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Weed management in onion: A review

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ABSTRACT

The bulbous vegetable onion *Allium cepa* Var. *aggregatum* L. (2n=16) is the most important species of *Allium* group and is regarded as the single most important vegetable spices as it forms an indispensable part of many diets, both vegetarian and non-vegetarian. Onion is valued for its bulbs having characteristic odour, flavor and pungency. Onion is regarded as a highly export oriented crop and earns a valuable foreign exchange for the country. Weeds are of great menace as they interfere with production of crop and add to the cost of cultivation. The reduction in crop yield has direct correlation with weed competition. Onion exhibits greater susceptibility to weed competition as compared to other crops due to its inherent characteristics such as their slow growth, small stature, shallow roots and lack of dense foliage. The effective weed control involves identification of weed flora, method of weed control and judicious combination of effective weed control methods. Hand weeding in onion is a common practice in India, but it is a tedious, expensive and time consuming task due to closer spacing and shallow root system. Non-availability of labourers during critical period of crop makes hand weeding difficult leading to heavy yield losses. Spraying of pre-emergence herbicides keeps the crop in weed free conditions during the early stages. At later stage, second flush of weeds will affect the bulb formation. Hand weeding helps to keep the weed population below economic threshold level throughout the crop growth period. Pre-emergence combined with hand weeding may be costly because of the reduced labour availability and higher labour cost. After bulb formation manual or mechanical methods of weed control will damage the bulb. Application of early post emergence may be helpful to reduce damage to the bulb, weed competition and cost of weeding. Hence a brief review was presented to find out the effect of different weed management method in onion.

Key words: Growth, Onion, Weed management, Yield attributes.

Weed is a plant that does more harm than good and has a habit of encroaching crop production. Onions do not compete well with weeds. They are slow growing and can suffer from successive flush of weed. They have narrow upright leaves which do not shade out weeds that emerge in the row. So, early season weed control is essential for successful crop production. Hand weeding, a conventional method of weed control is effective but it is time consuming, cumbersome and under many situations become uneconomical. Manual weeding is very tedious and expensive laborious method of weed control, even often damages the crop as well. Numerous herbicides with high potency and environmental safety are becoming available for effective control of weeds in field crops in present days. Hence, a brief review is presented on the effect of weed on crop growth, yield and different weed control methods.

Effect of weeds on crop growth and yield

Growth components: Singh and Singh (1994) reported that unweeded onion plots recorded reduced plant height, number of leaves, which in turn reduced the bulb diameter and bulb yield due to increased weed competition. Maximum number of leaves plant^{-1} at 90 days after transplanting and at harvest was observed in oxyfluorfen applied plots due to reduction in weed population as noticed by Ravinder Singh *et al.* (2001). Taller plants, higher bulb diameter and bulb weight were recorded under weed-free condition, followed by alachlor 2.0 kg ha^{-1}+ Hand Weeding on 45 days after transplanting and pendimethalin at 1.5 kg ha^{-1} followed by Hand Weeding on 45 DAT (Ved Prakash *et al.,* 2000). Plant height, number of leaves, fresh and dry weight were found to be higher under weed free condition and pendimethalin treated plots as reported by Sharma and Khandwe (2008). Taller plants, neck thickness and dry matter accumulation was observed under pendimethalin applied plots by Patel *et al.* (2011).

Yield and yield components : James and Harlen (2010) reported that uncontrolled weed growth caused 49-86 per cent reduction in bulb yield compared with the best herbicidal treatment. The higher onion bulb yield of 38.3 t ha^{-1} due to lesser weed population and weed growth from initial crop growth as compared to weedy check was obtained by Patel

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et al. (2011). Higher fresh bulb weight (135.4 g) was obtained in the plots where hand weeding was done after every 15 days while lesser fresh bulb weight (65.75 g) was recorded in control plots where no weeding was done throughout the season. Bulb diameter, bulb height, bulb volume, bulb weight and bulb yield were found to be high in weed free plots followed by pendimethalin (Rahman *et al.,* 2011).

Saini and Walia (2012) confirmed that oxyfluorfen treated plots recorded higher fresh bulb weight and diameter of the bulb. Karimi *et al.* (2012) recorded higher bulb yield of 15.3 t ha^{-1} in pendimethalin treated plots while lesser yield of 4.2 t ha^{-1} in weedy control plots. Rahman *et al.* (2012) reported lower bulb yield of onion in weedy check to the fact that weeds appeared immediately after sowing and competed with onion crop until harvest. Higher bulb yield was recorded under early post emergence application of quizalofop-ethyl under grass dominated field as recorded by Dhananivetha *et al.* (2015).

