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**RESEARCH NOTE**

# Effect of weed control methods on weeds, onion growth and yield

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**ABSTRACT**

Onion (*Allium cepa* L.) is a widely grown vegetable crop in India. Onion production is severely affected by the weed menace which hampers onion growth and yield. A study was conducted at Birsa Agricultural University, Ranchi during 2018 to identify the best feasible method for weed management in onion. Treatments tested include: plastic mulch, available weed mulch at 6t/ha, paddy straw mulch at 7 t/ha, cover crop, pre-emergence application (PE) of oxyfluorfen 0.5 kg/ha, pendimethalin 1 kg/ha PE, mechanical weeding, hand weeding and weedy check. Amongst the treatments, black plastic mulch was found to be most effective in controlling weeds with minimum weed density and biomass, weed index (%) and highest weed control efficiency (%) as compared to other treatments. Onion grown with black plastic mulch showed better onion growth in terms of maximum plant height, number of leaves/plant, neck thickness and maximum onion yield attributes like average bulb weight, average bulb diameter and bulb yield. However, pendimethalin PE recorded highest net returns and B:C as it was cost effective.

**Keywords**: Mulching, Onion, Oxyfluorfen, Pendimethalin, Weed management

Onion (*Allium cepa* L.) is an important vegetable crop grown all over the world. India grows onion in 1.65 million hectare with production of 26.9 million metric (National Horticulture Board 2020). Onion has sparse foliage and shallow root system which results in greater susceptibility to weeds infestation ultimately leading to low productivity. The growth rate of onion after sprouting is far slow than the weed growth which is often rapid and thus generating competition for space and nutrients. Weed problem in onion is a major constraint in onion which interferes with crop production causing onion yield losses in a range of 49-86% (James and Harlen 2010) and adds to the cost of cultivation (Dhananivetha *et al*. 2017). Close spacing in onion makes manual weeding laborious and expensive. The approach of integration of physical, mechanical and chemical methods involving mulching, hand weeding and use of herbicides, respectively seem better and effective alternative to the traditional hand weeding. The objective of this study was to identify the best method of weed control to realize increased onion growth and yield.

The field experiment was carried out during *Rabi* season of 2018 in the agronomical research farm of Birsa Agricultural University, Ranchi, Jharkhand. The experimental site has sub-humid climate and the soil was of red-yellow light grey type soil representing the major soil group of Chhotanagpur plateau. The experiment was laid out in a randomized block design with nine treatments replicated thrice. The treatments studied were: black plastic mulch, available weed mulch at 6 t/ha, paddy straw mulch at 7 t/ha, cover crop, pre-emergence application (PE) of oxyfluorfen 0.5 kg/ha, pendimethalin 1.0 kg/ha PE, mechanical weeding, hand weeding and weedy check. Coriander was used as a cover crop. Treatments black plastic mulch, available weed mulch, paddy straw mulch and cover crop were applied at the time of transplanting whereas oxyfluorfen and pendimethalin treatments were applied before transplanting. Mechanical weeding with dutch hoe and hand weeding treatments were carried out at three times intervals *i.e*. at 20, 40 and 60 days after transplanting (DAT). Treatment of weedy check was taken as control.

The effect of above treatments on the weed dynamics were evaluated by recording weed density and biomass and estimating weed control efficiency and weed index using standard procedures. Observations on weeds and onion growth parameters were recorded at 30, 60 and 90 days after planting. The density of different weed species in each plot were studied with the help of a square iron frame (quadrat) measuring 25 x 25 cm placed at random spots. Weeds within the quadrat were counted. Thereafter, they were classified into three categories, *viz*. grassy, broad-leaved and sedge weeds. The

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observation thus recorded was computed to give weed density. For estimating dry matter of weeds (biomass), the collected weed samples were sun dried followed by oven drying at 60±5ÚC until attainment of constant weight. Weed control efficiency was calculated on the basis of reduction in weed biomass in treated plot in comparison with the control plot. Weed index was calculated on the basis of reduction in yield of onion in weed free compared to yield in treated plot. Apart from this, their effect on various growth attributes such as plant height, number of leaves/plant, number of tillers/plant and yield attributes like average weight of bulb, bulb diameter, total bulb yield were also recorded.

The analysis of variance method (Gomez and Gomez 2003) was followed for statistical analysis of various data. The significance of different sources of variations was tested by "error mean square method" of Fisher Snedecor's 'F' test at probability level 5 %. Weed density and dry matter of weed were subjected to square root transformation before statistical analysis.

