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**Original Paper**

# Influence of different weed control methods on weed biomass, growth and yield of mango ginger (*Curcuma amada* Roxb.) in forest savannah transition agro-ecological zone of Nigeria

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Field trials were conducted in the early cropping seasons of 2016 and 2017 at the Teaching and Research Farm of the Federal University of Agriculture Abeokuta (07° 20′ N, 3° 23′ E 159 m above sea level) in the forest – savannah transition agroecology of South-western Nigeria to evaluate the effect of weed control methods on weed biomass, growth and yield of mango ginger. Ten weed control methods were evaluated and laid out in a randomized complete block design with three replications. Data were collected on weed biomass, crop vigour score, stand count, number of rhizomes and rhizome yield. Results on weed biomass at 8 WAP showed that plots treated with different rates of pre-emergence herbicide gave lower weed biomass than hoe weeded plots. Also, at 24 WAP, plots treated with pre-emergence herbicide followed by different post emergence treatments gave lower weed biomass than plots when only pre-emergence herbicide was applied. In both years, plots hoe weeded five times at 4, 8, 12, 16 and 20 WAP gave the highest rhizome yield. Application of only pre-emergence herbicide throughout crop life cycle irrespective of the rate resulted in 60.7 to 62.0% reduction in rhizome yield relative to the maximum across the two years. Uncontrolled weed interference resulted in 91.9 and 92.1% rhizome yield reduction in 2016 and 2017, respectively. This study reveals that, mango ginger being a long-seasoned crop should be kept weed free beyond 12 WAP for acceptable yield.

**Keywords:** herbicide, hoe weeded, pre-emergence, rhizome yield, weed biomass

## 1 Introduction

Mango ginger (*Curcuma amada* Roxb.) is a distinct spice that looks like ginger but tastes like raw mango (Sasikumar, 2005). Mango ginger (*Curcuma amada* Roxb.) is a perennial herb that originated from Asia and widely cultivated for its mango-flavoured rhizomes (Chatterjee et al., 2012). It is used in Ayurvedic medicine to treat ailments such as jaundice, haemorrhage, and colic. The leaves of mango ginger are used in orthodox medicine to kill some cancer cells (Vishnupriya et al., 2012). It is used as both a flavouring and a spice, and its yellow colour can be seen in drinks (Vishnupriya et al., 2012). According to Vishnupriya et al. (2012) its rhizomes look like ginger rhizome (*Zingiber officinale*). The leaves of mango ginger had been describing as long, oblong-lanceolate, and with a petiole, and its aerial shoot as reaching 90 cm above ground level (Samant, 2012).

Ginger grows slowly initially and stays on the field for a long period; the crop is highly susceptible to weed competition, especially at the initial stages of crop growth. As a result, yield loss due to weed competition is expected to be enormous. Weeds compete for soil moisture, soil nutrients, and space with ginger. Weed competition has also been identified as a source of root and tuber production constraints (Unamma, 1984). According to the All India Coordinated Research Project on Weed Control, 30–45% yield reduction in ginger may occur because of uncontrolled weed growth (KAU, 2006), and Eshetu and Addisu (2015) reported that when weeding was completely ignored, yield reduction as a result of uncontrolled weed growth amounted to 100 percent under Jimma conditions. The present study hypothesized that mango ginger, being a long duration crop needs longer weed free period that will reduce will

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pressure, enhance crop growth, and maximize rhizome yield. Therefore, objective of the present study is to identify appropriate weed management method that will reduced weed pressure and maximize mango ginger productivity.

## 2 Material and methods

The field experiments were conducted at the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria (70 15′ N, 30 23′ E 159 m above sea level) during 2016 and 2017 early wet cropping seasons (June – December). The experimental site was located in the forest-savanna transition zone of south-western Nigeria. In 2016 and 2017, the site received a total rain fall of 669.6 mm and 560.7 mm, respectively from June to December (Figure 1). The mean monthly temperature ranged from a minimum of 22.5 °C and 25.2 °C to a maximum of 28.1 °C and 28.9 °C in 2016 and 2017, respectively (Figure 1).

