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Effect of weed control method on gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty on weed growth

Manisha Bhaskar, Samir Kumar and Madan Kumar Jha

Abstract

The present investigation “Effect of weed control methods on gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty” was conducted in the Department of Floriculture and Landscape Architecture, College of Agriculture, Indira Gandhi Agricultural University, Raipur, Chhattisgarh during the *rabiseason* of year 2017-18. The experiment consisted of 11 treatment combinations of different weed control treatments viz. Pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP (T₁), Pendimethalin 30% EC @ 2.0 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP (T₂), Oxyfluorfen 23.5% EC @ 0.25 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP (T₃), Oxyfluorfen 23.5% EC @ 0.50 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP (T₄), Pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ (PE) + Fenoxaprop-p-ethyl 9.3% EC @ 0.10 kg a.i. ha⁻¹ at 30 DAP (PoE) (T₅), Pendimethalin 30% EC @ 2.0 kg a.i. ha⁻¹ (PE) + Fenoxaprop-p-ethyl 9.3% EC @ 0.10 kg a.i. ha⁻¹ at 30 DAP (PoE) (T₆), Oxyfluorfen 23.5% EC @ 0.25 kg a.i. ha⁻¹ (PE) + Fenoxaprop-p-ethyl 9.3% EC @ 0.10 kg a.i. ha⁻¹ at 30 DAP (PoE) (T₇), Oxyfluorfen 23.5% EC @ 0.50 kg a.i. ha⁻¹ (PE) + Fenoxaprop-p-ethyl 9.3% EC @ 0.10 kg a.i. ha⁻¹ at 30 DAP (PoE) (T₈), One Hand Weeding at 30 DAP (T₉), Two Hand Weeding at 30 and 650 DAP (T₁₀) and Un weeded (Control) (T₁₁). The plots treated with pre-emergence herbicides *i.e.* pendimethaline and oxyfluorfen significantly reduced the weed population at early stage of crop growth as compared to plots where other treatments were applied like hand weeding and unweeded (control). The least weed density (3.67 and 5.00 at 30 and 60 DAP, respectively) and dry weight (0.04 g at 30 DAP and 0.09 g at 60 DAP) was recorded under Pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ (PE) + Hand Weeding at 30 DAT *i.e.* T₁. At later stage of crop growth *i.e.* 90 DAP, minimum weed density (11.89) and dry weight (0.49 g) was observed in treatment Two Hand Weeding at 30 and 60 DAP. The maximum values for these parameters were recorded in un weeded treatment. Significantly maximum weed control efficiency (95.8% at 30 DAP and 98.4% at 60 DAP) was observed in Pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ (PE) + Hand Weeding at 30 DAT. However, it was maximum (94.2%) in treatment Two Hand Weeding at 30 and 60 after transplanting of gladiolus crop. Minimum (00%) was noted in un weeded treatment at all stages of crop growth.

Keywords: Weed management & gladiolus

Introduction

Flowers are wonderful creation of God and one of most beautiful gift of nature to human. They are used to express the feelings of love, joy, sorrow and happiness because they have the power to make us happy and cheerful on different occasion like marriage, valentine day, birthday, funeral wedding etc. Different kind and types of flowers are used by people on different occasions and it stands for strength and moral integrity.

Gladiolus (*Gladiolus grandiflorus* L.) belongs to family Iridiaceae with chromosome number n=15 and native of South Africa and Tropical Africa (Mukhopadhyay, 1995). The name gladiolus was originally coined by Pliny the Elder (A.D.23-79), from the Latin word *gladius*, meaning a sword, also known as ‘Sword lily’. Gladiolus was introduced to India during 19th century (Apte, 1958) ^[1]. It is referred as “Queen of bulbous flowers” crop, due to its magnificent inflorescence, brilliant colours, attractive shapes, varying sizes, straight and considerably hardy spike with long vase life are desirable characteristics.

