1</sup>) and Pendimethalin + 75% RDF + HW (Rs 40230 ha<sup>-1</sup>) and Oxyfluorfen + 125% RDF + WF (Rs 66560 ha<sup>-1</sup>) and Oxyfluorfen + 100% RDF + WF (Rs 64210 ha<sup>-1</sup>) at 45 DAT, mainly

because of combination of herbicide with 125% RDF + Hand weeding. The lowest cost of cultivation (Rs 30980) was observed in weedy check since there were no labour costs for hand weeding or herbicide spraying (**Singh et al., 1997**) reported similar results.

#### 4.26.3. Net monetary returns:

In case of net monetary returns, Pendimethalin + 125% RDF + HW 25 DAT were superior among all herbicide treatments which recorded significantly higher net monetary returns, (Rs 158018 ha<sup>-1</sup>). It was followed by Pendimethalin + 100% RDF + HW (Rs 148610 ha<sup>-1</sup>) and weed free treatment (Rs 158842 ha<sup>-1</sup>) the lowest net monetary returns (Rs 19250) was recorded in weedy check.

This might be due to higher cost of cultivation in weed free treatment because of requirement of labour charges resulted into lower net monetary returns and in the integrated treatment there was minimal use of labour and under combined use of herbicide and hand weeding cause the effective weed control and lesser cost of cultivation than weed free with optimum yield which resulted into maximum net monetary returns in this treatment .Further it was followed by sequential application of herbicide i.e. pre emergence herbicide followed by combined use of herbicide with 125%RDF+HW which resulted into effective control of both monocot and dicot weeds.

**Singh et al. (1992)** reported similar results. He stated that the higher net returns and B: C ratio might be due to cost- effective weed control techniques. **Nadagouda (1995)** and **Rameshwar et al. (2002)** also reported higher net returns from herbicide treated plots compared to hand weeded plots.

#### 4.26.4. Benefit cost ratio (B: C):

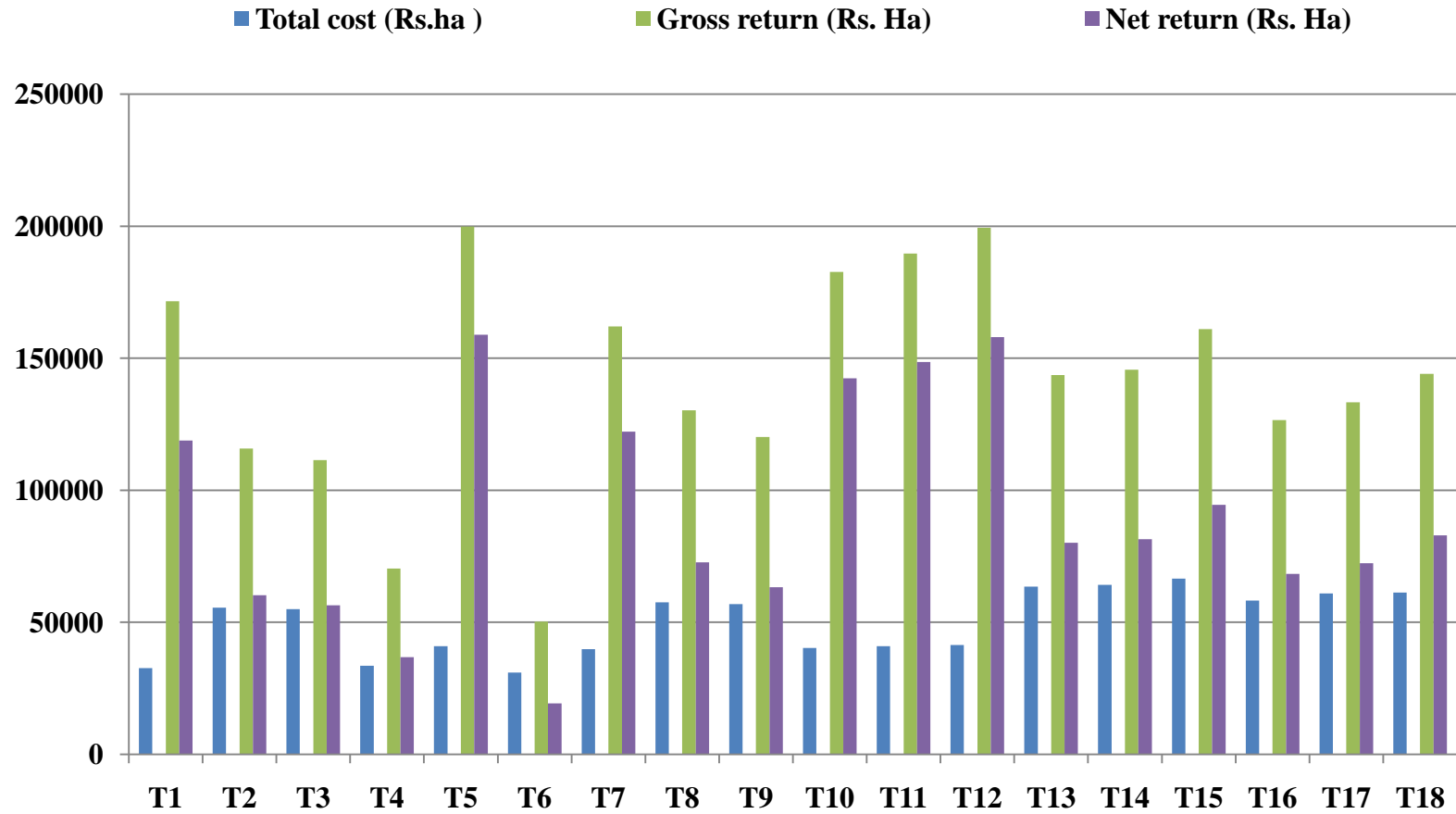
Critical analysis of data presented in above Table revealed the expressive differences in Benefit cost ratio (B: C) due to various treatments of weed management.