**Effect on weed flora**

The observed weeds in the onion experimental field were: *Cyperus rotundus, Cynodon dactylon, Parthenium hysterophorus, Digitaria sanguinalis, Convolvulus arvensis, Anagallis arvensis, Chenopodium album, Meliotus indica, Sphaeranthus indicus, Ageratum conyzoides, Ageratum conyzoides, Stellaria media* and *Sorghum halepense*.

Black plastic mulching recorded the lowest weed density at 30, 60 and 90 DAT **(Table 1)**. Black plastic mulch was at par with hand weeding, pendimethalin PE and oxyfluorfen PE at all the studied dates in case of broad-leaved, while in case of narrow-leaved weeds, these treatments were at par at 30 DAT. At 90 DAT black plastic mulch was significantly superior over other treatments. The hand weeding, use of polythene mulch and herbicides reduced the fresh and dry weed biomass. Rajablariani and Aghaalikhani (2012) also reported similar results and attributed it to increase in soil temperature 3.3 to 6.6$^0$C in mulching compared to no mulch.

The black plastic mulch recorded the lowest biomass of broad- and narrow-leaved weeds at 30, 60, 90 DAT **(Table 1)** and was at par with hand weeding, pendimethalin PE and oxyfluorfen PE at all dates of observation. The highest weed biomass was noted in the weedy check due to the increased weed density, continuous growth and higher amount of nutrient uptake confirming the findings of Ashrafuzzaman *et al.* (2011), Bobby *et al.* (2017), Sathiyamurthy *et al.* (2017) and Barla *et al.* (2018).

Weed control efficiency (58.09, 56.87 and 62.89% at 30, 60, 90 DAT, respectively) was highest with black plastic mulch and it was at par with hand weeding, pendimethalin PE and oxyfluorfen PE at all the time intervals. The weedy check recorded lowest weed control efficiency at all recorded dates.

**Table 1. Effect of weed control methods on weed density and biomass in onion**

| Treatment | Weed density (no./m$^2$) | | | | | | Weed biomass (g/m$^2$) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Broad-leaved weeds | | | Narrow-leaved weeds | | | Broad-leaved weeds | | | Narrow-leaved weeds | | |
| | 30 DAT | 60 DAT | 90 DAT | 30 DAT | 60 DAT | 90 DAT | 30 DAT | 60 DAT | 90 DAT | 30 DAT | 60 DAT | 90 DAT |
| Black plastic mulch | 1.99 (1.90) | 2.31 (2.01) | 2.27 (1.98) | 2.44 (2.06) | 2.49 (2.07) | 2.24 (1.95) | 1.00 (1.48) | 2.50 (2.42) | 2.76 (2.15) | 1.21 (1.55) | 1.92 (1.89) | 1.33 (1.61) |
| Available weeds as mulch | 3.97 (2.49) | 4.03 (2.50) | 4.07 (2.51) | 5.48 (2.84) | 5.76 (2.89) | 4.49 (2.62) | 1.82 (1.84) | 4.47 (2.61) | 4.43 (2.60) | 1.74 (1.79) | 3.15 (2.27) | 4.72 (2.67) |
| Straw mulch | 3.53 (2.38) | 3.66 (2.41) | 3.76 (2.43) | 4.46 (2.61) | 4.80 (2.69) | 4.63 (2.63) | 1.63 (1.77) | 4.12 (2.51) | 3.99 (2.47) | 1.7 (1.78) | 3.12 (3.12) | 3.63 (2.41) |
| Cover crop | 3.99 (2.50) | 4.05 (2.50) | 4.12 (2.53) | 5.73 (2.89) | 5.92 (2.92) | 6.04 (2.96) | 1.74 (1.81) | 4.49 (2.61) | 4.56 (2.61) | 1.82 (1.83) | 3.49 (2.37) | 4.80 (2.67) |
| Oxyfluorfen PE | 3.25 (2.30) | 3.38 (2.33) | 3.49 (2.36) | 3.83 (2.45) | 4.49 (2.62) | 4.89 (2.71) | 1.38 (1.66) | 3.68 (2.41) | 3.53 (2.37) | 1.48 (1.65) | 2.79 (2.16) | 2.75 (2.15) |
| Pendimethalin PE | 3.25 (2.30) | 3.32 (2.32) | 3.39 (2.34) | 3.75 (2.43) | 4.19 (2.54) | 4.89 (2.71) | 1.28 (1.62) | 3.49 (2.35) | 3.48 (2.36) | 1.47 (1.68) | 2.16 (1.89) | 2.33 (2.01) |
| Mechanical weeding | 3.48 (2.37) | 3.58 (2.39) | 3.68 (2.42) | 4.72 (2.65) | 4.72 (2.67) | 6.11 (2.97) | 1.47 (1.70) | 4.07 (2.50) | 3.97 (2.49) | 1.51 (1.70) | 2.85 (2.19) | 3.31 (2.31) |
| Hand weeding | 2.76 (2.16) | 2.93 (2.21) | 3.07 (2.25) | 2.57 (2.10) | 4.16 (2.54) | 6.88 (3.11) | 1.21 (1.58) | 3.07 (2.22) | 3.25 (2.29) | 1.28 (1.59) | 2.12 (1.94) | 2.30 (2.00) |
| Weedy check | 4.56 (2.64) | 4.53 (2.63) | 4.49 (2.62) | 6.32 (3.01) | 6.6 (3.07) | 7.60 (3.26) | 3.01 (2.22) | 4.99 (2.32) | 5.06 (2.73) | 3.01 (2.21) | 3.12 (2.27) | 5.18 (2.76) |
| LSD (p=0.05) | 0.41 | 0.49 | 0.49 | 0.45 | 0.53 | 0.52 | 0.29 | 0.51 | 0.48 | 0.32 | 0.46 | 0.41 |