Gladiolus is a very popular flowering plant in international cut flower trade and occupies fourth place after rose, carnation, and chrysanthemum (Bose, 2000) ^[2]. Commercial cultivation of gladiolus is gaining popularity due to export potential in various parts of the country (Sidhu and Arora, 1989). Delhi, Mumbai, Bangalore are major domestic market centers and the main centers for commercial cultivation are Srinagar (Jammu and Kashmir), Shimla (Himachal Pradesh), Chaubattia and Supi (Uttar Pradesh), Kalimpong and Darjeeling (West Bengal), Shillong and Jorhat (Assam), Pune (Maharashtra), Bangalore (Karnataka) and Ooty (Tamil

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nadu) etc. It is a popular flower among growers of state because thousands of spikes are being sold every year. In the Chhattisgarh state, it is estimated that gladiolus is cultivated in an area of 1922 ha with a production of 5279 MT (Krishi diary 2017-18).

Material and methods

Weed density

Total number of weeds presented in a experimental plots were counted with the help of quadrates of 0.5 m² and weed density was recorded. All the weeds present in the experimental plots were classified under three major group (i) Grasses (ii) Sedges and (iii) Broad leaved weeds. The numbers of weeds were counted at 30, 60 and 90 DAT and the average was worked out.

3.10.2. Dry matter of weeds (g)

After collecting the weeds from individual treatments at a specific day, weed samples were kept for drying in oven at 60 °C for 72 hours. After complete drying, the dry matter production of weeds was recorded for different treatments.

3.10.3. Weed control efficiency (WCE)

The weed control efficiency was calculated on the basis of reduction in dry matter production in treated plot in comparison with the control plot and expressed in percentage. Where,

WCE = Weed control efficiency

DWC = Dry weight of weeds in weedy check plot

DWT = Dry weight of weeds in treated plot

Results and discussion

Influence of different weed control treatments on weed growth

Observation on weeds

In the experimental plots, the prominent weed species observed were *Acalyphaindica*, *Ageratum conyzoides*, *Alternanthera abetzickiana*, *Alternanthera paranychioides*, *Amaranthus viridis*, *Anagallis arvensis*, *Brachiariae rusiformis*, *Commelina benghalensis*, *Corchorus aestuans l.*, *Cyprus rotandus*, *Euphorbia geniculata*, *Euphorbia microphylla*, *Ipomoea obscura*, *Medicago denticulata*, *Mimosa pudica*, *Parthenium hysterophorus*, *Pedalium murex linn*, *Sphaeranthusindicus* etc. Weed flora observed during the crop period of gladiolus was categorized as grasses, sedges and broad leaved weeds. Among the grasses, *Commelina benghalensis* *Echinochloa colonum* was predominant. The only sedge observed was *Cyperus rotundus* and the minimum weed count was noted for *Medicago denticulata* followed by *Alternanthera paranychioides*. The predominant species of weeds are presented in table. 4.8 Presence of monocot and dicot weed flora was also reported by Manjunath *et al.* (2010) in lentil and Shalini and Patil (2006)^[7] in gerbera.

Table 1: List of weed observed in experimental field during crop period.

S. No.	Botanical name	Common name	Life cycle	Family
Grasses				
1	<i>Echinochloa colonum</i>	Barnyard	Annual	Graminaea
	<i>Cynodondactylon</i>	Bermuda grass	Perennial	Poaceae
Sedges				
2	<i>Cyperu srotundus</i>	Purple nut sedge	Perennial	Cyperaceae
Broad leaved weeds				
4	<i>Ageratum conyzoides</i>	Goat weed	Annual, Perennial	Asteraceae
5	<i>Sphaeranthus indicus</i>	East indioglobethistle	Annual	Asteraceae
6	<i>Amaranthus viridis</i>	Janglichaulai	Annual	Amaranthaceae
7	<i>Parthenium hysterophorus</i>	Chandani	Annual	Asteraceae
8	<i>Pedalium murex linn</i>	Large caltrops	Perennial	
9	<i>Mimosa pudica</i>	Sensitive plant	Annual, Perennial	Fabaceae
10	<i>Comelinabengalensis</i>	Dayflower	Annual	Commelinaceae
11	<i>Alternentheraseselis</i>	Joyweed	Annual	Amaranthaceae
12	<i>Medicagodenticulata</i>	Rough medic	Annual	Fabaceae
13	<i>Corchorus aestuans l.</i>	East indianjawas mallow	Perennial	
14	<i>Ipomoea obscura</i>	Obscure morning glory	Annual	Convolvaceae
15	<i>Alternantherabetzickiana</i>	Red calico plant	Perennial	Amaranthaceae
16	<i>Euphorbia microphylla</i>	None	Annual	Euphorbiaceae
17	<i>Acalypha indica</i>	Indian copper leaf	Perennial	Euphorbiaceae
18	<i>Anagallisarvensis</i>	Scarlet pimpernet	Annual	Perimulaceae
19	<i>Euphorbia geniculata</i>	Wild poinsettia	Annual	Euphorbiaceae

