

Review Article

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Review on Pre and Post Emergence Herbicides against Weeds, Yield Attributes and Yield of Onion

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ABSTRACT

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Weeds are undesirable plants out of place and function as an uneconomic tax on the crop by taking the space required for the plant, absorbing the water and nutrients from the soil and by competing for other essentials like light, moisture etc. There are two methods generally employed for controlling weeds. viz., (i) Hand weeding, and (ii) Use of herbicides. In India, the first one is generally practiced by the farmers. This method is the most labour intensive and costly. Due to the industrial development, the agricultural labourers are engaged towards the industries for higher wages. This migration creates the labour problems particularly during the critical periods of different cultural operations. To overcome this difficulty, with the recent introduction of new herbicides, chemical weed control has come to the forefront as an additional tool to fight weeds.

Introduction

Onion (*Allium cepa* L.) is one of the most important vegetable crops grown throughout the world. It is said to be native of Central Asia and Mediterranean region. It belongs to economically important family Alliaceae. Among the vegetable crops listed by FAO, onion is second in terms of annual world production. The major onion producing countries are China, India, USA, Turkey, Japan, Iran, Pakistan, Spain and Brazil.

Onion bulb and green leaves both are rich in minerals, protein and ascorbic acid. The

pungency in onion odour is formed by enzymatic reaction only when tissues are damaged. The pungency in onion is due to volatile oil as allyl-propyl disulphide. The colour of the outer skin of onion bulbs is due to quercetin. Among the various constraints in onion production, weeds pose serious problem in its cultivation which reduce bulb yield to the extent of 40-80% (Singh *et al.*, 1992 and Verma and Singh, 1997). The weeds infestation is problematic especially at early stage of crop growth. The inherent characteristic of onion crop such as short stature, non-branching habit, slow growth and shallow root system render it poor competitor

with the weeds. Further problem is solved by excessive use of nutrients, use of farm yard manure and frequent irrigation.

Weeds are undesirable plants out of place and function as an uneconomic tax on the crop by taking the space required for the plant, absorbing the water and nutrients from the soil and by competing for other essentials like light, moisture etc. Weeds being much more hardy and tenacious than crops plants, if unchecked, get the upper hand and adversely affect the growth and yield of crop plant. There are two methods generally employed for controlling weeds. viz., (i) Hand weeding, and (ii) Use of herbicides. In this review a various experimental findings of different experiments covering important aspect of weed flora, losses caused by weeds and effect of weed management practices on crops, yield and yield attributes, use of chemical and cultural methods of weed management and economics is given below.

Composition of weed flora and degree of their population

The composition of weed flora and degree of their population in onion fields has been found to vary from place to place and even at the same place from year to year depending upon the agro climatic conditions and cultural practices.

Pandey (2000) reported that the major weed flora in onion consisted *Galinsoga parviflora*, *Brachiaria ramosa*, *Cyperus rotundus*, *Cannabis sativa*, *Polygonum plebeium*, *Fumaria parviflora*, *Phalaris minor* and *Oxalis latifolia*. Syed and Malik (2001) reported that the major weed flora in onion consisted *Amaranthus hybridus*, *Convolvulus arvensis*, *Cyperus rotundus*, *Chenopodium album*, *Echinochloa* spp., *Sophora alopecuroides* were the most damaging.

Amrutkar *et al.*, (2002) recorded that the major weed flora in onion consisted *Cyperus rotundus*, *Cynodon dactylon*, *Dinebra retroflexa*, *Parthenium hysterophorus*, *Chenopodium album*, *Anagallis arvensis*, *Argemone maxicana*, *Physalis minima*, *Euphorbia geniculata*, *Lagasca mollis* and *Portulaca oleracea*. Naresh *et al.*, (2002) recorded the dominant weed flora associated with crop at Udaipur, which included *Chenopodium album* L., *Chenopodium murale* L., *Amaranthus viridis* L., *Anagallis arvensis* L., *Convolvulus arvensis* L., *Parthenium hysterophorus* L., *Spergula arvensis* L., *Digera arvensis* Fork., *Cyperus rotundus*, *Trianthema portulacastrum*, *Euphorbia hirta* and *Cynodon dactylon* L.