In both years, the experiment consisted of ten treatments arranged in a randomized complete block design and replicated three times. The ten treatments includes: oxyfluorfen (oxy) at 0.36 kg a.i $ha^{-1}$ followed by (fb) oxyfluorfen at 0.24 kg a.i $ha^{-1}$; oxyfluorfen at 0.36 kg a.i $ha^{-1}$ fb hoe weeding; oxyfluorfen at 0.36 kg a.i $ha^{-1}$ alone; oxyfluorfen at 0.24 kg a.i $ha^{-1}$ fb oxyfluorfen at 0.24 kg a.i $ha^{-1}$; oxyfluorfen at 0.24 kg a.i $ha^{-1}$ fb hoe weeding; oxyfluorfen at 0.24 kg a.i $ha^{-1}$ alone; hoe weeding at 4, 8, 12 weeks after planting (WAP); hoe weeding at 4, 8, 12, 16 WAP; hoe weeding at 4, 8, 12, 16, 20 WAP and weedy check (follow up treatments were applied at 8 WAP in all the plots). Weeds were removed by hand hoeing at the required time according to the treatments on the hoe weeded plots.

In each year, field was ploughed, and harrowing was done after two weeks to ensure a tilth weed-free soil. After the removal of weed stumps and debris, field layout was done, and beds of 3 × 3 m were made manually with hoe. Mango ginger rhizomes were planted per hill at 0.20 × 0.20 m to give total plant population of 250,000 plants/ha.

Before any weeding operation, total weed control rating was done using a scale of 0–10 (where 0 means no weed control and 10 means complete weed destruction). Hoe weeding was carried out according to the treatment requirements using West African hand hoe. The weeding operation on the hoe weeded plots were preceded by collection of weed samples using systematic random sampling on the plots. Weed samples were collected from quadrat size of 0.5 × 0.5 m before every weeding according to the treatments. The weed samples collected were pooled together to get the total weed biomass. Data on mango ginger stands, crop vigour score using a scale of 1–10 (where 1 mean no crop growth and 10 mean excellent crop growth), rhizome yield at harvest were also taken. Data collected were subjected to Analysis of Variance (ANOVA) according to the procedures of GENSTAT. Significant means were separated using Duncan's Multiple Rage Test at 5% level probability.

## 3 Results and discussion

Mango ginger stand count at 24 WAP was significantly affected by weed control methods (Table 1). Application of oxy at 0.24 kg a.i $ha^{-1}$ fb oxy at 0.24 kg a.i $ha^{-1}$ and the weedy check resulted in the maximum and the lowest mango ginger stand count at 24 WAP, respectively. Hoe