Original values in parentheses are subjected to $\sqrt{x+0.5}$ transformation

The black plastic mulch recorded the lowest weed index (10.58%) followed by pendimethalin (11.51%), oxyfluorfen (17.64 %) whereas highest was noted in weedy check (56.34%).

**Effect on onion**

Maximum onion plant height, number of leaves, neck thickness was observed with black plastic mulch at all the crop growth stages, due to lesser crop-weed competition at earlier stages of growth for availability of space, light, moisture and nutrients. The crop weed competition for growth resources, water conservation and optimal soil temperature for plants were found to be better under the mulched than unmulched plots. Mulching created a favourable environment in the root zone resulting in absorption of more water and nutrients from soil and provided better control over weed competition throughout different growth stages of the crop. Similar findings were also reported by Rajablariani *et al.* (2012), Hamma (2013) and Rachel *et al*. (2018).

The vitamin C content was highest with black plastic mulch (13.33 mg) which was significant over only treatments of cover crops (11.00 mg) and weedy check (11.00 mg) but was at par with rest of the treatments.

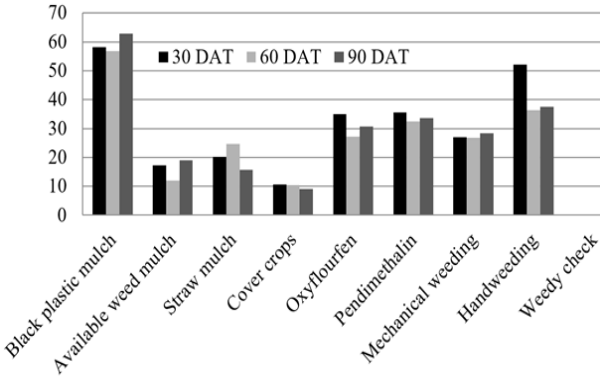


**Figure 1. Effect of weed control treatments on weed control efficiency (%) in Onion**

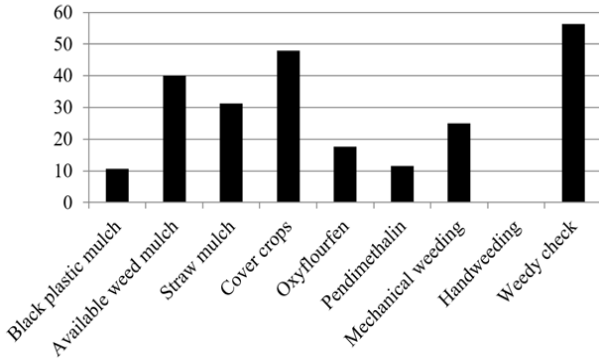


**Figure 2. Effect of weed control treatments on weed index (%) in Onion**

**Table 2. Effect of weed control treatments on vegetative growth and yield parameters in onion**

| Treatment | Plant height (cm) | | | No. of leaves | | | Neck thickness (cm) | | | Yield t/ha | Average bulb circumference (cm) | Average bulb weight (g) | Vit. C content (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 DAT | 60 DAT | 90 DAT | 30 DAT | 60 DAT | 90 DAT | 30 DAT | 60 DAT | 90 DAT | | | | |
| Black plastic mulch | 19.39 | 34.02 | 42.32 | 2.66 | 4.00 | 7.20 | 1.96 | 4.33 | 4.13 | 20.99 | 20.99 | 89.95 | 13.33 |
| Available weed mulch | 15.42 | 23.68 | 32.58 | 2.32 | 3.43 | 4.83 | 1.37 | 3.19 | 2.89 | 15.00 | 17.32 | 67.86 | 11.33 |
| Straw mulch | 16. 23 | 25.33 | 35.08 | 2.27 | 3.67 | 4.97 | 1.76 | 3.62 | 2.94 | 15.99 | 17.50 | 68.55 | 12.00 |
| Cover crops | 14.73 | 23.60 | 28.75 | 2.23 | 3.33 | 4.60 | 1.23 | 2.85 | 2.53 | 14.19 | 16.82 | 67.04 | 11.00 |