The maximum Benefit cost ratio (B: C) i.e. 7.95 and 8.94 were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) i.e. 7.59 and 8.58 during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value i.e. 4.52 and 5.51 were recorded in treatment T<sub>6</sub> (Weedy check (Control)).

It was revealed that there were differences in Benefit cost ratio (B: C) due to various weed management treatments. Among the different treatments, the T<sub>5</sub> (Weed free) treatment recorded the highest average Benefit cost ratio (B:C) 8.03 and it was at par with the integrated weed management treatment of Pendimethalin + 125% RDF + HW (7.77) + Pendimethalin + 100% RDF + HW (7.29) + Pendimethalin + 75% RDF + HW (7.14) + Oxyfluorfen + 125% RDF + WF (7.07) + Oxyfluorfen + 100% RDF + WF (6.86) these treatment were superior as compared to other treatment. The treatment of T<sub>6</sub> (Weedy check (Control)). recorded significantly lowest average Benefit cost ratio (B: C) (4.42) as compared to rest of the treatment.

Table 4.37.1: Effect of weed and fertilizers management on average Economics of weed control in onion.

TREATMENTS	TREATMENTS COMBINATION	Total cost (Rs.ha )	Gross return (Rs. Ha)	Net return (Rs. Ha)
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	32640	171540	118880
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	55520	115830	60310
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	54980	111425	56445
T <sub>4</sub>	Hand weeding at 20 DAP	33560	70325	36765
T <sub>5</sub>	Weed free	40950	199792	158842
T <sub>6</sub>	Weedy check (Control)	30980	50230	19250
T <sub>7</sub>	Pendimethalin+HW	39780	162010	122230
T <sub>8</sub>	Oxyfluorfen+Weed free	57530	130250	72720
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	56840	120120	63280
T <sub>10</sub>	Pendimethalin+75% RDF+HW	40230	182630	142400
T <sub>11</sub>	Pendimethalin+100% RDF+HW	40980	189590	148610
T <sub>12</sub>	Pendimethalin+125% RDF+HW	41350	199368	158018
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	63540	143654	80114
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	64210	145630	81420
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	66560	161054	94494
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	58250	126590	68340
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	60880	133256	72376
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	61220	144110	82890
	SE.m ±	-	-	-
	CD at 5%	-	-	-



**Fig. 4.37.1: Effect of weed and fertilizers management on average Economics of weed control in onion.**

Table 4.37.2: Effect of weed and fertilizers management on Benefit cost ratio (B: C)

TREATMENTS	TREATMENTS COMBINATION	2015-16	2016-17	Pooled
T <sub>1</sub>	Pendimethalin @1.0 kg a.i/ha	7.65	6.64	5.85
T <sub>2</sub>	Oxyfluorfen@0.250 kg a.i/ha	5.42	6.41	5.34
T <sub>3</sub>	Fluazipop-p-butyl@0.250kg a.i/ha	5.29	6.28	5.18
T <sub>4</sub>	Hand weeding at 20 DAP	5.11	6.10	4.90
T <sub>5</sub>	Weed free	7.95	8.94	8.03
T <sub>6</sub>	Weedy check (Control)	4.52	5.51	4.42
T <sub>7</sub>	Pendimethalin+HW	5.83	6.82	5.97
T <sub>8</sub>	Oxyfluorfen+Weed free	5.94	6.93	6.03
T <sub>9</sub>	Fluazipop-p-butyl+Weed check	4.90	5.89	4.61
T <sub>10</sub>	Pendimethalin+75% RDF+HW	7.22	8.21	7.14
T <sub>11</sub>	Pendimethalin+100% RDF+HW	7.42	8.41	7.29
T <sub>12</sub>	Pendimethalin+125% RDF+HW	7.59	8.58	7.77
T <sub>13</sub>	Oxyfluorfen+75%RDF+WF	6.54	7.53	6.87
T <sub>14</sub>	Oxyfluorfen+100%RDF+WF	6.84	7.83	6.86
T <sub>15</sub>	Oxyfluorfen+125%RDF+WF	6.96	7.94	7.07
T <sub>16</sub>	Fluazipop-p-butyl +75%RDF+WC	6.06	7.05	6.32
T <sub>17</sub>	Fluazipop-p-butyl +100%RDF+WC	6.13	7.12	6.46
T <sub>18</sub>	Fluazipop-p-butyl +125%RDF+WC	6.27	7.26	6.52
	SE.m ±	0.012	0.012	0.774
	CD at 5%	0.033	0.034	0.257