Method of weed management : Weeds can be controlled by different weed control methods such as manual, cultural, chemical, mechanical and biological. Usually farmers do not remove weeds early enough to prevent major damage due to this weed competition.

Manual and cultural: Calamai and Martini (1994) reported that 86 per cent weed control efficiency was with hoeing alone in onion. Hand weeding on 45 DAP gave more yield due to minimum crop weed competition for resources (Saraf *et al*., 1994). Higher bulb yield was obtained with three Hand Wdeding (HW) and it was statistically on par with fluchloralin 1.0 kg ha^{-1} and pendimethalin 1.25 kg ha^{-1} with one hand weeding for each (Sharma and Mehta, 1994). Shah *et al*. (1996) reported that hand weeding was significantly better in increasing the bulb diameter, bulb weight, bulb yield and loss of bulb weight when compared with unweeded control.

Singh *et al.* (1997) observed higher onion bulb yield and weed control efficiency in treatment combination of one HW on 30 DAT + mulching. According to Melander and Hartvig (1997), hoeing close to the row leaving 5 cm untilled strip, has the potential of saving labour cost for hand weeding in non herbicidal growing system of onion. The higher bulb and weed control efficiency were recorded in the weed free treatment followed by three HW on 20, 40 and 60 days after transplanting (Amrutkar *et al*., 1998).

Comparable weed control efficiency of 89.8 per cent could be achieved with manual weeding with that of pendimethalin at 0.75 kg ha^{-1} + hand weeding (90.6 per cent) or Metolachlor 1.25 kg ha^{-1} + hand weeding (77 per cent) or oxyfluorfen 0.07 kg ha^{-1} + hand weeding (74.0 per cent) (Tewari *et al*., 1999). Weed management by hoeing gave higher yield closely followed by the application of oxadiazon and pendimethalin (Ishwar Singh *et al*., 2000). Priyadharshini and Anburani (2004) reported that dry biomass of weeds was significantly reduced by the application of herbicides and through hand weeding practices.

Higher weed control was obtained with manual weeding throughout the crop season (Zubiar *et al.,* 2009). Maximum bulb size and yield of onion were recorded in hand weeded plots followed by pendimethalin as compared to weedy check as noticed by Hussain *et al.* (2008). Rahman *et al.* (2011) reported that hand weeding throughout the growing season controlled all weeds and resulted in higher onion bulb yield.

Chemical: Ranpise and Patil (2001) observed that pre-emergence application of oxyfluorfen at 0.4 kg ha^{-1} in onion recorded maximum yield (242.2 q ha^{-1}) followed by oxyfluorfen 0.2 kg ha^{-1} (233.3 q ha^{-1}) as compared to the lower yield under control (50 q ha^{-1}) due to maximum weed intensity. Kolhe (2001) indicated that dry matter of weeds was significantly reduced due to application of pendimethalin, metalachlor, oxyfluorfen either alone or in combination with hand weeding at 35 DAP compared to weedy check in onion. Presently herbicides are widely applied for weed destruction and oxyfluorfen is a very effective herbicide suitable for weed destruction in onion and cabbage (Stall and Gilreath, 2002).

Oxyfluorfen, pendimethalin and metribuzin significantly reduced the weed population and increased onion yield to levels comparable to yields of weeded control in a relay cabbage-onion cropping system (Sanjeev *et al.,* 2003). Priyadharshini and Anburani (2004) recorded lesser weed population of 67.90 m^{-2} with the application of pendimethalin at 1.0 kg ha^{-1} with mulching in onion.

Dawale *et al*. (2009) inferred that quizalofop ethyl at 40 g ha^{-1} as post-emergence + one HW and one inter culture operation on 40-45 DAS (1889 kg ha^{-1}) was effective in sesame. Sharma and Khandwe (2008) observed lesser weed population and dry weight of weeds m^{-2} with pendimethalin at 1.25 kg ha^{-1}. An increase in the bulb yield of onion by 62.69 per cent with pendimethalin at 2.5 l ha^{-1} than the unweeded plots was recorded by Zubiar *et al*. (2009).

Meena *et al*. (2009) reported that quizalofop ethyl at 50 g ha^{-1} + chlorimuron ethyl at 9 g ha^{-1} as post emergence significantly reduced weed density, weed dry weight and recorded higher seed, straw yield and weed control efficiency in soybean. Patel *et al*. (2009) revealed that application of quizalofop-p-ethyl at 200 g ha^{-1} on 30 days after sowing was effective in controlling weeds in groundnut. In onion, pendimethalin at 1.0 kg ha^{-1} + hand weeding and oxyfluorfen at 0.24 kg ha^{-1} recorded higher weed control efficiency of 80.6 and 73.4 per cent (Patel *et al.,* 2011).

