EFFECT OF WEED MANAGEMENT PRACTICES OF SMALL ONION (ALLIUM CEPA VAR. AGGREGATUM) NURSERY ON THE WEED FLORA, WEED CONTROL EFFICIENCY AND SEEDLING PRODUCTION

Comment [M1]: The article has minor flaws and is acceptable after fixing the flaws.

ABSTRACT

Control of weeds in nursery is necessary for production of healthy and sturdy seedlings. In this regard, field experiments were conducted to study the effect of different weed management practice on weed control efficiency and performance of onion seedling in nursery at two phases. The results from the first experiment revealed that, among the herbicide treatments, lowest weed density and weed dry weight was observed in Pre-emergence (PE) application of oxyfluorfen at 0.250 kg a.i ha 1 followed by PE application of oxyfluorfen at 0.125 kg a.i ha 1. Whereas, the highest weed control efficiency was observed in hand weeded plots followed by pre-emergence application of oxyfluorfen at 0.250 kg a.i ha 1. In the second experiment, lower weed density, weed dry weight and higher weed control efficiency was observed in lay by application oxyfluorfen @ 0.125 kg ha^{-1} as PE + 2nd application @ 0.0625 kg ha-1 at 20 DAS. Seedling characters viz., higher root length, seedling height, 100 seedling weight and seedling yield was recorded in PE application of oxyfluorfen at 0.125 kg a.i ha^{-1} and PE application of oxyfluorfen at 0.125 kg a.i ha^{-1} + oxyfluorfen at 0.0625 kg a.i ha^{-1} (lay by) at 20 DAS in the first and second experiment respectively.

Key words – Onion, pendimethalin, oxyfluorfen, weed control efficiency, seedling yield

Comment [M2]: It is better not to use the words used in the title in the keywords. Use related or synonymous words.

1. INTRODUCTION

Onion (Allium cepa var. aggregatum) is popularly called as “Queen of kitchen” because of its characteristic flavour. One of the most significant and exported crops in the world, including India, is the onion. It is a condiment crop that is eaten as a fresh salad and used as a spice in cooking recipes (Baloch 1994). The onion bulb is high in phosphorus, calcium, Vitamins C and B1, fibre, and carbohydrates. Weeds are undesired plants that compete with the onion crop for water, nutrients, and light, lowering productivity. Controlling weed growth is critical for achieving a good commercial output. Weeds cause an average loss of almost Rs. 1,00,000 crores in field crops alone (Khankhane *et al*., 2010)

Due to its intrinsic qualities such as slow growth, tiny stature, shallow roots, and lack of dense foliage, onions are more susceptible to weed competition than other crops. This encourages weed growth in the early stages, resulting in significant weed competition and a 48 to 85 percent drop in bulb production.

The weeds problem is not only in main field as well in the nursery. Seedling production in onion nurseries is hampered by a number of problems, one of the most significant of which is the presence of weeds. The use of organic manure and regular irrigation in the nursery promotes weed establishment and luxuriant development, often even before onion seed germination. Hand weeding is successful in many crops, however inefficient due to the crop's closer spacing and shallow root system, also it is time consuming. Furthermore, weeds are not controlled at the right stage of the crop due to a lack of timely labour availability, resulting in the generation of week seedlings. As a result, one of the choices available to farmers to decrease crop weed competition at the early growing stage of seedlings in the nursery is to employ pesticides.

Though pre-emergence herbicides maintain the crop weed-free in the early stages, the second flush of weeds has an impact on seedling quality. This demands the use of early preemergence herbicides, the layby technique of application, and hand weeding throughout the nursery period to keep the weed population below the economic threshold. As a result, early post-emergence weeding may be beneficial in reducing bulb damage, weed competition, and weeding costs. With these considerations in mind, the current experiment was carried out to investigate weed management strategies in onion nurseries for successful weed control and the development of healthy seedlings.

2. MATERIAL AND METHODS

A field experiment was conducted during 2017 rabi season at Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai to study the weed management practices on onion nursery and its influence on weed control efficiency and seedling quality. The experimental site was located at 9°54'N and 78°12'E, with an altitude of 147 m above mean sea level. The study location comes under the southern agro climatic zone of Tamil Nadu. The average annual rainfall at the experimental site is 856 mm, with mean maximum and minimum temperatures of 33.5 and 21.3 degrees Celsius, respectively, and a relative humidity of 65.5 percent.