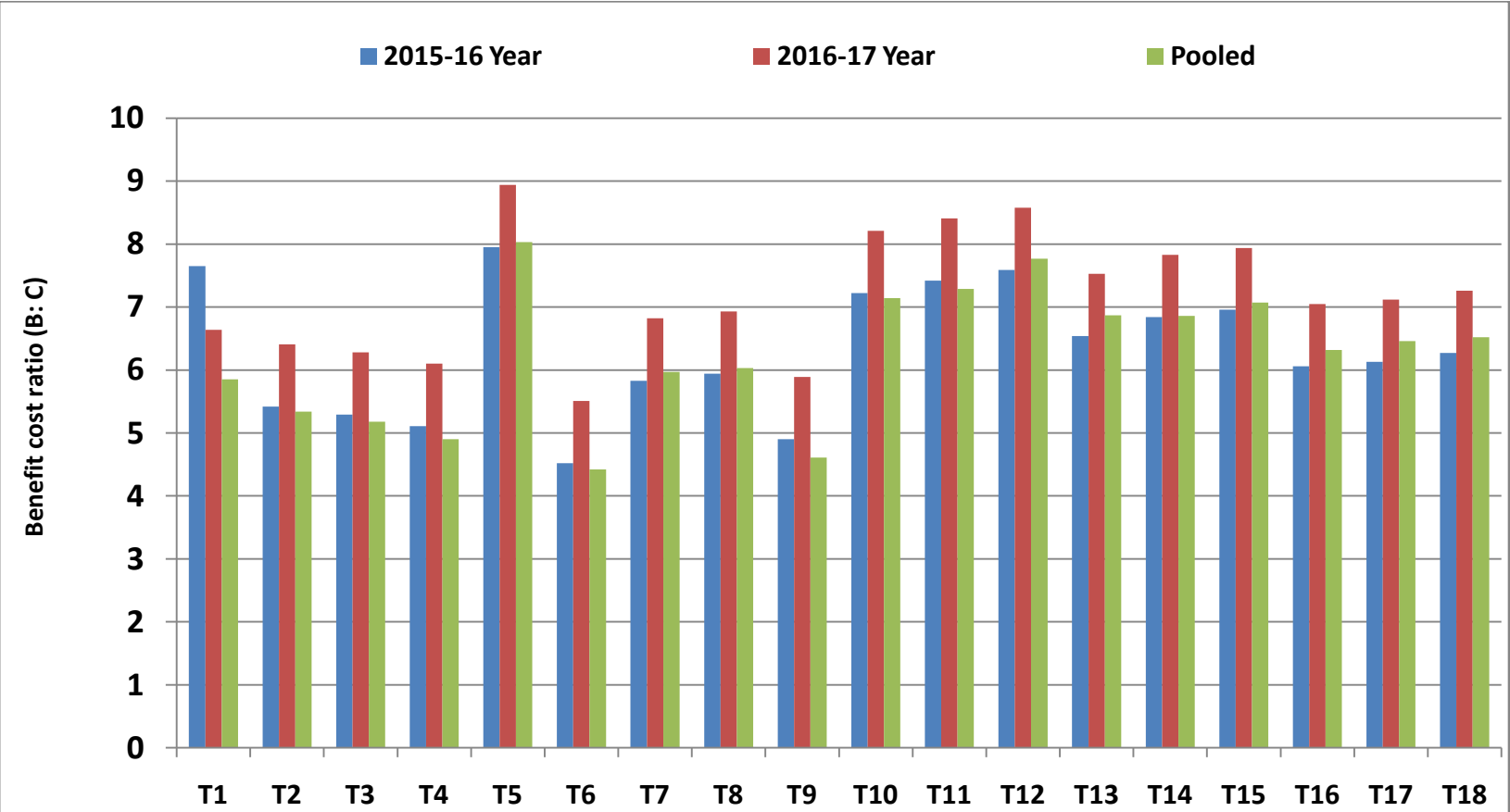


Fig. 4.37.2: Effect of weed and fertilizers management on Benefit cost ratio (B: C)

# *Discussion*

## CHAPTER-V

**DISCUSSION**

The present investigation entitled “**Studies on Weed and Fertilizer Management on Growth, Yield and Quality of Onion (*Allium cepa* L.) Under Lucknow Conditions**“ was planned for the execution of present experiment during Rabi season of the year 2015-16 and 2016-17, respectively. The experiment was performed at the Horticulture Research Farm, Department of Applied Plant Science, Babasaheb Bhimrao Ambedkar University (A central University), Vidya- Vihar, Rae Bareli Road, Lucknow (U.P.) India. Three weedicides namely Pendimethalin @ 750g a.i. /ha (Stomp) + 75%, 100%, 125% RDF + Hand weeding, Oxyfluorfen@0.250kga.i/ha + 75%, 100%, 125% RDF + Weed free and Fluazipop-p-butyl@0.250kg a.i/ha + 75%, 100%, 125% RDF + Weedy check at different intervals were done compared with Weedy check (Control).

The observation on vegetative characters, yield and quality behaviour offer information of paramount importance to research workers as well as commercial growers of vegetables. The experimental findings described in previous chapter are discussed here in with probable causes and supporting evidences on the subject which could be made available to the author.

### **5.1. Effect of integrated weed management on weed incidence in transplanted onion.**

#### **5.1.1 Effect of weed density (no /m<sup>2</sup>) monocot weeds:**

All treatments caused significant in weed density (no /m<sup>2</sup>) monocot weeds as compared to Weedy check control. Significantly lower weed density (no /m<sup>2</sup>) monocot weeds and higher weed control efficiency were observed under weed free check closely followed by treatments T<sub>12</sub> (Pendimethalin+125% RDF+HW). The

results obtained during the investigation in Integrated Weed Management. The maximum Weed Density (no./m)<sup>2</sup> of monocot weeds at 30, 60 and 90 DAT were noted by the application of T<sub>6</sub> (Weedy check (Control) closely followed by T<sub>9</sub> (Fluazipop-p-butyl + Weed check) during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, the lowest value were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW). Similarly Found that the monocotyledon weeds **Singh and Singh (1994)** and **Chittapur and Shenoy (2002)**.