Sukhadia *et al.*, (2002) recorded that the major weed flora in percentage at Junagarh during *kharif* season were *Echinochloa colonum*, (31%), *Eluopus villosus* (10%), *Dactyloctenium aegyptium* (3%), *Digera arvensis* (16%), *Phyllanthus nirusi* (8%), *Cyperus rotundus* (14%) and *Cyperus iria* (2%).

Ahuja *et al.*, (2003) observed that the dominant weed species in the experimental field was *Poa annua* in both cabbage and onion crops and *Cyperus rotundus* in onion among the narrow-leaf weeds. *Trianthema portulacastrum*, *Chenopodium* spp., *Trigonella polycerta* [*T. polyceratia*], *Medicago denticulata*, *Lepidium sativum* and *Anagallis arvensis* in both cabbage and onion crops, *Amaranthus* spp. and *Tribulus terrestris* in onion among the broad-leaf weeds.

Husrev and Dogan (2003) observed the dominant weed species in the field experiment was *Chenopodium album*, *Amaranthus retroflexus*, *Convolvulus arvensis*, *Heliotropium europaeum* and *Solanum nigrum*.

Rathore and Shekhawat (2004) reported that the major weeds in onion field at Ajmer during *kharif* were *Amaranthus viridis*, *Cyperus rotundus*, *Cynodon dactylon*, *Digera arvensis*, *Eclipta alba*, *Fumria parviflora*, *Solanum nigrum*, *Trianthema monogyna*, *Xanthium strumarium*. Dobrzanski (2004) recorded that the major weeds in onion were *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 crus-galli* and *Poa annua*.

Dobrzanski and Paczynski (2005) reported that the major weeds in onion are *Chenopodium album*, *Galinsoga parviflora*, *Capsella bursa-pastoris*, *Sinapis arvensis*, *Thlaspi arvense*, *Urtica urens*. Channappagoudar and Biradar (2007) observed that the major weeds in onion were *Commelina benghalensis*, *Cyperus rotundus*, *Parthenium hysterophorus*, *Phyllanthus niruri*, *Euphorbia geniculata* and *Dinebra retroflexa*. Tariq *et al.*, (2007) screened that the major weeds in onion were *Phalaris minor*, *Cronopus didymus*, *Medicago denticulata*, and *Rumex dentatus*.

Effect of weed management practices on crop growth and development

Singh and Singh (1993) showed that weed free treatment produced the maximum plant height, numbers of leaves plant⁻¹, bulb diameter, fresh weight of bulb, dry weight of leaves, bulb and bulbs yield was however at par with pendimethalin and oxadiazon @1.5 kg ha⁻¹ with one HW. Minimum value of crops parameters were recorded under weedy check control. Saikia *et al.*, (1997) indicated

that Fluchloralin (0.5 or 1.0 kg ha⁻¹) alone or in combination with one HW (after 60 days) or HW (after 40 and 60 days) reduced weed dry weight significantly and improved onion plant growth and bulb development.

Ved *et al.*, (2000) observed that Alachlor at @ 2.0 kg ha⁻¹ + HW at 45 DAT being at par with pendimethalin at @ 1.5 kg ha⁻¹ + 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 diameter and bulb weight. Nandal and Singh (2002) also reported that fluchloralin @ 1.0 kg in combination with one HW at 45 DAT proved to be the significantly superior in increasing the plant height and number of leaves per plant and remained at par with oxyfluorfen @ 0.15 kg ha⁻¹ with one HW at 45 DAT.

Thakral *et al.*, (2003) stated that the weed-free treatment provided the maximum number of total and healthy seedlings. Among the herbicidal treatments, trifluralin at @ 1.00 kg ha⁻¹ as pre-sowing soil incorporation, pendimethalin at @ 1.00 kg ha⁻¹ and alachlor at @ 2.00 kg ha⁻¹ applied as pre-emergence were the most effective herbicides for controlling weeds and producing healthy seedlings. Ghaffoor (2004) observed that Swat-I was superior in terms of the number of leaves plant⁻¹, length of leaves, number of bulbs plot⁻¹, bulb diameter, weight of bulbs and bulb yield. The herbicides significantly controlled the weeds.