Weed population 0.5m⁻² at 30, 60, and 90 DAP

Data on weed population at different growth stages of gladiolus are presented in table no. 4.9. Weed population varied significantly at different growth intervals of gladiolus. Weed density was maximum at 90 DAP compared to 30 and 60 DAP. Differences in density of weed flora at 30, 60 and 90 DAP due to weed control treatments were significant. It ranged from 3.67 to 21.00 at 30 DAP, 5.00 to 43.33 at 60 DAP and 11.99 to 77.33 at 90 DAP.

At 30 DAP, the weed population was found to be significantly affected by different weed management treatments. The result of the experiment clearly showed that at early stage of crop

growth *i.e.* 30 DAP, the plots treated with pre-emergence herbicides *i.e.* pendimethalin and oxyfluorfen significantly reduced the weed population as compared to plots where other treatments were followed like hand weeding and unweeded (control). The minimum number of weed (3.67) was recorded under Pendimethalin 30% EC @ 1.0 kg a.i.ha⁻¹ (PE) + Hand Weeding at 30 DAT *i.e.* T₁ which closely followed by treatment T₂ (4.33), T₃ (4.33) and T₆ (5.49) and these all three treatments were statistically comparable with each other. Treatment T₁₁ (unweeded) recorded the highest population of weed at 30 DAP (21.00) which was statistically similar with T₁₀ (Two hand weeding at 30 and 60 DAP) and T₉ (one hand

weeding at 30 DAP). Other treatments T₆, T₃, T₄, T₇ and T₈ were also recorded significantly lower weed population compared to T₁₁. This could be attributed to the fact that application of pendimethalin might have caused the death of relative weeds from starvation and oxidative damage caused by break down in electron transport process because of the herbicide functions by binding to the plasto-quinone binding protein in photosynthesis (Appleby *et al.* 2002). Oxyfluorfen also causes the stomatal closure as a result of increased membrane permeability (Govske and Hopen, 1976) and by inhibit phosphorylation and photosystem-II electron transport (Pritchard *et al.*, 1980). However, Pendimethalin provides the excellent weed control in gladiolus in this experiment when compared to oxyfluorfen.

At 60 DAP, all weed control treatments were recorded significantly lower weed population than T₁₁. Treatments T₁ (Pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP) recorded least weed population (5.00) which was significantly superior in terms of weed control than rest of weed control treatments except T₂ (Pendimethalin 30% EC @ 2.0 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP), T₃ (Oxyfluorfen 23.5% EC @ 0.25 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP) and T₄ (Oxyfluorfen 23.5% EC @ 0.50 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP). The application of pre emergence herbicides which provided good control of weeds at early stages of crop growth and thereafter hand weed was helpful in controlling later germinating weeds might be the reason of suppressed weed population under these treatments. Meena and Mehta (2009) also noticed that herbicide in combination with one hand weeding at 30 DAT was superior and recorded better weed suppression compared to other treatments. These findings are in agreement with those of Rao *et al.* (2014)^[6] in gladiolus. Similar results were reported by Sharma *et al.* (2014)^[8] in Chrysanthemum (*Dendranthema grandiflora* T.) under Chhattisgarh plains. The maximum weed population (43.0) was observed under T₁₁ *i.e.* unweeded. However, other treatments T₅, T₆, T₇, T₈, T₉ and T₁₀ were also recorded significantly lower weed population compared to T₁₁.