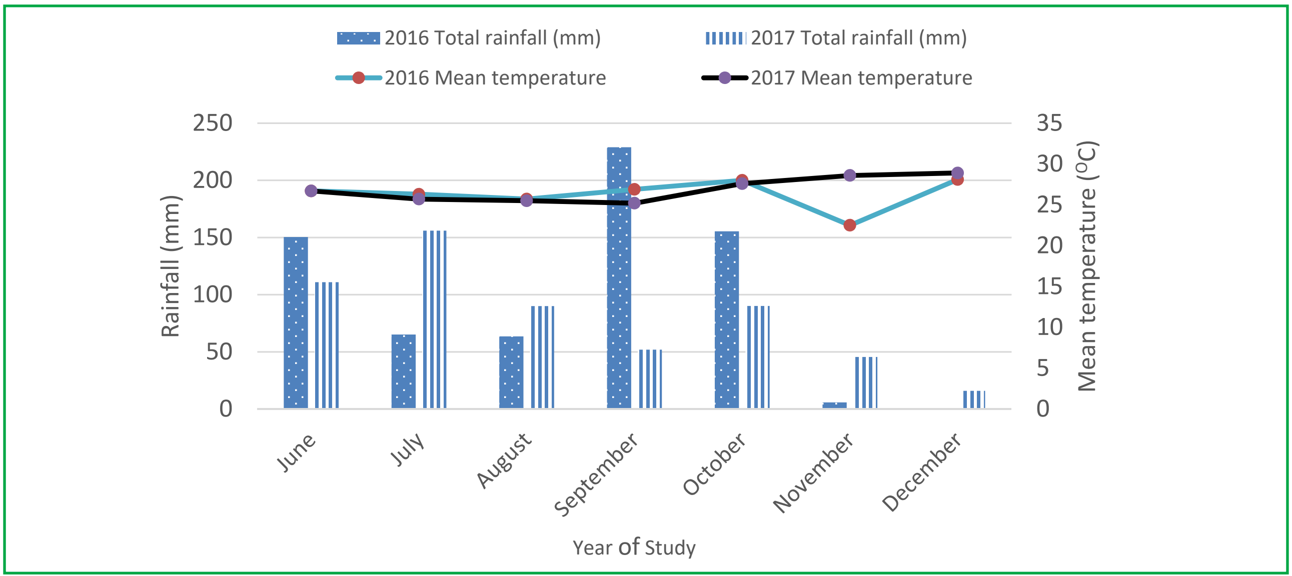


**Figure 1** Rainfall and temperature data during the experiment

weeding at 4, 8 and 12 WAP resulted in significantly lower stand count compared to the maximum of those with the application of oxy at 0.24 kg a.i $ha^{-1}$ fb oxy at 0.24 kg a.i $ha^{-1}$ (Table 1). The lower mango ginger stands on the weedy check plots could be attributed to the uncontrolled weed growth on the plot which could have competed with the crop for environmental resources. Initial slow growth of the crop also made it worse as the weeds could have form canopy over the crop and depriving the crop from getting enough sunlight needed for photosynthesis. This result agrees with earlier report of Eshetu and Addisu (2015) who reported less ginger stands as a result of weed infestation.

Weed control methods significantly influenced mango ginger vigour score throughout the period of observation (Table 2). At 6 and 12 WAP in both years, application of oxy at 0.24 kg a.i $ha^{-1}$ fb oxy at 0.24 kg a.i $ha^{-1}$ and hoe weeding resulted in maximum crop vigour score which was significantly higher than those of oxy at 0.36 kg a.i $ha^{-1}$ alone and the weedy check. At 12 and 16 WAP in both years, the lowest crop vigour score was recorded on weedy check plots. Also, at 12 and 16 WAP in 2016, application of oxy at 0.24 kg a.i $ha^{-1}$ and oxy at 0.36 kg a.i $ha^{-1}$ alone resulted in significantly lower crop vigour score than the maximum (Table 2). The lowest crop vigour score on the weedy check plots could be attributed to

**Table 1** Effect of weed control treatments on mango ginger stand count

| Treatments | Stand count (000 $ha^{-1}$) | | | |
|---|---|---|---|---|
| | 6 WAP | | 24 WAP | |
| | 2016 | 2017 | 2016 | 2017 |
| oxy at 0.36 kg a.i $ha^{-1}$ alone | 227.5 | 224.6 | 229.1b | 234.0ab |
| oxy at 0.36 kg a.i $ha^{-1}$ fb oxy at 0.24 kg a.i $ha^{-1}$ | 233 | 234.8 | 238.9ab | 239.6ab |
| oxy at 0.36 kg a.i $ha^{-1}$ fb HW | 227.4 | 208.9 | 233.3ab | 237.4ab |
| oxy at 0.24 kg a.i $ha^{-1}$ alone | 229.5 | 224.7 | 232.1ab | 235.9ab |
| oxy at 0.24 kg a.i $ha^{-1}$ fb oxy at 0.24 kg a.i $ha^{-1}$ | 239.3 | 211.1 | 243.7a | 247.4a |
| oxy at 0.24 kg a.i $ha^{-1}$ fb HW | 241.5 | 215.9 | 246.3a | 238.9ab |
| HW @ 4, 8, 12 WAP | 233.3 | 212.6 | 239.3ab | 225.2b |
| HW @ 4, 8, 12, 16 WAP | 239.3 | 224.8 | 243.0ab | 231.5ab |
| HW @ 4, 8, 12, 16, 20 WAP | 238.5 | 222.2 | 242.2ab | 238.1ab |
| Weedy check | 240.4 | 225.9 | 89.6c | 100.4c |
| SE | 3.95ns | 7.75ns | 4.21 | 5.09 |

Oxy – oxyfluorfen; Fb – followed by: HW – how weeding; WAP – weeks after planting