| Oxyfluorfen PE | 16.85 | 26.89 | 39.02 | 2.61 | 3.73 | 6.93 | 1.78 | 3.88 | 3.56 | 17.84 | 19.27 | 78.02 | 12.33 |
| Pendimethalin PE | 17.94 | 27.64 | 40.13 | 2.62 | 3.90 | 7.03 | 1.83 | 4.08 | 3.82 | 18.99 | 20.08 | 84.94 | 12.67 |
| Mechanical weeding | 16.62 | 26.46 | 38.37 | 2.55 | 3.73 | 5.00 | 1.76 | 3.62 | 3.29 | 16.78 | 19.15 | 72.72 | 12.00 |
| Hand weeding | 18.07 | 32.11 | 42.32 | 2.63 | 3.93 | 6.50 | 1.93 | 4.18 | 3.99 | 18.82 | 20.55 | 89.84 | 12.67 |
| Weedy check | 14.27 | 20.28 | 26.68 | 2.17 | 3.23 | 4.60 | 1.12 | 2.73 | 2.52 | 13.42 | 16.45 | 56.35 | 11.00 |
| LSD (p=0.05) | 3.21 | 4.78 | 5.63 | 0.48 | 0.84 | 1.10 | 0.33 | 0.77 | 0.66 | 30.10 | 3.42 | 12.83 | 2.19 |

**Table 3. Effect of weed control treatments on yield and economics of onion**

| Treatment | Yield (t/ha) | Cost of cultivation (₹/ha) | Gross returns (₹/ha) | Net returns (₹/ha) | B:C |
|---|---|---|---|---|---|
| Black plastic mulch | 20.99 | 253148 | 524755 | 271607 | 2.07 |
| Available weed mulch | 15.00 | 156897 | 375007 | 218110 | 2.39 |
| Straw mulch | 15.99 | 165960 | 399754 | 233794 | 2.41 |
| Cover crops | 14.19 | 156523 | 354756 | 198233 | 2.27 |
| Oxyfluorfen PE | 17.84 | 156139 | 446004 | 289865 | 2.86 |
| Pendimethalin PE | 18.99 | 159690 | 474757 | 315067 | 2.97 |
| Mechanical weeding | 16.78 | 155022 | 419511 | 264489 | 2.71 |
| Hand weeding | 18.82 | 166268 | 470509 | 304241 | 2.83 |
| Weedy check | 13.42 | 153148 | 335496 | 182348 | 2.19 |
| LSD (p=0.05) | 3.10 | | | | |

Price of onion= ₹ 25.00/kg

Onion average bulb circumference, average bulb weight and yield was highest with black plastic mulch treatment followed by pendimethalin PE and hand weeding. Lowest yield observed in the weedy check. Similar results were reported by Rahman *et al.* (2013), Hamma (2013), Masalkar *et al.* (2014) and Rachel *et al.* (2018). Pendimethalin PE recorded highest net return and B:C ratio as it is cost effective (**Table 3**).

It can be concluded that use of black polythene mulch was superior among all studied treatments in reducing weed growth and to attain better growth, development and yield of onion. But in terms of economics, pendimethalin PE was more cost effective and give highest returns and B:C than other control methods.

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