The experiment was conducted in two different set of treatments in randomized block design with three replications. In first experiment, different dose of pendimethalin (0.25, 0.50 and 0.75 kg/ha) and oxyfluorfen (0.0625, 0.125 and 0.250 kg/ha) were applied as pre emergence (PE). From the first results of the experiment, dose of pendimethalin and oxyfluorfen was optimized based on its weed control efficiency. The second experiment was conducted with the optimized doses of herbicides with combination of hand weeding, lay by method and early post emergence application of quizalofop ethyl @ 0.05 kg ha-1 were tested. The details of the treatments were presented in table 1.

Table 1. Treatment details of the study

First nursery	Second nursery
T_1 - PE application of pendimethalin 0.25 kg a.i ha^{-1} (PEP 0.25)	T_1 - PE of pendimethalin @ 0.750 kg ha^{-1} + 1 HW at 20 DAS (PEP 0.75-HW)
T_2 - PE application of pendimethalin 0.50 kg a.i ha^{-1} (PEP 0.50)	T_2 – PE of pendimethalin @ 0.750 kg ha^{-1} + 2nd application @ 0.50 kg ha^{-1} at 20 DAS (Lay by method) (PEP 0.75-0.50LB)
T_3 - PE application of pendimethalin 0.75 kg a.i ha^{-1} (PEP 0.75)	T_3 -PEA of pendimethalin @ 0.75 kg ha^{-1} + EPOE application of quizalofop ethyl @ 0.05 kg ha^{-1} (PEP 0.75+EPOEQ 0.05)
T_4 - PE application of oxyfluorfen 0.0625 kg a.i ha^{-1} (PEO 0.0625)	T_4 -PEA of oxyfluorfen @ 0.125 kg ha^{-1} + 1 HW at 20 DAS (PEO 0.125-HW)
T_5 - PE application of oxyfluorfen 0.125 kg a.i ha^{-1} (PEO 0.125)	T_5 -PEA of oxyfluorfen @ 0.125 kg ha^{-1} + 2nd application @ 0.0625 kg ha^{-1} at 20 DAS (Lay by method) (PEO 0.125-0.0625LB)

T_6 - PE application of oxyfluorfen 0.250 kg a.i ha^{-1} (PEO 0.250)	T_6 -PEA of oxyfluorfen @ 0.125 kg ha^{-1} + EPOE application of quizalofop ethyl @ 0.05 kg ha^{-1} (PEO 0.125- EPOEQ 0.05)
T_7 - Weed free check (WFC)	T_7 -Weed free check (WFC)
T_8 - Unweeded control (UnWC)	T_8 -Unweeded control (UnWC)

The text in the parenthesis is the treatment code.

To get a fine tilth, the nursery area was ploughed twice with a cultivator and then rotovated, and a raised bed of 5 m × 2 m x 0.15 m length, breadth, and height was prepared. As a basal dose, 15 kg of FYM was applied to each bed. The onion variety CO 5 seeds were sown in 5 cm rows and coated with a thin coating of FYM mixed with soil at the recommended seed rate of 1 kg ha-1. To develop healthy seedlings, the recommended plant protection measures and nursery techniques were followed.
The weed density in the different treatmental nursery were counted by placing the 0.5 m2 quadrats and expressed in no m2 than the weeds were shade dried and oven dried for 12 hrs at 65 °C than weed dry weight was accounted. The approach proposed by Mani et al. 1973 was used to calculate weed control efficiency (WCE)

WCE (%)=(WDc-WDt)/WDc ×100

Where,

WCE – Weed control efficiency

WDc – Weed density in the weed free check

WDt - Weed density in the treated plot

For recording the biometric observations five onion seedlings were selected randomly and tagged for recording seedlings height, root length and 100 seedlings weight at 35 DAS. The data on weed and crop was statistically analysed following the procedure given by Gomez and Gomez (2010). The variables mean data was compared least significance difference at 5% level. Weed data was translated to a square root scale (X + 2) and analysed according to Snedecor and Cochran's recommendations (1967).