**Table 2** Effect of weed control treatments on crop vigour score of mango ginger

| Treatments | Crop vigour score | | | | | |
|---|---|---|---|---|---|---|
| | 6 WAP | | 12 WAP | | 16 WAP | |
| | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| oxy at 0.36 kg a.i $ha^{-1}$ alone | 2.5b | 2.8bc | 5.7d | 6.0b | 6.3b | 6.7c |
| oxy at 0.36 kg a.i $ha^{-1}$ fb oxy at 0.24 kg a.i $ha^{-1}$ | 2.8ab | 2.8bc | 6.3ab | 6.3ab | 7.0a | 7.2ab |
| oxy at 0.36 kg a.i $ha^{-1}$ fb HW | 3.0ab | 3.0b | 6.0bcd | 6.0b | 6.5b | 7.2ab |
| oxy at 0.24 kg a.i $ha^{-1}$ alone | 2.7b | 2.8bc | 5.8cd | 6.2ab | 6.5b | 6.8bc |
| oxy at 0.24 kg a.i $ha^{-1}$ fb oxy at 0.24 kg a.i $ha^{-1}$ | 3.3a | 3.5a | 6.7a | 6.7a | 7.0a | 7.3a |
| oxy at 0.24 kg a.i $ha^{-1}$ fb HW | 3.3a | 3.5a | 6.7a | 6.7a | 7.2a | 7.2ab |
| HW @ 4, 8, 12 WAP | 3.0ab | 3.0b | 6.3ab | 6.3ab | 7.0a | 7.0abc |
| HW @ 4, 8, 12, 16 WAP | 3.0ab | 3.0b | 6.3ab | 6.3ab | 7.0a | 7.0abc |
| HW @ 4, 8, 12, 16, 20 WAP | 2.8ab | 3.0b | 6.2bc | 6.3ab | 7.0a | 7.0abc |
| Weedy check | 2.5b | 2.5c | 3.5e | 3.3c | 3.6c | 3.5d |
| SE | 0.16 | 0.14 | 0.14 | 0.15 | 0.08 | 0.12 |

Oxy – oxyfluorfen; Fb – followed by; HW – how weeding; WAP – weeks after planting uninterrupted crop-weed competition. Weed compete with crop for water, soil nutrients, light and even harbour insect pest and thereby reducing the vigour of the crop as a result of shortage in environmental resources. Less vigorous crop on plots with application of oxy at 0.24 kg a.i ha$^{-1}$ and oxy at 0.36 kg a.i ha$^{-1}$ alone compared to when they are followed up by either hoe weeding or post emergence herbicide could be attributed to subsequent weed infestation on the plots. This agrees with the findings Sivakumar et al. (2019) who reported better crop performance under integrated weed management approach than when only pre-emergence herbicide is used.

Weed control methods significantly influenced total weed control throughout the period of observation (Table 3). Generally, at 4 WAP, application of pre-emergence herbicide resulted in significantly higher weed control compared to the hoe weeded plots and the weedy check plots. The weed control rating on the treated plots is as a result of the pre-emergence herbicides applied at planting which attacked the weed seeds and preventing them from germinating. These results corroborate the earlier report of Imoloame (2014) who reported higher weed control on herbicide treated plots compared to plots where no pre-emergence herbicide was applied. In both years at 8 and 24 WAP, weedy check plots resulted in the lowest weed control. In both years at 8 WAP, application of oxy at 0.36 kg a.i ha$^{-1}$ irrespective of the follow up treatments resulted in significantly higher weed control than all the plots weeded at 4 WAP and the weedy check. Hoe weeding at 4, 8, 12, 16 and 20 resulted in the highest weed control at 24 WAP in both years. Also, in both years at 24 WAP, application of oxy at 0.24 kg a.i ha$^{-1}$ alone, oxy at 0.36 kg a.i ha$^{-1}$ alone and hoe weeding at 4, 8, 12 resulted in significantly lower weed control compared to herbicide treated plots irrespective of rate and follow up treatments as well as plots hoe weeded beyond 12 WAP (Table 3). At 8 WAP, higher weed control rating was recorded on plots treated with pre-emergence herbicide compared to plots weeded once at 4 WAP. However, at 24 WAP, application of pre-emergence herbicide alone resulted in lower weed control than when followed up with post emergence treatment and when plots were hoe weeded for various periods. The reason for lower weed control on the plots with only pre-emergence treatment at 24 WAP could be attributed to loss of persistence by the herbicide applied at planting. Also new flush of weeds that emerged later and weed seed dispersal during the crop life cycle reduced the weed control rating on the plots. These results corroborate the findings of Peer et al. (2013) who reported that when herbicides are combined with one hoe weeding, they are more effective, and that the initial goal of limiting weed growth by the pre-emergence herbicides is maintained because hand weeding eliminates the fresh flush of weeds that may regenerate due to herbicides' loss of persistence when used alone.