### **5.1.2 Effect of weed density (no /m<sup>2</sup>) dicot weeds:**

All treatments caused significant in weed density (no /m<sup>2</sup>) dicot weeds as compared to Weedy check control. Significantly lower weed density (no /m<sup>2</sup>) dicot weeds and higher weed control efficiency were observed under weed free check closely followed by treatments T<sub>12</sub> (Pendimethalin+125% RDF+HW). The maximum Weed Density (no./m)<sup>2</sup> of dicot weed at 30,60 and 90 DAT were noted by the application of T<sub>6</sub> (Weedy check (Control) closely followed by T<sub>9</sub> (Fluazipop-p-butyl + Weed check) during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW). Results agree with the findings of **Chopra and Chopra (2007)**, **Verma and Singh (1997)**, **Singh et al. (1997)**.

### **5.1.3 Effect of Fresh Weight of monocot weeds (g/m<sup>2</sup>):**

All treatments caused significant in fresh weight of monocot weeds (g/m<sup>2</sup>) as compared to Weedy check control. Significantly lower fresh weight of monocot

weeds ( $\text{g/m}^2$ ) and higher weed control efficiency were observed under weed free check closely followed by treatments T<sub>12</sub> (Pendimethalin+125% RDF+HW).

The maximum fresh weight of monocot weeds ( $\text{g/m}^2$ ) at 30, 60 and 90 DAT were noted by the application of T<sub>6</sub> (Weedy check (Control) closely followed by T<sub>9</sub> (Fluazipop-p-butyl +Weed check) during 2015-16 and 2016-17, respectively this improvement was significantly highest than rest of the treatment however, lowest were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW). Similarly results reported that control plots having no weed control produced maximum weed fresh biomass (635 and 679  $\text{g m}^{-2}$ ) during 2003–04 and 2004–05, respectively. While pendimethalin in combination with hoeing at 60 DAT resulted in lower weed population (32 and 37  $\text{m}^{-2}$ ) and weed fresh biomass production (60 and 79  $\text{g m}^{-2}$ ) compared to oxadiazon during both the years **Khalid *et al.* (2006)**.

#### **5.1.4 Effect of Fresh Weight of dicot weeds ( $\text{g/m}^2$ ):**

The maximum fresh weight of dicot weeds ( $\text{g/m}^2$ ) at 30,60 and 90 DAT were noted by the application of T<sub>6</sub> (Weedy check (Control)closely followed by T<sub>9</sub>(Fluazipop-p-butyl + Weed check) during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest value were recorded in treatment T<sub>5</sub> (weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW). **Saimbhi *et al.* (2000); Ved Prakash *et al.* (2000)**.

#### **5.1.5 Effect of Dry weight of weeds ( $\text{g/m}^2$ ):**

All treatments caused significant reduction in dry weight of weeds as compared to Weedy check control. Significantly lower dry matter of weeds and higher weed control efficiency were observed under weed free check closely followed

by Pendimethalin+125% RDF+HW. This is attributed to the effective control of weeds under these treatments, which reflected on less number of weeds and ultimately lower weed biomass. The weedy check recorded the highest dry matter of weeds and the lowest weed control efficiency, where is due to uncontrolled condition favoured luxurious weed growth leading to increased dry matter accumulation. The maximum Dry weight of weeds ( $\text{g/m}^2$ ) at 90 DAT were noted by the application of T<sub>6</sub> Weedy check (Control) closely followed by T<sub>9</sub> (Fluazipop-p-butyl + Weed check) during 2015-16 and 2016-17, Similar results found Saimbhi *et al.* (2000) reported that the pendimethalin @  $0.56 \text{ kg ha}^{-1}$  + HW at 105 DAS gave excellent control of weeds, reduced weed density as well as weed dry matter in seed crop of onion. And Ved Prakash *et al.* (2000), Nandal and Singh (2002), Yadav *et al.* (2009), Bharathi *et al.* (2011).

### **5.1.6 Effect of integrated weed management practices on Weed control efficiency (%):**

Among the herbicide treatment, the maximum weed control efficiency(%) recorded in T<sub>5</sub>(Weed free) 64.31% and T<sub>12</sub> application of Pendimethalin+125% RDF+HW 63.96% at 30 DAT Recorded significantly higher weed control efficiency application of Pendimethalin+100% RDF+HW at 45 DAT found third rank in respect of weed control efficiency (62.53%). Significantly lower weed control efficiency was noticed in a T<sub>6</sub> (Weedy check (Control) followed by T<sub>9</sub> (Fluazipop-p-butyl+Weed check). The weed free treatment was found significantly superior by recording 100% weed control efficiency. Similarly results were also reported by Singh *et al.* (1996); Patil, (1999); Channappagoudar and Biradar (2007) and Dalavai (2009).