Chaitanya *et al*. (2012) stated that pre-emergence application of pendimethalin at 1.0 kg a.i.ha^{-1} along with post emergence application of quizalofop ethyl at 50 g a.i.ha^{-1} on 25 DAS recorded lower weed growth and higher

yield of *kharif* groundnut. Pre-emergence application of oxyfluorfen (23.5per cent EC) at 200 g ha^{-1} recorded lesser weed density and dry weight in onion (Sathya Priya *et al.,* 2013). Early post emergence application of quizalofop-ethyl at 75 g ha^{-1} recorded lower weed density and dry weight which resulted in increased yield of onion under grass dominated field conditions (Dhananivetha *et al.* 2015a)

Mechanical: Yadav and Pond (2007) reported that mechanical weed control not only uproot the weeds between the crop rows but also keep the soil surface loose, ensuring better soil aeration and water intake capacity. Weed morphology and stage of growth would influence the selection and efficacy of weeding implement. It is found that the physical damage by burial to one cm depth is effective for controlling weeds followed by cutting at the soil surface as noticed by Rajakumar (2008). Gore *et al*. (2010) reported that cycle hoe weeder produced significantly higher grain yield and found to be effective in controlling grass as well as broad leaved weeds (69 and 44per cent) and (63 and 67per cent) at 30 and 60 DAS in soybean.

Gowsalya *et al*. (2010) observed that effective and economical weed management in rainfed pigeonpea was obtained either by pre-emergence application of pendimethalin at 0.75 kg ha^{-1} on 3 DAS followed by one weeding with oleo weeder on 45 DAS or pre-emergence application of pendimethalin at 0.75 kg ha^{-1} on 3 DAS followed by one weeding with wheel hoe weeder on 45 DAS. According to Sathya Priya *et al.* (2013) pre-emergence application of pendimethalin at 0.75 kg ha^{-1} + Rotary weeding on 45 DAS recorded lower gross and net returns.

Economics of weed management: Nandal and Ravinder Singh (2002) observed higher net return when oxyfluorfen at 0.25 kg ha^{-1} was supplemented with hand weeding at 40 DAT (₹ 60,196 ha^{-1}) followed by oxyfluorfen at 0.75 kg ha^{-1} (₹ 54,978 ha^{-1}) and pendimethalin at 1.00 kg ha^{-1} plus hand weeding at 40 DAT (₹ 51,162 ha^{-1}) and net loss of ₹ 2,624 ha^{-1} where weeds were not controlled under weedy check in onion.

According to Mondal *et al*. (2005) higher net monetary returns were obtained with pre-emergence application of oxyfluorfen at 100 g ha^{-1} supplemented with one hand weeding on 25 DAT (₹ 33,650 ha^{-1}) followed by fluchloralin at 750 g ha^{-1} + hand weeding (₹ 31,983 ha^{-1}), pendimethalin at 750 g ha^{-1} + hand weeding (₹ 31,450 ha^{-1}) and oxyfluorfen at 200 g ha^{-1} (₹ 31,400 ha^{-1}). There was net loss of ₹ 3,900 ha^{-1} under weedy check. Pre-emergence application of pendimethalin at 1.00 kg ha^{-1} supplemented with one hand weeding in onion gave the higher net return of ₹ 51,296 ha^{-1} with maximum benefit cost ratio of 8.77 (Channappagoudar and Biradar, 2007).

Economic analysis by Patel *et al.* (2011) revealed that higher net profit (₹ 2,69,422 ha^{-1}) in onion crop was obtained with application of pendimethalin at 1.0 kg ha^{-1} + HW on 40 DAT with the B:C ratio of 7.85 followed by oxyfluorfen at 1.0 kg ha^{-1} + HW on 40 DAT (₹ 2,51,910 ha^{-1}) and weed free control. In onion higher net return (₹ 1,85,600) with B:C ratio of 7.63 was registered with the application of oxyfluorfen (Saini and Walia, 2012).

CONCLUSION

From the above points of view, it could be concluded that onion among vegetables has very poor competitive ability with weeds due to its inherent characteristics such as shallow root system, narrow leaf and less area. Among various causes of low productivity of onion in India, the weed infestation is a serious problem. The conventional method of weed control is effective but due to labour scarcity and high cost of human labour weeding during the critical stage of the crop is a problem. As an alternate chemical method of weed control can be adopted. Numerous herbicides with varying mode of action are available in the market with wide spectrum of weed control. Hence, selection of method of weed control should be based on the nature of the crop and mode of action of the herbicide that should control weeds effectively and increase the yield of the crop.

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