Effect of weed management practices on Yield and yield attributes

Pandey *et al.*, (1992) also obtained maximum bulb yield of onion with oxadiazon @ 0.75 kg ha⁻¹. Low dry matter accumulation by weeds and higher weed control efficiency resulted in larger size bulb which ultimately resulted in higher yield under pre-emergence application

of either oxadiazon @ 0.75 kg ha⁻¹ or oxyfluorfen @ 0.24 kg ha⁻¹ along with one HW at 40 DAT as well as conventional practice of two HW at 20 and 40 DAT and proved its superiority over remaining treatments resulting in 459, 380 and 372 per cent higher bulb yield over the unweeded control.

Sandhu *et al.*, (1993) observed that all weed control treatments reduced weed DW from untreated control values of 3350-4030 kg ha⁻¹ to 330-1240 kg ha⁻¹ and increased onion bulb yields from 3030-8570 kg ha⁻¹ to 14760-22460 kg ha⁻¹. Pendimethalin at 0.75 kg resulted in the greatest crop yields.

Singh and Singh (1993) observed that oxyfluorfen @ 1.0 kg ha⁻¹ with one HW at 50 DAT (295.70 q ha⁻¹) when applied at higher rate gave significantly better yield than applied at lower rate but this is not true in case of trifluralin and alachlor where, non-significant increase was observed.

Porwal (1995) reported that superiority of pendimethalin in controlling weeds in garlic resulting in increased yield of bulbs. Similarly, Sandhu *et al.*, (1993) also opined out similar results of pendimethalin and fluchloralin in onion and garlic.

Saikia *et al.*, (1997) screened that Fluchloralin (1.0 kg ha⁻¹) + one HW at 40 DAT resulted in the greatest bulb yield (16.9 t ha⁻¹), followed by the weed-free treatment (16.0 t ha⁻¹).

Verma and Singh (1997) found that weed population and weed dry weight m⁻² were lowest in plot treated with @ 1.5 kg ha⁻¹ pendimethalin in onion. Yadiraju and Ahuja (1999) showed that post-emergence application of fluchloralin @ 0.9 kg ha⁻¹, oxadiazon @ 0.75 kg ha⁻¹ and oxyfluorfen @ 0.24 kg ha⁻¹ at 25 DAT gave lower bulb yield and remained at par with unweeded control.

Pandey (2000) also recorded the maximum yield of bulb (227.76 q ha⁻¹) with application of pendimethalin @ 1.0 kg ha⁻¹ which was significantly higher as compared to the yield obtained under weed check (163.22 q ha⁻¹).

Yadav *et al.*, (2000) reported from Hisar that weed free treatment recorded the higher bulb yield of 323.45 q ha⁻¹ which was statistically at par with pendimethalin @ 1.5 kg ha⁻¹. However, the highest net income and yield of bulbs was recorded with the application of oxyfluorfen @ 0.15 kg ha⁻¹ closely followed by pendimethalin @ 1.5 kg ha⁻¹ due to effective control of weeds during critical period of crop-weed competition.

Kolhe (2001) recorded that Pre-emergence application of oxyfluorfen @ 0.15 kg ha⁻¹ supplemented with one HW at 35 DAT was equally effective to that of two HW at 20 and 35 DAT in alleviating weed competition and bulb yield in the range of 159.36-447.25 per cent was observed due to adoption of weed management practices.

Nandal and Singh (2002) recorded the highest bulb yield (304.43 q ha⁻¹) and net returns (Rs 60 196 ha⁻¹) with the application of oxyfluorfen (0.25 a.i. kg ha⁻¹) + HW at 40 DAT. The lowest weed density at all the stages of crop growth was observed under oxyfluorfen (0.37 a.i. kg ha⁻¹).

Ramachandraprasad *et al.*, (2002) reported the highest bulb yield in the weed free plot (15.4 t ha⁻¹), which was equivalent with those in the herbicide treatments, except fluchloralin.

Ghaffoor (2004) observed that plots treated with pendimethalin at 3 litres/ha gave the highest yield (40.28 t ha⁻¹) and weight of bulbs (127.9 g).

Priyadharshini and Anburani (2004) screened that pendimethalin + mulching treatments had

the lowest weed population (68 m⁻²) and weed dry matter (205 g m⁻²) and the highest onion bulb yield (25.51 t ha⁻¹).