## **5.2 Effect of integrated weed management practices on Vegetative growth attributes of onion:**

### **5.2.1 Effect on crop:**

Every one of the weed management treatments was significantly superior over control in respect of all growth attributes significantly the highest growth attributes (*viz.*, plant height, 30, 60, 90 DAT, no. of leaves, 30, 60, 90 DAT and neck thickness 90 DAT. The maximum plant height, no of leaves at 30, 60, 90 DAT and neck thickness at 90 DAT were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin + 125% RDF + HW) during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment Whereas, significantly the lowest all growth were recorded in treatment T<sub>6</sub> (Weedy check (Control) followed by T<sub>9</sub> (Fluazipop-p-butyl+Weed check). It might be due to less weed crop competition throughout crop growth period by manual weeding, which in turn maintain the soil fertility status by way of removing less plant nutrients through weeds and ultimately have favourable effect on growth parameters These findings are in close conformity with those reported by **Ved Prakash *et al.* (2000); Bharathi *et al.* (2011); Kalhapure and Shete (2012) and Kalhapure *et al.* (2013).**

### **5.2.2 Effect of Number of day taken to bulb formation:**

The minimum number of day taken to bulb formation were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) during 2015-16 and 2016-17, respectively and this improvement was significantly than rest of the treatment however, highest value were recorded in

treatment T<sub>6</sub> (Weedy check (Control)). Similar results were reported by **Patel et al. (2011)**.

### **5.2.3 Effect of integrated weed management practices on Number of day taken to maturity:**

The minimum number of day taken to maturity were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) during 2015-16 and 2016-17, respectively and this improvement was significantly than rest of the treatment however, highest value were recorded in treatment T<sub>6</sub> (Weedy check (Control)). Similar results were reported by **Patel et al. (2011)**.

### **5.3. Effect of integrated weed management practices on Yield attributes of onion:**

Significantly the highest yield attributes (bulb diameter, fresh bulb weight and bulb yield) were observed in weed free check. Significant variations were also observed for average bulb weight and total bulb yield in onion. The pooled average bulb weight in onion varies from 68.68g (T<sub>6</sub>) to 105.19g (T<sub>5</sub>). Significantly heaviest bulb was recorded in T<sub>5</sub> (105.19g) than rest of the treatments except (T<sub>12</sub>)103.04 g and (T<sub>11</sub>) 99.27 g. All the weed control treatments produced significantly higher fresh weight of bulb (g), Bulb diameter (cm), Number of scales/bulb, Bulb yield/plot bulb yield q/ha were noted by the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW). The results also showed that treatment effect were significant in pooled total bulb yield in onion. Significantly highest total bulb yield was recorded in T<sub>5</sub> (331.00q ha<sup>-1</sup>) followed by T<sub>12</sub> (315.00q ha<sup>-1</sup>), T<sub>11</sub> (306.36q ha<sup>-1</sup>), T<sub>10</sub> (303.70q ha<sup>-1</sup>) and T<sub>15</sub> (295.69q ha<sup>-1</sup>) than the rest of the treatments. On the other hand, significantly lowest pooled total yield of 154.37q ha<sup>-1</sup> was recorded in

T<sub>6</sub>, (Weedy check (Control) during 2015-16 and 2016-17, The results are in agreement with Vidhya and Anburani (2004), Ghosh *et al.* (2004)

#### **5.4. Effect of integrated weed management practices on quality of onion:**

Under present investigation the marked influence of various herbicides and fertilizers were observed on the quality parameters of onion bulb. Significant average increment toward Calcium mg/100g, (24.48) Phosphorus mg/100g, (35.22) Sulphur mg/100g, (0.120) vitamin C, (10.84) T.S.S, (13.74) reducing sugars, (8.83) non-reducing sugars(10.24) and total sugars(18.13) were recorded under the application of T<sub>5</sub> (weed free) closely followed by T<sub>12</sub> Pendimethalin + 125% RDF + HW during 2015-16 and 2016-17, respectively and this improvement was significantly highest than rest of the treatment however, lowest average value were recorded Calcium mg/100g, (18.78) Phosphorus mg/100g, (25.16) Sulphur mg/100g, (0.108) vitamin C, (7.66) T.S.S, (11.58) reducing sugars, (5.80) non-reducing sugars(8.03) and total sugars(14.54) in treatment T<sub>6</sub> (Weedy check (Control)).

#### **5.5 Effect of integrated weed management practices on economics of onion:**

From the economics point of view, Significantly highest gross returns, net returns and B:C ratio were recorded in treatment weed free check as compared to control. Among weedicide treatments, pre-plant application of pendimethalin 0.750 kg/ha along with 75%,100%,125% RDF + HW and post emergence application of oxyfluorfen 0.250 kg/ha with 75%,100%,125% RDF +WF significantly higher gross returns, net returns and B:C ratio. The average benefit: cost ratio was maximum in weed free check 8.03 followed by treatments T<sub>12</sub> (Pendimethalin+125% RDF+HW)

(7.77) and T<sub>11</sub> (Pendimethalin+100% RDF+HW) (7.29). The average highest net profit of (Rs.158042 /ha) was obtained from treatment weed free check followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) (Rs.158018 /ha), respectively. When weeds in onion were controlled either by herbicides or by hand weeding Though Pendimethalin+125% RDF+HW fetched the higher gross monetary return (Rs 199368/-) over all the other treatments, Whereas, minimum net realization (19250), Gross return ( Rs. 50230) and B: C ratio (4.42) was recorded with Weedy check (Control). Similar results were reported by **Nandal and Singh (2002); Kalhapure and Shete (2013) and Patel *et al.* (2011).**