Weed control methods significantly influenced weed biomass at 8 and 24 WAP in both years (Table 4). In both years at 8 and 24 WAP, the highest weed biomass was recorded on the weedy check plot. At 8 WAP, application of pre-emergence herbicide irrespective of the rate of application resulted in significantly lower weed biomass compared to the all the plots where hoe weeding was done at 4 WAP. Higher weed biomass was recorded on the weedy check plots compared to herbicide treated

**Table 3** Effect of weed control methods on total weed control in mango ginger

| Treatments | Total weed control (%) | | | | | |
|---|---|---|---|---|---|---|
| | 4 WAP | | 8 WAP | | 24 WAP | |
| | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| oxy at 0.36 kg a.i ha$^{-1}$ alone | 10.0a | 10.0a | 7.7a | 8.0a | 4.7d | 5.8c |
| oxy at 0.36 kg a.i ha$^{-1}$ fb oxy at 0.24 kg a.i ha$^{-1}$ | 9.7a | 10.0a | 7.7a | 7.7a | 6.7b | 6.8b |
| oxy at 0.36 kg a.i ha$^{-1}$ fb HW | 9.7a | 10.0a | 8.0a | 7.7a | 6.5b | 6.7b |
| oxy at 0.24 kg a.i ha$^{-1}$ alone | 9.7a | 10.0a | 7.3ab | 7.7a | 4.3d | 5.7c |
| oxy at 0.24 kg a.i ha$^{-1}$ fb oxy at 0.24 kg a.i ha$^{-1}$ | 9.7a | 9.7ab | 7.7a | 6.8b | 6.8b | 6.7b |
| oxy at 0.24 kg a.i ha$^{-1}$ fb HW | 9.7a | 9.3b | 7.7a | 6.7b | 6.7b | 6.5b |
| HW @ 4, 8, 12 WAP | 0.0b | 0.0c | 6.7b | 6.3b | 5.8c | 5.7c |
| HW @ 4, 8, 12, 16 WAP | 0.0b | 0.0c | 6.7b | 6.7b | 6.8b | 6.8b |
| HW @ 4, 8, 12, 16, 20 WAP | 0.0b | 0.0c | 6.7b | 6.3b | 8.0a | 8.0a |
| Weedy check | 0.0b | 0.0c | 0.0c | 0.0c | 0.0e | 0.0d |
| SE | 0.24 | 0.15 | 0.27 | 0.22 | 0.21 | 0.22 |

Oxy – oxyfluorfen; Fb – followed by; HW – how weeding; WAP – weeks after planting

**Table 4** Effect of weed control treatments on weed dry matter production in mango ginger

| Treatments | Weed biomass (kg/ha) | | | |
|---|---|---|---|---|
| | 8 WAP | | 24 WAP | |
| | 2016 | 2017 | 2016 | 2017 |
| oxy at 0.36 kg a.i ha$^{-1}$ alone | 223c | 54c | 2,358b | 2,290b |
| oxy at 0.36 kg a.i ha$^{-1}$ fb oxy at 0.24 kg a.i ha$^{-1}$ | 204c | 62c | 273c | 323c |
| oxy at 0.36 kg a.i ha$^{-1}$ fb HW | 157c | 61c | 233c | 276c |
| oxy at 0.24 kg a.i ha$^{-1}$ alone | 226c | 63c | 2,163b | 1,948b |
| oxy at 0.24 kg a.i ha$^{-1}$ fb oxy at 0.24 kg a.i ha$^{-1}$ | 287c | 257c | 285c | 320c |
| oxy at 0.24 kg a.i ha$^{-1}$ fb HW | 198c | 206c | 305c | 335c |
| HW @ 4, 8, 12 WAP | 1,068b | 1,699b | 1,555c | 1,834b |
| HW @ 4, 8, 12, 16 WAP | 903b | 1,445b | 636c | 756c |
| HW @ 4, 8, 12, 16, 20 WAP | 883b | 1,416b | 270c | 342c |
| Weedy check | 4,925a | 3,181a | 8,976a | 10,486a |
| SE | 150.3 | 182.9 | 172.2 | 228.2 |