At 90 DAP, the lowest weed population (11.89) was noted under T₁₀ *i.e.* two hand weeding at 30 and 60 DAP which was statistically comparable with T₁ *i.e.* pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP, T₃ *i.e.* oxyfluorfen 23.5% EC @ 0.25 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP, T₂ *i.e.* pendimethalin 30% EC @ 2.0 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP and T₄ *i.e.* oxyfluorfen 23.5% EC @ 0.50 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP and all these weed control treatments were significantly superior in terms of weed control over rest of the treatments. Pre-emergence application of herbicides followed by sequential application of two manual hand weeding reduced the population of weeds which resulted in less population at 90 DAP. The similar finding was reported by Manuja *et al.* (2005), Kumar *et al.* (2012)^[4] and Kadam *et al.* (2014). The highest weed population (77.33) was recorded with T₁₁ (Unweeded). Weed population was also noted significantly lower under rest of all weed control treatments as compared to T₁₁.

■ Weed dry matter (g 0.5m²) at 30, 60 and 90 DAP

The variation due to different weed control treatments at 30, 60 and 90 DAP in respect to dry weight of weeds were significant (Table. 4.9). Weed dry weight gradually increased with time and higher weed dry weight was found at harvest

stage.

At 30 DAP, the weed dry weight ranged from 0.04 to 1.04 g 0.5m². Minimum dry weight of weeds (0.04 g) were noted under treatments *i.e.* T₁ (Pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP) and T₅ (Pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ (PE) + fenoxaprop-p-ethyl 9.3% EC @ 0.10 kg a.i. ha⁻¹ at 30 DAP (PoE) which were *on par* with T₂, T₃, T₄ and T₆. Other treatments T₆, T₇ and T₈ were also recorded significantly lower weed population compared to T₁₁ *viz.* unweeded, T₁₀ *viz.* two hand weeding at 30 and 60 DAP and T₉ *viz.* one hand weeding at 30 DAP. This was attributed to lower weed population under these treatments due to better weed control by pre emergence application of pendimethaline and oxyfluorfen. However, Treatment T₁₁ (Unweeded) recorded the highest dry weight of weed at 30 DAP (1.04 g) and recorded *at par* with treatments consisting hand weeding (T₁₀ (0.95 g), and T₉ (0.95 g)) which was might be due to these treatments were left unweeded after transplanting and giving free environment to weeds to flourish completely up to 30 DAT.

Data recorded at 60 DAP clearly indicated that all the treatments differed significantly with each other with respect to weed dry weight (g) at 60 days after planting of gladiolus cv. American Beauty. All the weed control treatment showed their superiority over control and resulted significantly lowest dry weight of weeds at 60 DAP. The minimum dry weight of weeds (0.09 g) was noted in treatment T₁ (Pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP) which was *at par* with T₂ (Pendimethalin 30% EC @ 2.0 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP), T₉ (One hand weeding at 30 DAP), T₃ (Oxyfluorfen 23.5% EC @ 0.25 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP), T₄ (Oxyfluorfen 23.5% EC @ 0.50 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP) and T₁₀ (Two hand weeding at 30 and 60 DAP) while significantly superior in terms of lower dry weight of weed over rest of the weed control treatments.

At 90 DAP, the dry weight of weed varied between 0.71 to 8.39 g 0.5 m². At 90 DAP, all the weed control treatments significantly reduced the dry matter of weeds than T₁₁ *viz.* unweeded. Two hand weeding at 30 and 60 DAP (T₁₀) significantly reduced the weight of weeds and resulted minimum dry weight of weeds which was statistically *at par* with pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP (T₁), pendimethalin 30% EC @ 2.0 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP (T₂), oxyfluorfen 23.5% EC @ 0.25 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP (T₃) and oxyfluorfen 23.5% EC @ 0.50 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP (T₄). These four treatments showed their superiority over rest of treatments. However, rest of treatments *i.e.* T₅, T₆, T₇, T₈ and T₉ were also markedly reduced dry weight of weeds as compared to control.