3. RESULTS AND DISCUSSION

3.1. Weed flora

The experimental field's major weed flora comprises five species of grasses namely Brachiaria reptans, Chloris barbata, Digitaria bicornis Dactylotenium aegyptium,, Echinochloa colonum and ten species of broad leaved weeds namely Trianthema portulacastrum, Eclipta prostrate, Boerhavia diffusa, Digera muricata, Cleome gynandra, Phyllanthus maderasapatensis, Melothria madaraspatnas, Convolvulus arvensis, Cardiospermum miccrocarpum, and Phyllanthus niruri. The only sedge weed found in the experimental field was Cyperus rotundus. Grassy weeds dominated the experimental field followed by broad leaved and sedge weeds throughout the crop growth.

3.2. Total weed density in onion nursery

In both experiments, there was a significant difference in total weed density between the weed control methods (Fig 1). Herbicide treated plots reduced the population of weeds at all the stages of observation. However, the lowest and highest total weeds density was accounted in the WFC and UnWC in both the experiments respectively. In the first experiment, PEO 0.250 recorded lower weed density of 24.3 and 29.2 no m-2 at 20 and 30 DAS respectively. It was followed by PEO 0.125 (175.3 and 210.3 no m-2 at 20 and 30 DAS respectively). It was due to the effect of diphenyl ethers on cell membranes, which caused cell disruption, ionic balance, and eventually weed death. The herbicide was found effective in controlling germinated as well as the germinating weed seeds. Similar findings were also reported by Ramachandra Prasad (2000) and Prendeville and Warren (1997). Increasing the dose of herbicide reduced the density of weeds to a greater extent. These results were corroborating with the findings of by Hussain and Walsh (2008), Rahman et al. (2011) and Yumnam et al. (2009).

The result obtained from second nursery showed that PEO 0.125-0.0625LB recorded lower weed density of at 20 and 30 DAS (18.6 and 12.0 no m-2) respectively. It was followed by PEO 0.125- EPOEQ 0.05 and PEO 0.125-HW at 20 and 30 DAS respectively. The result revealed that pendimethalin has lesser effect on control of weeds than compared to oxyfluorfen in the onion nursery. This might be due to broad spectrum nature of herbicide thereby it controls all weed species including grasses, broad leaved weeds and to some extend by sedges leads to reduction in total weed density. Similar findings were also reported by Ramachandra Prasad (2000) and Prendeville et al. (1997).

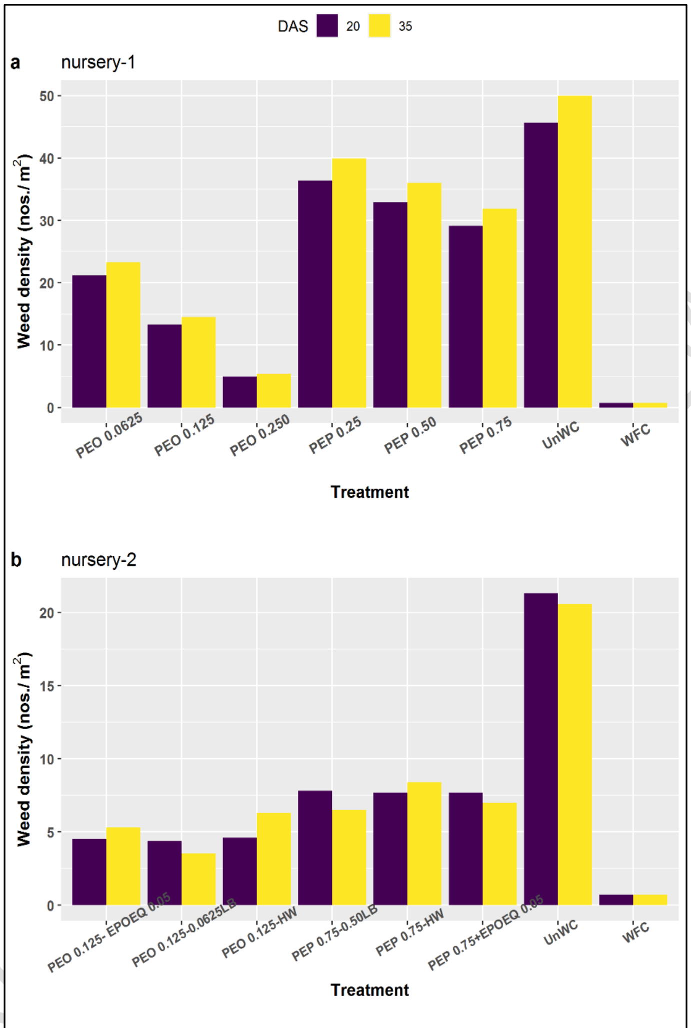

Figure 1. Weed management practices on total weed density (nos./m^2) in onion nursery