*Summary  
and  
Conclusion*

## CHAPTER-VI

## SUMMARY AND CONCLUSION

The present investigation entitled ““**Studies on Weed and Fertilizer Management on Growth, Yield and Quality of Onion (*Allium cepa* L.) Under Lucknow Conditions**“ carried out during Rabi season of the year 2015-16 and 2016-17. at Horticulture Research Farm, Department of Applied Plant Science, Babasaheb Bhimrao Ambedkar University (A central University), Vidya- Vihar, Rae Bareli Road, Lucknow (U.P.), India. Eighteen treatment combinations were compared in randomized block design with three replications. The studies were concentrated on plant growth yield, quality and benefit cost ratio. The silent features of the findings of the investigation are summarized below:

- The maximum plant height at 30, 60 and 90 DAT was recorded under the treatment T<sub>5</sub> (Weed free), followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) respectively as compared to the control treatment T<sub>6</sub> (Weedy check).
- The maximum No of leaves/plant at 30, 60 and 90 DAT was found under the treatment T<sub>5</sub> (Weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) respectively as compared to the control treatment T<sub>6</sub> (Weedy check).
- The highest Neck thickness (cm) was noted under the treatment T<sub>5</sub> (Weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) respectively as compared to the control treatment T<sub>6</sub> (Weedy check).
- The minimum number of days taken for bulb formation was calculated under the treatment T<sub>5</sub> (Weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub> (Pendimethalin+100% RDF+HW) respectively as compared to the other treatments. While, maximum number of days required for bulb formation was recorded in the control treatment T<sub>6</sub> (Weedy check).

➤ The minimum no of days taken to maturity was recorded under the treatment T<sub>5</sub> (Weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub> (Pendimethalin+100% RDF+HW) respectively as compared to the other treatments. While maximum number of days required for maturity was recorded in the control T<sub>6</sub> (Weedy check).

➤ The bulb diameter was influenced significantly with the treatment T<sub>5</sub> (Weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub> (Pendimethalin+100% RDF+HW) respectively as compared to the other treatments .While, less bulb diameter was found in the control T<sub>6</sub> (Weedy check).

➤ The bulb weight was also influenced significantly with the treatment T<sub>5</sub> (Weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub> (Pendimethalin+100% RDF+HW) respectively as compared to the other treatments .While, less bulb weight was found in the control T<sub>6</sub> (Weedy check).

➤ The more number of scales per bulb was observed with the treatment T<sub>5</sub> (Weed free) followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub> (Pendimethalin+100% RDF+HW) respectively as compared to the control treatment T<sub>6</sub> (Weedy check).

➤ The yield per plot and per hectare was increased significantly under treatment T<sub>5</sub> (Weed free), followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub> (Pendimethalin+100% RDF+HW) respectively as compared to the control treatment T<sub>6</sub> (Weedy check).

➤ The maximum calcium content was found of the treatment T<sub>5</sub> (Weed free), followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub> (Pendimethalin+100% RDF+HW) respectively as compared to the control treatment T<sub>6</sub> (Weedy check).

- The maximum phosphorus and sulphur content was found of the treatment T<sub>5</sub> (Weed free), followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub> (Pendimethalin+100% RDF+HW) respectively as compared to the control treatment T<sub>6</sub> (Weedy check).
- The maximum total soluble solids were found of the treatment T<sub>5</sub> (Weed free), followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub> (Pendimethalin+100% RDF+HW) respectively as compared to the control treatment T<sub>6</sub> (Weedy check).
- The maximum vitamin C was found of the treatment T<sub>5</sub> (Weed free), followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub> (Pendimethalin+100% RDF+HW) respectively as compared to the control treatment T<sub>6</sub> (Weedy check).
- The highest reducing sugars, on reducing and total sugars was recorded with the treatment T<sub>5</sub> (Weed free), followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub> (Pendimethalin+100% RDF+HW) respectively as compared to the control treatment T<sub>6</sub> (Weedy check).
- The highest gross income per hectare was obtained with the treatment T<sub>5</sub> (Weed free), followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub> (Pendimethalin+100% RDF+HW) respectively as compared to the control treatment T<sub>6</sub> (Weedy check).
- The maximum net return per hectare was obtained with the treatment T<sub>5</sub> (Weed free), followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub> (Pendimethalin+100% RDF+HW) respectively as compared to the control treatment T<sub>6</sub> (Weedy check).
- The maximum benefit: cost ratio per hectare was obtained with the treatment T<sub>5</sub> (Weed free), followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub>

(Pendimethalin+100% RDF+HW) respectively as compared to the control treatment T<sub>6</sub> (Weedy check).

➤ The minimum Weed density (no./m)<sup>2</sup> at 30, 60 and 90 DAT monocot and dicot observed in the treatment T<sub>5</sub>(Weed free), followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub> (Pendimethalin+100% RDF+HW) respectively as compared to the other treatments. While, maximum Weed density (no./m)<sup>2</sup> at 30, 60 and 90 DAT monocot and dicot was recorded in the control T<sub>6</sub> (Weedy check ).

➤ The minimum Fresh weight of weeds (g/m<sup>2</sup>) at 30, 60 and 90 DAT monocot and dicot recorded in the treatment T<sub>5</sub> (Weed free), followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub> (Pendimethalin+100% RDF+HW) respectively as compared to the other treatments. While maximum Fresh weight of weeds (g/m<sup>2</sup>) at 30, 60 and 90 DAT monocot and dicot was recorded in the control T<sub>6</sub> (Weedy check).