Dry matter production of weeds recorded at different stages is a better reflection of the efficiency of weed control methods. Dry weight of weeds was more at initial stages but less at later stages. This situation occurred in the treatments where pre emergence herbicides not applied but later received the hand weeding. This was due to the dominance of some weeds which accumulated the biomass, suppressing the others. However, dry weights of weeds were less even at later stages in case of treatments like hand weeding (at 30 and 60 DAT) and it was also reported by Shalini and Patil (2006)^[7] in gerbera, and Sharadamma *et al.* (2002) in crossandra.

Thus, on the basis of above results, it can be inferred that the use of pre-emergence herbicide reduced the dry weight of

weeds in initial stage *i.e.* 30 DAP and followed by the application of post-emergence herbicide or a manual weeding significantly reduced the dry weight of weeds at later stage in gladiolus. These results are corroborative with the findings of Bhat and Sheikh (2012) [3], Kumar *et al.* (2012) [4] and Kaur *et al.* (2014).

▪ Weed control efficiency%

Weed control efficiency of different weed control treatments at 30, 60 and 90 DAP are presented in table no. 4.9.

The data at 30 DAP clearly indicate that highest weed control efficiency (95.8%) was noted under T₁ viz. pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP and T₅ viz. pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ (PE) + fenoxaprop-p-ethyl 9.3% EC @ 0.10 kg a.i. ha⁻¹ at 30 DAP (PoE) while the lowest weed control efficiency is associated with T₁₁ viz. two hand weeding at 30 and 60 DAP closely followed by T₁₀ viz. two hand weeding at 30 and 60 DAP and T₉ viz. one hand weeding at 30 DAP. Higher weed control efficiency at early stage of crop *i.e.* 30 DAP was observed in pendimethalin and oxyfluorfen treated plots due to reduced weed population and weed dry weight under these treatments which created better environment for crop growth and development of gladiolus. Our results are in line with report of Rao *et al.* (2014) [6] and Sharma *et al.* (2014) [8] who also observed reduced weed count and dry weight of weeds with pre emergence application of pendimethaline at 25 DAT in gladiolus and 30 DAT in chrysanthemum, respectively.

At 60 DAP, among the different weed control treatment combination, pendimethalin as pre emergence followed by hand weeding resulted the maximum weed control efficiency (98.40%) and it was followed by T₂ (Pendimethalin 30% EC @ 2.0 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP), (98.0), T₃ (Oxyfluorfen 23.5% EC @ 0.25 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP) T₄ (Oxyfluorfen 23.5% EC @ 0.50 kg a.i. ha⁻¹ (PE) + hand weeding at 30 DAP), one hand weeding at

30 DAT and two hand weeding at 30 and 60 DAP. It was might be due to the action of pre-emergence herbicidal application which lasts generally up to 25-30 DAT and further control achieved by hand weeding at 30 DAT and hand weeding also provided the good control over weeds when applied at any time of crop growth. Effective control of weeds with the pre-emergence herbicides followed by hand weeding which was *on par* with hand weeding was also reported by Nagar *et al.* (2009) and Nish Chopra and Chopra (2007). Archrya *et al.* (2008) also reported highest weed control efficiency (92.50%) with pendimethalin 1.0 kg a.i. ha⁻¹ followed by two hand weeding in marigold var. Pusa Basanti Gaiinda.