3.3. Total weeds dry weight in onion nursery

Weed dry weight depicted a similar response in line with the weed density in various treatments (Fig 2). In first nursery, PEO 0.250 recorded lowest total weed dry weight of 8.0 and 12.8 kg ha 1 at 20 and 35 DAS respectively. The result attributed due to lower weed density by preventing the germination of weeds also effective control of grasses and broadleaved weeds which were dominated the experimental field by higher dose of herbicide. It was followed by PEO 0.125 in which 35.0 and 56.0 kg ha-1 was recorded. The lower weed density in PEO 0.250 might be due to preventing the germination of weeds during initial period of growth (Patel et al., 2011). Similar type results were also observed by Priyadharshini and Anburani (2004) and Zubiar et al. (2009).

In second nursery, at 20 DAS there is no significant result was found between treatments. Whereas, at 35 DAS among the herbicide applications, PEO 0.125-0.0625LB recorded lower total weed dry weight followed by PEO 0.125- EPOEQ 0.05. However, in both nurseries, the weed free check had the lowest total weed dry weight and the weedy check had the greatest total weed dry weight, with 20 and 35 DAS, respectively. This was due to effective control of broad leaved weeds and grasses which dominated the experimental field by herbicides. Similar findings were also reported by Priyadharshini and Anburani (2004) and Zubiar et al. (2009).

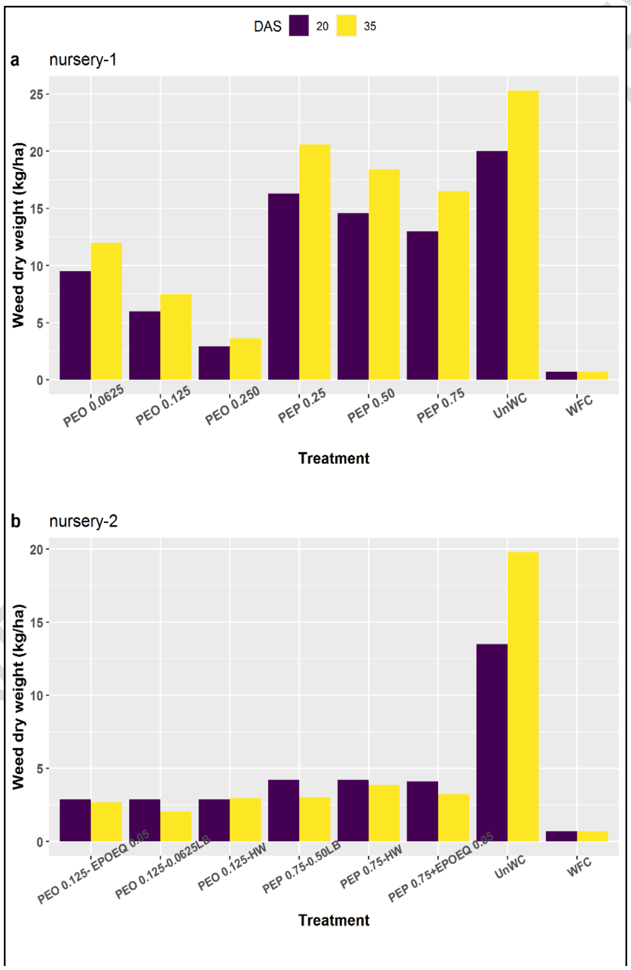

Figure 2. Weed management practices on total weed dry weight (kg/ha) in onion nursery

3.4. Weed control efficiency

The relative degree of dry weight reduction by weed control treatments is measured by weed control efficiency (Fig 3). Both nurseries produced considerable results in terms of weed control efficiency. Due to the complete eradication of weeds, weed free check has the highest weed control efficiency (100 per cent) in both nurseries. Similar type of results also observed by Patel et al. (2000) and Raj et al. (2012). In the first nursery, highest weed control efficiency of 98 per cent was observed with PEO 0.250 followed by PEO 0.125 at 20 and 35 DAS respectively. The higher weed control efficiency was attributed due to reduced weed population and weed dry weight. The oxyfluorfen applied treatments registered more WCE than pendimethalin applied treatments. Similar line of findings was also reported by Shinde et al. (2012) in onion.