➤ The minimum Dry weight of weeds (g/m)<sup>2</sup> at 90 DAT monocot and dicot recorded in the treatment T<sub>5</sub> (Weed free), followed by T<sub>12</sub> (Pendimethalin+125% RDF+HW) and treatment T<sub>11</sub> (Pendimethalin+100% RDF+HW) respectively as compared to the other treatments. While, maximum Dry weight of weeds (g/m)<sup>2</sup> at 90 DAT monocot and dicot was recorded in the control T<sub>6</sub> (Weedy check).

➤ The minimum weed control efficiency (%) recorded in the treatment T<sub>6</sub> Weedy check (Control) followed by T<sub>9</sub> (Fluazipop-p-butyl Weed check) and T<sub>4</sub> (Hand weeding at 20 DAP) respectively as compared to the other treatments. While maximum weed control efficiency (%) recorded in T<sub>5</sub> (Weed free), and T<sub>12</sub> (pendimethalin+125% RDF+HW).

## CONCLUSION

The result obtained from present investigation led to an inference that treatment T<sub>5</sub> (Weed free), should be taken as most effective treatment followed by treatment T<sub>12</sub> (Pendimethalin+125% RDF+HW) hand weeding was more effective than application of pendimethalin with the combination of 125% RDF, T<sub>11</sub> (Pendimethalin+100% RDF+HW) and T<sub>10</sub> (Pendimethalin+75% RDF+HW) respectively. Enhancing vegetative, morphological and qualitative parameters of onion plants and fruits respectively. Combination of herbicide and fertilizers with hand weeding showed the significant effect on various growth parameters, yield and yield attributing characters, quality and benefit : cost ratio of the crop .Therefore ,it is concluded that combination of herbicide and fertilizers with hand weeding may not only achieve highest onion yield and net returns but also improved quality of onion bulb.

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## APPENDIX-1

Analysis of variance of plant height (cm) at 30 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	0.348			
Treatment	17	400.961	23.586	142.663	0.00000
Error	17	2.811	0.165		
Total	35	404.119			

## APPENDIX-2

Analysis of variance of plant height (cm) at 60 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	1.157			
Treatment	17	428.298	25.194	1,266.238	0.00000
Error	17	0.338	0.020		
Total	35	429.794			

## APPENDIX-3

Analysis of variance of plant height (cm) at 90 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	8.993			
Treatment	17	467.754	27.515	28,305.535	0.00000
Error	17	0.017	0.001		
Total	35	476.763			

## APPENDIX-4

Analysis of variance of number of leaves (cm) at 30 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	0.010			
Treatment	17	2.996	0.176	8.376	0.00003
Error	17	0.358	0.021		
Total	35	3.364			

## APPENDIX-5

Analysis of variance of number of leaves (cm) at 60dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	0.232			
Treatment	17	22.218	1.307	15.668	0.00000
Error	17	1.418	0.083		
Total	35	23.868			

## APPENDIX-6

Analysis of variance of number of leaves at 90 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	0.622			
Treatment	17	20.874	1.228	26.102	0.00000
Error	17	0.800	0.047		
Total	35	22.295			

**APPENDIX-7**

Analysis of variance of neck thickness (cm) as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	0.229			
Treatment	17	38.029	2.237	16.881	0.00000
Error	17	2.253	0.133		
Total	35	40.510			

**APPENDIX-8**

Analysis of variance of number of days required for bulb formation as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	0.469			
Treatment	17	803.305	47.253	879.065	0.00000
Error	17	0.914	0.054		
Total	35	804.687			

**APPENDIX-9**

Analysis of variance of number of days taken to maturity as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	3.784			
Treatment	17	1,916.273	112.722	18,562.803	0.00000
Error	17	0.103	0.006		
Total	35	1,920.161			

**APPENDIX-10**

Analysis of variance of weed density (no./m<sup>2</sup>) of monocot weeds at 30 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	7.930			
Treatment	17	19,851.635	1,167.743	40,116.523	0.00000
Error	17	0.495	0.029		
Total	35	19,860.060			

**APPENDIX-11**

Analysis of variance of weed density (no./m<sup>2</sup>) of monocot weeds at 60 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	2.994			
Treatment	17	61,277.919	3,604.583	77,652.617	0.00000
Error	17	0.789	0.046		
Total	35	61,281.702			

**APPENDIX-12**

Analysis of variance of weed density (no./m<sup>2</sup>) of monocot weeds at 90 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	31.793			
Treatment	17	107,654.334	6,332.608	61,308.995	0.00000
Error	17	1.756	0.103		
Total	35	107,687.883			

## APPENDIX-13

Analysis of variance of fresh weight of monocot weeds ( $\text{g/m}^2$ ) at 30 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	34.842			
Treatment	17	10,865.220	639.131	120,518.269	0.00000
Error	17	0.090	0.005		
Total	35	10,900.152			

## APPENDIX-14

Analysis of variance of fresh weight of monocot weeds ( $\text{g/m}^2$ ) at 60 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	36.288			
Treatment	17	4,983.668	293.157	27,788.359	0.00000
Error	17	0.179	0.011		
Total	35	5,020.136			

## APPENDIX-15

Analysis of variance of fresh weight of monocot weeds ( $\text{g/m}^2$ ) at 90 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	0.010			
Treatment	17	74,146.422	4,361.554	1,326,701.136	0.00000
Error	17	0.056	0.003		
Total	35	74,146.488			

**APPENDIX-16**

Analysis of variance of weed density (no./m<sup>2</sup>) of dicot weeds at 30 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	8.193			
Treatment	17	247.121	14.537	512.956	0.00000
Error	17	0.482	0.028		
Total	35	255.796			