At 90 DAP, among all the treatments maximum weed control efficiency was observed in treatment two hands weeding at 30 and 60 DAT (94.20%). Further, the best weed control efficiency was observed with pendimethalin (1.0 and 2.0 kg a.i. ha⁻¹) as pre emergence followed by one hand weeding (91.50% and 88.20%, respectively) and oxyfluorfen (0.25 and 0.50 kg a.i. ha⁻¹) as pre emergence followed by one hand weeding (86.90% and 85.20%, respectively). Higher weed control efficiency under these treatments can be accounted to lower dry weight of weeds in treatments. The lowest weed control efficiency (00% at 30, 60 and 90 DAP) was observed in treatment unweeded control due to poor or no control of weeds (Table no. 4.8). All other treatments recorded higher weed control efficiency due to lower dry weight of weeds as compared to unweeded control. The variability in weed densities in different treatments can be attributed to the fact that some herbicides are more effective for weed control than others (Khan *et al.* (2008) and Meena (2004). Shaikh *et al.* (2002) also recorded highest weed control efficiency with two hand weeding at 20 and 40 DAT and pre emergence herbicide + 1 HW in marigold. The results are in agreement with the findings of Kadam *et al.* (2014), Jeevan *et al.* (2016), and Rathod and Venugopal (2017).

Table 2: Effect of different weed control treatments on weed density, dry weight of weeds and WCE.

Treatments	weed density (No.)			Dry Weight of weeds (g)			WCE (%)		
	At 30 DAP	At 60 DAP	At 90 DAP	At 30 DAP	At 60 DAP	At 90 DAP	At 30 DAP	At 60 DAP	At 90 DAP
T ₁ : Pendimethalin 30% EC @ 1.0 kg a.i. ha ⁻¹ (PE) + hand weeding at 30 DAT	3.67	5.00	18.09	0.04	0.09	0.71	95.8	98.4	91.5
T ₂ : Pendimethalin 30% EC @ 2.0 kg a.i. ha ⁻¹ (PE) + hand weeding at 30 DAT	4.33	5.33	16.58	0.06	0.11	0.99	93.9	98.0	88.2
T ₃ : Oxyfluorfen 23.5% EC @ 0.25 kg a.i. ha ⁻¹ (PE) + hand weeding at 30 DAT	6.00	7.67	15.10	0.10	0.13	1.10	90.4	97.6	86.9
T ₄ : Oxyfluorfen 23.5% EC @ 0.50 kg a.i. ha ⁻¹ (PE) + hand weeding at 30 DAT	7.00	6.67	19.32	0.06	0.16	1.24	94.6	97.1	85.2
T ₅ : Pendimethalin 30% EC @ 1.0 kg a.i. ha ⁻¹ (PE) + fenoxaprop-p-ethyl 9.3% EC @ 0.10 kg a.i. ha ⁻¹ at 30 DAT (PoE)	4.33	13.00	34.71	0.04	0.68	2.19	95.8	87.5	73.9
T ₆ : Pendimethalin 30% EC @ 2.0 kg a.i. ha ⁻¹ (PE) + fenoxaprop-p-ethyl 9.3% EC @ 0.10 kg a.i. ha ⁻¹ at 30 DAT (PoE)	5.49	12.67	32.49	0.07	0.71	1.92	93.6	87.0	77.1
T ₇ : Oxyfluorfen 23.5% EC @ 0.25 kg a.i. ha ⁻¹ (PE) + fenoxaprop-p-ethyl 9.3% EC @ 0.10 kg a.i. ha ⁻¹ at 30 DAT (PoE)	7.33	15.67	42.87	0.17	1.14	2.73	84.0	79.1	67.5
T ₈ : Oxyfluorfen 23.5% EC @ 0.50 kg a.i. ha ⁻¹ (PE) + fenoxaprop-p-ethyl 9.3% EC @ 0.10 kg a.i. ha ⁻¹ at 30 DAT (PoE)	9.33	16.00	55.34	0.19	1.10	2.34	81.5	79.9	72.1
T ₉ : One hand weeding at 30 DAT	20.33	9.33	30.18	0.96	0.18	2.76	8.1	96.7	67.1
T ₁₀ : Two hand weeding at 30 and 60 DAT	20.67	9.33	11.89	0.94	0.21	0.49	10.3	96.2	94.2
T ₁₁ : Unweeded (Control)	21.00	43.33	77.33	1.04	5.46	8.39	0.0	0.0	0.0
SEm±	0.65	0.96	2.21	0.03	0.1	0.18			
CD (p=0.05)	1.92	2.84	6.52	0.09	0.3	0.52			

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