Rathore and Shekhawat (2004) reported that fluchloralin applied @ 1.0 kg ha⁻¹ as pre-planting incorporation in combination with one HW at 45 DAT proved to be most effective to control the weeds giving maximum weed control efficiency (92.56%) and bulb yield (121.42 q ha⁻¹) of *kharif* onion.

Marwat *et al.*, (2005) recorded the maximum weeds kill percentage (88.6%), size of onion bulbs (78.25 ml), onion diameter (5.49 cm) and onion yield (29950 kg ha⁻¹) in pendimethalin treatment, unlike the weedy control which recorded 00.0%, 47.75 ml, 4.06 cm, and 13700 kg ha⁻¹, respectively. Therefore, pendimethalin is recommended at 1.32 kg ha⁻¹ for significantly reducing weed population and enhancing the bulb yield in onion.

Nargis *et al.*, (2006) reported that weedicides applied at the pre-emergence stage, significantly controlled the weed population.

However, the 3.0 litre pendimethalin ha⁻¹-treated plots gave the highest yield (40.28 t ha⁻¹) and bulb weight (127.90) and was superior to other herbicidal treatments in increasing length, diameter, weight and yield of bulb.

Tariq *et al.*, (2007) reported that herbicide treatments followed by hoeing except metribuzin gave bulb yield at par with weed free treatment. Metribuzin resulted in minimum bulb yield (0.59 t ha⁻¹) because of its extreme phytotoxicity to garlic crop, which resulted in the survival of a few plants. Pendimethalin in combination with manual hoeing gave the highest bulb yield and monetary returns.

Effect of chemical and cultural methods of weed management

Singh *et al.*, (1992) studied weed control in onion cv. Pusa Red growing on a moderately fertile soil at Karnal (Haryana) following application of pendimethalin @ 1.0, 1.5 or 2 kg ha⁻¹ after transplanting of seedling in January 1990. The persistence of pendimethalin was determined in onion plants and soil. Pendimethalin residues in the soil persisted up to 45 days when applied @ 1.0 kg ha⁻¹ pendimethalin and in onion plants varied from 11-15 days.

Sandhu *et al.*, (1997) reported that pendimethalin 30 EC @ 2.5 kg and 1.87 kg ha⁻¹ and fluchloralin 45 EC @ 2.5 kg and 1.87 kg ha⁻¹ supplemented with one hoeing conducted after 105 days of sowing resulted in significant increase in bulb yield comparable to weed control.

Oliveria *et al.*, (1997) reported that application of oxyfluorfen should be made at the time when weeds are still susceptible but the onion crop has become sufficiently tolerant to the herbicides. Singh *et al.*, (1997) screened that 0.37 kg Oxyfluorfen was the most effective treatment for reducing population of *Poa annua*, *Coronopus didymus*, *Rumex acetosella* and *Medicago denticulate*, with 0.25 kg Oxyfluorfen + hand weeding next best. None of the treatments gave season-long reductions in *Cyperus rotundus* populations. Vanhala *et al.*, (1998) studied the effects of physical weed control measures (hoeing, flaming once or 3 times, and hand weeding) on carrot (cv. Fontana) and onion (cv. Sturon) quality during 1992-94 at 2 locations in Finland. Weed free plots were maintained with prometryn 1 kg ha⁻¹ + hand weeding. In onion, weedy plots resulted in the lowest marketable yield. However, repeated flaming, although providing the best weed control, inhibited onion development

resulting in poorer quality onion as compared with a single flaming treatment and hand weeding.

Ramachandraprasad *et al.*, (2002) noted the lowest weed population with oxyfluorfen at 0.12 kg ha⁻¹. The highest weed control efficacy was obtained with oxyfluorfen at 0.06 kg ha⁻¹ + HW, followed by metolachlor + HW.

Sukhadia *et al.*, (2002) reported that to manage weed problem, Oxidiazon at 0.75 kg ha⁻¹ or Oxyfluorfen at 0.24 kg ha⁻¹ as pre-emergence application along with one HW at 40 DAT as well as conventional practices of two HW proved to be the most effective.