In second nursery, highest weed control efficiency of 96 per cent was observed in PEO 0.125-HW, PEO 0.125-0.0625LB and PEO 0.125-EPOEQ 0.05 respectively at 20 DAS. This was due to reduced weed population, weed dry weight was also reduced which increased weed control efficiency. Whereas, at 35 DAS highest weed control efficiency of 99 per cent was accounted by PEO 0.125-0.0625LB followed by PEO 0.125 - EPOEQ 0.05, PEO 0.125-HW and PEP 0.75-LB. This could be because of lower weed density and dry weight. Similar trend of response was observed by Patel et al. (2000) and Raj et al. (2012).

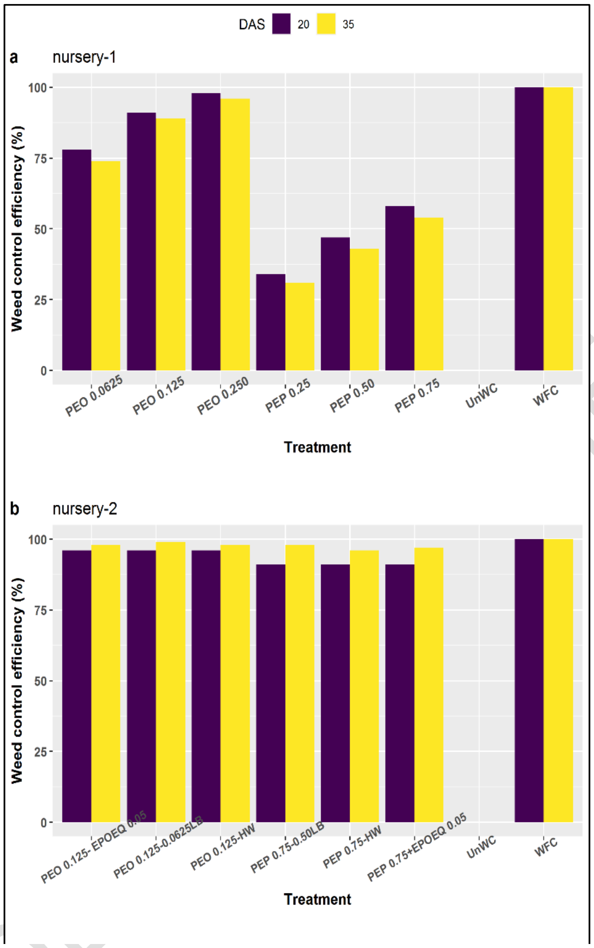

Figure 3. Weed management practices on weed control efficiency (%) onion nursery

3.5. Effect of weed control treatments on onion seedlings

3.5.1. Root length of seedlings

Weed control treatments significantly influenced the root length of onion seedlings presented in Table 2. The root length was highest under WF (7.4 cm) followed by PEO 0.125 (T5). However, it was on par with PEO 0.250 (T6) and PEO 0.0625 (T4). The shortest root length of 4.15 cm was recorded in UnWC at the time of transplanting. In second nursery (Table 3), the root length was higher under WF (7.2 cm) and this treatment was comparable with PEO 0.125-0.0625LB (T5) and PEP 0.75-0.50LB. UnWC recorded shortest root length. Weed free situation ensures highest root length. Similar trend of results was also observed by Sharma et al., (2009).

Table 2. Weed management methods on height of seedlings, root length, weight of seedlings and yield of seedlings in onion (first nursery)

Treatments	Height of seedlings(cm)	Root length(cm)	100 seedlings Weight (g)	Yield of seedlings (kg/ha)
PEP 0.25	15.51	4.88	35.3	1918
PEP 0.50	18.41	4.85	48.0	2232
PEP 0.75	19.89	5.20	49.7	2090
PEO 0.0625	20.91	5.78	51.0	3019
PEO 0.125	22.14	6.20	53.7	3064
PEO 0.250	22.04	6.90	55.0	1094
WFC	25.26	7.40	58.0	3717
UnWC	11.91	4.15	0	0
SEd	**0.54**	**0.17**	**1.38**	**71.22**
CD (P=0.05)	**1.14**	**0.36**	**2.89**	**148.78**

Table 3. Weed management methods on height of seedlings, root length, weight of seedlings and yield of seedlings in onion (Second nursery)