Oxy – oxyfluorfen; Fb – followed by; HW – how weeding; WAP – weeks after planting

plots and the hoe weeded plots. Lower weed biomass on hoe weeded plots was due to frequent weed removal which did not allow weed growth. Also, on the herbicide treated plots, lower weed biomass obtained was due to few numbers of weeds on the plots as a result of the pre-emergence herbicide applied at planting which prevented the establishment of weed seedlings initially. This is in agreement with earlier report by Channappagoudar et al. (2013), who reported higher total dry weight of weed per meter square on the untreated plots in turmeric. Hill and Santlemann (1969) attributed lower weed dry weight on treated plots to rapid depletion of carbohydrate reserves of weeds through rapid respiration. In both years at 24 WAP, application of oxy at 0.36 kg a.i ha$^{-1}$ and oxy at 0.24 kg a.i ha$^{-1}$ alone resulted in significantly higher weed biomass than oxy at 0.36 kg a.i ha$^{-1}$ and oxy at 0.24 kg a.i ha$^{-1}$ irrespective of the follow up treatments as well as when plots were weeded beyond 12 WAP (Table 4). The lower weed biomass on plots treated with pre-emergence herbicide plus a followed treatment is because of further weed removal which enhanced early crop canopy closure and thereby smothering weeds. This result corroborates the earlier findings of Imoloame (2014) who reported further suppression of late emerging weeds as a result of integrated weed management. Kaur et al. (2008, 2016) also reported effective and long-term weed control with integration of herbicide and straw mulch in turmeric. There is 75.9% to 97.4% reduction in weed biomass as a results of different weed control methods in mango ginger relative to the weedy check. Application of 0.36 kg

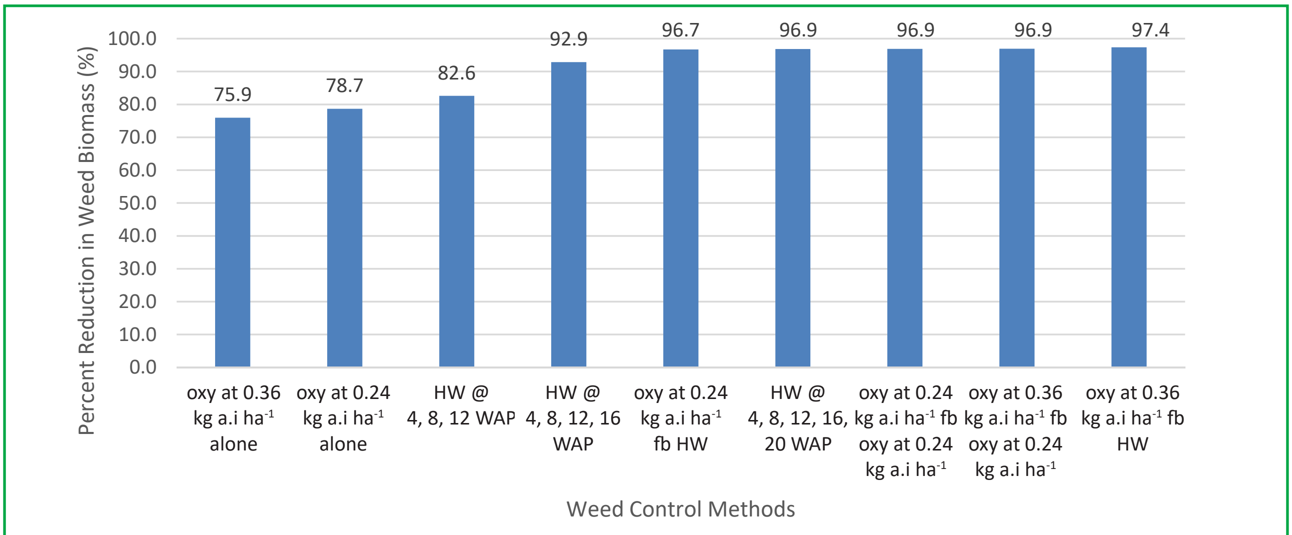


**Figure 2** Percentage weed biomass reduction in mango ginger relative to the weedy check in both years

 