**APPENDIX-17**

Analysis of variance of weed density (no./m<sup>2</sup>) of dicot weeds at 60 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	0.006			
Treatment	17	387.615	22.801	998.749	0.00000
Error	17	0.388	0.023		
Total	35	388.008			

**APPENDIX-18**

Analysis of variance of weed density (no./m<sup>2</sup>) of dicot weeds at 90 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	7.983			
Treatment	17	631.280	37.134	1,285.001	0.00000
Error	17	0.491	0.029		
Total	35	639.754			

## APPENDIX-19

Analysis of variance of fresh weight of dicot weeds ( $\text{g/m}^2$ ) at 30 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	8.856			
Treatment	17	1,835.095	107.947	28,594,005.259	0.00000
Error	17	0.000	0.000		
Total	35	1,843.951			

## APPENDIX-20

Analysis of variance of fresh weight of dicot weeds ( $\text{g/m}^2$ ) at 60 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	1.134			
Treatment	17	1,925.632	113.272	35,138.900	0.00000
Error	17	0.055	0.003		
Total	35	1,926.821			

## APPENDIX-21

Analysis of variance of fresh weight of dicot weeds ( $\text{g/m}^2$ ) at 90 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	2.296			
Treatment	17	5,262.482	309.558	984.797	0.00000
Error	17	5.344	0.314		
Total	35	5,270.122			

## APPENDIX-22

Analysis of variance of dry weight of weeds ( $\text{g/m}^2$ ) at 90 dat as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	3.937			
Treatment	17	19,528.918	1,148.760	627,307.502	0.00000
Error	17	0.031	0.002		
Total	35	19,532.886			

## APPENDIX-23

Analysis of variance of weed control efficiency (%) as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	7.737			
Treatment	17	15,557.052	915.121	27,245.704	0.00000
Error	17	0.571	0.034		
Total	35	15,565.360			

## APPENDIX-24

Analysis of variance of bulb weight (g) as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	0.960			
Treatment	17	4,309.586	253.505	33,602.591	0.00000
Error	17	0.128	0.008		
Total	35	4,310.674			

**APPENDIX-25**

Analysis of variance of bulb diameter (cm) as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	8.743			
Treatment	17	11.561	0.680	221.120	0.00000
Error	17	0.052	0.003		
Total	35	20.356			

**APPENDIX-26**

Analysis of variance of number of scales/bulb as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	0.981			
Treatment	17	33.511	1.971	205,599.927	0.00000
Error	17	0.000	0.000		
Total	35	34.493			

**APPENDIX-27**

Analysis of variance of bulb yield/plot (kg) as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	9.559			
Treatment	17	21.094	1.241	433,373.120	0.00000
Error	17	0.000	0.000		
Total	35	30.653			

**APPENDIX-28**

Analysis of variance of total bulb yield(q/ha)as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	42,221.908			
Treatment	17	93,375.505	5,492.677	153,024.393	0.00000
Error	17	0.610	0.036		
Total	35	135,598.023			

**APPENDIX-29**

Analysis of variance of calcium (mg/100g) as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	14.835			
Treatment	17	95.469	5.616	463.293	0.00000
Error	17	0.206	0.012		
Total	35	110.510			

**APPENDIX-30**

Analysis of variance of phosphorus (mg/100g) as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	0.647			
Treatment	17	250.694	14.747	532.959	0.00000
Error	17	0.470	0.028		
Total	35	251.811			

**APPENDIX-31**

Analysis of variance of sulphur (mg/100g) as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	0.647			
Treatment	17	250.694	14.747	532.959	0.00000
Error	17	0.470	0.028		
Total	35	251.811			

**APPENDIX-32**

Analysis of variance of total soluble solids (<sup>0</sup>brix) as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	7.950			
Treatment	17	16.782	0.987	79.146	0.00000
Error	17	0.212	0.012		
Total	35	24.943			

**APPENDIX-33**

Analysis of variance of ascorbic acid (vitamin c mg/100g) as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	3.848			
Treatment	17	27.038	1.590	8,632.446	0.00000
Error	17	0.003	0.000		
Total	35	30.888			

**APPENDIX-34**

Analysis of variance of reducing sugar (%) as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	3.806			
Treatment	17	27.427	1.613	257,099.168	0.00000
Error	17	0.000	0.000		
Total	35	31.233			

**APPENDIX-35**

Analysis of variance of non reducing sugars (%) as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	7.711			
Treatment	17	17.024	1.001	36.751	0.00000
Error	17	0.463	0.027		
Total	35	25.198			

**APPENDIX-36**

Analysis of variance of total sugars (%) as affected by integrated weed management.

Source of variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	1	1.324			
Treatment	17	40.447	2.379	86.324	0.00000
Error	17	0.469	0.028		
Total	35	42.240			

**APPENDIX-37**

**Analysis of variance of benefit cost ratio (B: C) as affected by integrated weed management.**

<b>Source of variation</b>	<b>DF</b>	<b>Sum of Squares</b>	<b>Mean Squares</b>	<b>F-Calculated</b>	<b>Significance</b>
<b>Replication</b>	<b>1</b>	<b>0.229</b>			
<b>Treatment</b>	<b>17</b>	<b>38.029</b>	<b>2.237</b>	<b>16.881</b>	<b>0.00000</b>
<b>Error</b>	<b>17</b>	<b>2.253</b>	<b>0.133</b>		
<b>Total</b>	<b>35</b>	<b>40.510</b>			