Ahuja *et al.*, (2003) reported that oxyfluorfen @ 0.16 kg ha⁻¹, pendimethalin @ 0.75 kg ha⁻¹ and metribuzin @ 0.70 kg ha⁻¹ significantly reduced the weed population and dry weight accumulated at 45 DAT cabbage and at harvest time of relay crop onion and increased the onion yield which was comparable to weeded control.

Dubey *et al.*, (2005) also noticed the maximum yield in pendimethalin @ 1.0 kg ha⁻¹ (PE) at 30 DAT (sand mix) in transplanted onion var. N-53 at NRC, Jabalpur (M.P). Hence, the sequential application of pendimethalin is more effective as compared to single dose.

Qasem (2005) reported that oxadiazon @ 0.75 kg ha⁻¹ and oxyfluorfen @ 0.6 kg ha⁻¹, both applied as pre sowing and post-emergence in onion seedlings resulted in the highest seedlings yield and the lowest weed biomass.

Chopra and Chopra (2006) reported that all the weed control treatments significantly reduced the weed density and dry weight of weeds, and in turn increased the bulb yield compared with weedy check.

Channappagoudar and Biradar (2007) observed that pendimethalin in combination with one HW recorded the lowest weed biomass. Tiwari *et al.*, (1999) also observed sharp decline in weed biomass when pre-emergence application of herbicides was supplemented with one hand weeding in onion.

Economics of weed management in onion

Saikia *et al.*, (1997) observed the maximum cost-benefit ratio (1:1.27) was obtained with Fluchloralin (1.0 kg ha⁻¹) + HW, Fluchloralin (0.5 kg ha⁻¹) + HW was more cost-effective than the weed-free treatment, due to reduced production costs. Unweeded plots led to a loss of 1662.97 Rs ha⁻¹.

Nadagonda *et al.*, (1998) also noted that pendimethalin @ 0.75 and 1.0 kg ha⁻¹ resulted in higher benefit: cost ratio than the unweeded control in onion. Singh and Singh (2000) obtained the maximum net profit with treatments pendimethalin @ 1.5 kg ha⁻¹ and pendimethalin @ 1.5 kg ha⁻¹ with one HW at 45 DAT in onion.

Ved *et al.*, (2000) reported that alachlor at 2.0 kg ha⁻¹ + HW at 45 DAT being at par with pendimethalin at 1.5 kg ha⁻¹ + HW at 45 DAT and weed-free, proved to be the superior integrated weed control approach to control weeds and also recorded high additional net returns.

However, the highest additional returns per rupee invested were obtained with alachlor at 2.0 kg ha⁻¹.

Ramachandraprasad *et al.*, (2002) reported the highest net return with metolachlor @ 0.75 kg ha⁻¹ + one HW (Rs. 52 007 ha⁻¹), followed by oxyfluorfen @ 0.06 kg ha⁻¹ + one HW (Rs. 50 240 ha⁻¹) and metolachlor @ 2 kg ha⁻¹ (Rs. 48 896 ha⁻¹).

Sukhadia *et al.*, (2002) observed that transplanting proved better than broadcast to manage weed problem. Application of oxadiazon @ 0.75 kg ha⁻¹ or oxyfloufen @ 0.24 kg ha⁻¹ as pre-emergence application along with one HW at 40 DAT or 40 DAS as well as conventional practice of 2 HW at 20 and 40 DAT/DAS proved most effective efficient and economic at Gujarat in onion crop.

Rathore and Shekhawat (2004) reported that application of fluchloralin in combination with HW at 45 DAT resulted in net returns (Rs 28097 ha⁻¹). Application of oxyfluorfen resulted in the highest benefit: cost ratio (11:63).

Chopra and Chopra (2006) reported maximum additional monetary returns and net monetary returns by oxyfluorfen 0.15 kg ha⁻¹ integrated with one HW at 35 DAT and oxyfluorfen 0.30 kg ha⁻¹, respectively.

Channappagoudar and Biradar (2007) studied the economic analysis of weed management practices and indicated that pre-emergence application of pendimethalin @ 1.0 kg ha⁻¹ supplemented with one HW gave the highest net return of Rs. 51,296 with maximum B: C ratio of 8.77.

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