**Table 5** Effect of weed control methods on yield of mango ginger

| Treatments | Rhizome fresh yield (t/ha) | | Number of rhizome (x000/ha) | |
|---|---|---|---|---|
| | 2016 | 2017 | 2016 | 2017 |
| oxy at 0.36 kg a.i ha$^{-1}$ alone | 12.0cd | 12.6de | 588.6b | 512.0b |
| oxy at 0.36 kg a.i ha$^{-1}$ fb oxy at 0.24 kg a.i ha$^{-1}$ | 20.0abc | 21.9abcd | 646.6ab | 711.3ab |
| oxy at 0.36 kg a.i ha$^{-1}$ fb HW | 18.2bc | 18.7bcd | 585.1b | 643.6b |
| oxy at 0.24 kg a.i ha$^{-1}$ alone | 11.5cd | 12.3de | 593.0b | 507.9b |
| oxy at 0.24 kg a.i ha$^{-1}$ fb oxy at 0.24 kg a.i ha$^{-1}$ | 23.2abc | 25.6abc | 746.7ab | 821.4ab |
| oxy at 0.24 kg a.i ha$^{-1}$ fb HW | 25.0ab | 27.5ab | 819.8ab | 901.7ab |
| HW @ 4, 8, 12 WAP | 15.1bc | 15.8cd | 784.2ab | 862.6ab |
| HW @ 4, 8, 12, 16 WAP | 24.5abc | 27.0abc | 734.7ab | 808.2ab |
| HW @ 4, 8, 12, 16, 20 WAP | 29.8a | 32.8a | 1,018.6a | 1,120.4a |
| Weedy check | 2.4d | 2.6e | 83.0c | 91.3c |
| SE | 3.1 | 3.48 | 112.7 | 124.4 |

Oxy – oxyfluorfen; Fb – followed by; HW – how weeding; WAP – weeks after planting

a.i ha$^{-1}$ fb hoe weeding resulted in the highest reduction in weed biomass (Figure 2). Guggari et al. (1995) observed 30 to 55 percent reduction in weed emergence when plots were treated with pre-emergence herbicide.

In both years, hoe weeding at 4, 8, 12, 16 and 20 WAP resulted in the maximum rhizome yield and numbers (Table 5). Also in both years, application of oxy at 0.24 kg a.i ha$^{-1}$ irrespective of the follow up treatments and weeding up to 16 WAP resulted in comparable rhizome yield and numbers to the maximum. Furthermore, in both years, application of pre-emergence herbicide irrespective of the follow up treatments and plots weeded beyond 12 WAP resulted in significantly higher rhizome yield and numbers than the weedy check. In both years, the lowest number of rhizomes was recorded on the weedy check plots (Table 5). The higher yield on the plots weeded up to 20 WAP was as a result of long seasoned weed control on the plots which make the environmental resources available to the crop alone. This implies that, mango ginger being a long duration crop also needs a long weed free period to maximize its full potential. Also, the higher yield on plots treated with oxy at 0.24 kg a.i ha$^{-1}$ irrespective of the follow up treatments and weeding up to 16 WAP was because of extended weed free period beyond 12 WAP. Also, integrated weed management approach of oxy at 0.24 kg a.i ha$^{-1}$ fb hoe weeding improves the crop vigour by further suppressing weeds thereby making more growth resources available to mango ginger for utilization. This result is similar to the findings of Peer et al. (2013) that hand weeding twice as well as application of pre-emergence herbicide