Treatments	Height of seedlings (cm)	Root length (cm)	100 seedlings weight (g)	Yield of seedlings (kg/ha)
PEP 0.75-HW	21.30	5.1	43.33	4615
PEP 0.75-0.50LB	24.87	6.2	56.67	6154
PEP 0.75+EPOEQ 0.05	22.70	5.3	46.53	5070
PEO 0.125-HW	23.43	5.6	53.67	7702
PEO 0.125-0.0625LB	25.73	6.8	59.00	8343
PEO 0.125- EPOEQ 0.05	23.87	5.8	55.30	8144
WFC	26.10	7.2	62.30	9569
UnWC	16.97	3.9	0.0	0.0
SEd	**0.59**	**0.36**	**1.30**	**178**
CD (P=0.05)	**1.23**	**0.77**	**2.71**	**372**

3.5.2. Seedling height

Different weed control treatments significantly influenced the height of seedlings. Data on Table 2. Shows that at the time of transplanting the seedlings height was highest in WF (25.26 cm) followed by PEO 0.125 (T5). This treatment was on par with PEO 0.250 (T6) and PEO 0.0625 (T4). UnWC (T8) recorded shortest seedlings height (11.91 cm) at the time of transplanting. In second nursery (Table 3), the seedlings were taller under WF (26.10 cm) (T7), it was on par with PEO 0.125-0.0625LB (T5) and PEP 0.75-0.50LB (T2). UnWC recorded shortest seedling height of (16.97 cm). Better weed control results in a more favourable environment in the root zone, allowing for more water and nutrients to be absorbed from the soil. The results are in conformity with the findings of Ramana et al. (2007), Yumnam et al. (2009) and Raj et al. (2012). Least height of seedlings was obtained under UnWc because of the poor exposure to direct sunlight as a result of smothering effect of weeds. Similar finding was reported by Channappagoudar and Biradar (2007).

3.5.3. Hundred Seedlings weight

Different weed management practices significantly influenced the 100 seedlings weight. In first nursery (Table 2), 100 seedlings weight was highest with WF (58 g cm) followed by PEO

0.250 however it was on par with PEO 0.125 (53.7 g) and PEO 0.0625 (51.0 g). Weedy check recorded lower 100 seedling weight of 24.3 g. In second nursery (Table 3), Significant result was obtained from the second experiment, the 100 seedlings weight was highest under WF (62.3 g) followed by PEO 0.125-0.0625LB (59.0 g). However, it was on par with PEP 0.75-LB (56.67 g) and PEO 0.125 - EPOEQ 0.05 (55.30 g). It may be inferred that keeping the onion nursery free of weeds will result in the healthiest seedlings. Similar trend was also observed by Sharma et al., (2009).

3.5.4. Seedling yield

In first nursery (Table 2), higher seedlings yield of 3,717 kg ha 1 was obtained under weed free check due to efficient control of weeds at critical stages resulting in least competition by weeds for nutrients providing favourable environment for growth and development of onion leading to increase in yield. This finding derives support from Patel et al. (2000) who also reported similar findings. Among the herbicide treatments, higher seedling yield of 3,064 kg ha-1 was obtained under PEO 0.125 however it was on par with PEO 0.0625. This might be due to efficient control of weeds in the early stage of crop growth by oxyfluorfen which leads to better availability of moisture and nutrients. This result is in line with the findings of Khokhar et al. (2006) and Ratnam et al. (2012).

In second nursery (Table 3), among the treatments higher seedlings yield of 8,343 kg ha 1 was obtained under PEO 0.125-0.0625LB and it was on par with PEO 0.125 - EPOEQ 0.05 (8,143 kg ha-1). This might be due to efficient control of weeds in the early stage of crop growth by pre-emergence herbicides and at later stages, by hand hoeing would help to remove the escaped weed propagules including sedges and further emerging weeds were prevented by lay by application. Therefore, total weed free situation existed in the treatment and favored better availability and nutrient leads to better seedling yield. This result is in line with the findings of Khokhar et al. (2006) and Ratnam et al. (2012).

4. CONCLUSION

Comment [M3]: The conclusion is very short, it is better to have a more interpretive result.

From the above study it could be concluded that PE application of oxyfluorfen at 0.125 kg a.i ha-1 + oxyfluorfen at 0.0625 kg a.i ha-1 at 20 DAS (Lay by method) recorded higher weed control efficiency and suggested for sturdy onion seedling production for better growth and yield of onion.

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