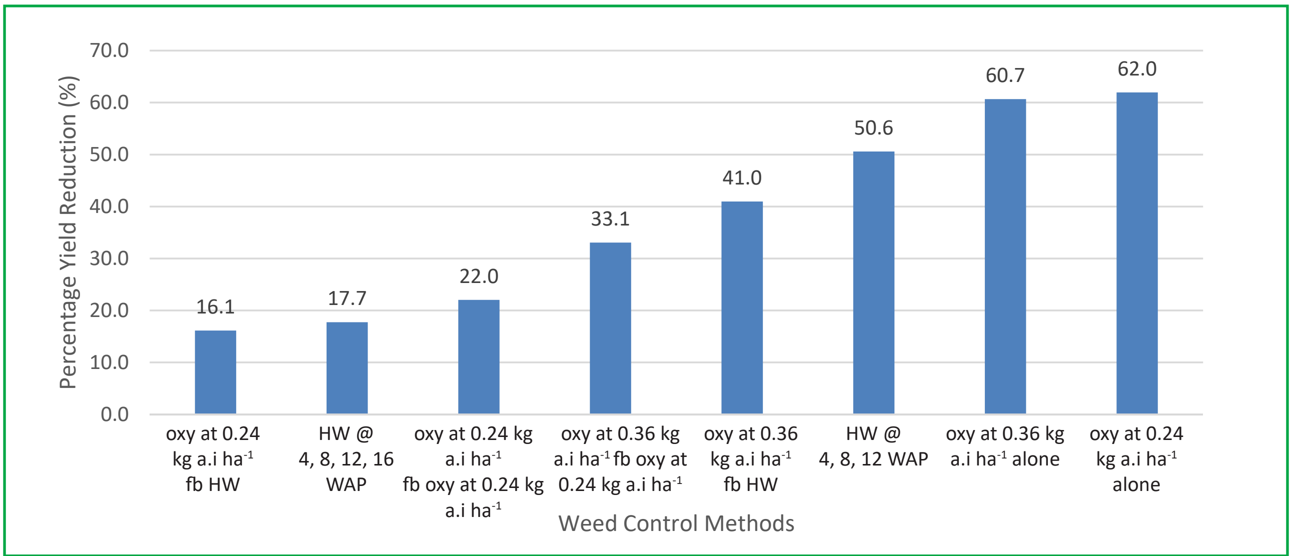


**Figure 3** Percentage rhizome yield reduction of mango ginger relative to plots weeded at 4, 8, 12, 16 and 20 WAP in both years

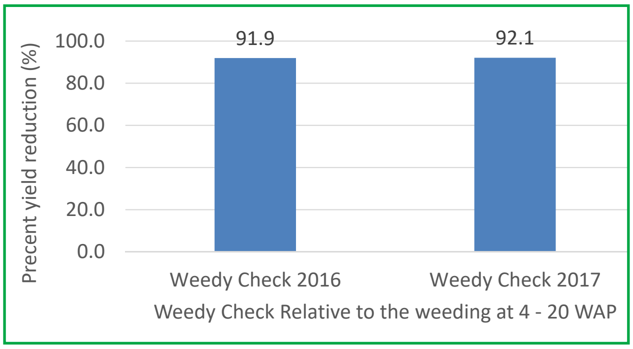


**Figure 4** Percentage rhizome yield reduction of mango ginger in the weedy check relative plot weeded at 4, 8, 12, 16 and 20 WAP

of fluchloralin and pendimethalin integrated with hand weeding recorded far superior yields of soybean seed. Also, a number of researchers like Sivakumar et al. (2019) held similar views and reported more ginger rhizome with integrated use of herbicides with hand weeding. Application of only pre-emergence herbicide throughout crop life cycle irrespective of the rates and those weeded for 4, 8 and 12 WAP resulted in 50% and more rhizome yield reduction relative to the maximum of those weeded at 4, 8, 12, 16 and 20 WAP (Figure 3). Uncontrolled weed interference resulted in 91.9% and 92.1% rhizome yield reduction in 2016 and 2017, respectively (Figure 4). This result corroborates the findings of Sivakumar et al. (2019) who reported 88% yield reduction in ginger as a result of uncontrolled weed growth.

## 4 Conclusions

This study showed that different weed control methods had different effect on weed biomass, growth, and yield of mango ginger. There was 75.9% to 97.4% reduction in weed biomass as a result of different weed control methods relative to the weedy check. Application of only pre-emergence herbicide throughout crop life cycle irrespective of the rate of application resulted in 60.7% to 62.0% reduction in rhizome yield relative to the maximum across the two years. While weeding thrice at 4, 8 and 12 WAP resulted in 50.6% yield reduction. Uncontrolled weed interference resulted in 91.9% and 92.1% rhizome yield reduction in 2016 and 2017, respectively. This study reveals that, mango ginger being a long-seasoned crop should be kept weed free beyond 12 WAP for acceptable yield. Therefore, for yield reduction less than 50% pre-emergence herbicide should be followed up by a post emergence treatment or plots weeded beyond 12 WAP where there is no pre-emergence herbicide application.

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