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**On-field assessment of critical period of weed interference in okra  
[*Abelmoschus esculentus* (L.) Moench] field in Ibadan, a rainforest-savanna  
transition eco-zone of Nigeria**

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**Abstract**

The critical period of weed interference is defined as the period in the life cycle of a crop during which it must be kept free of weeds to prevent unacceptable yield losses. The critical period of weed interference in okra [*Abelmoschus esculentus* (L.) Moench] was determined in the field trials during two cropping seasons (2006 and 2007) in the crop garden of the Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan located in the rainforest-savanna transition ecological zone of Nigeria. The study, consisting of two sets of treatments was carried out in a randomized complete block design with three replicates. In the first set of treatments, the crop was kept free of weeds for the first 2, 4, 6 and 8 weeks after planting (WAP) and subsequently weeds were allowed to grow (weed-free then weedy, WF-WD) until harvest, to determine the growth stage at which emerging weeds would no longer reduce the crop yields. In the second set of treatments, weeds were permitted to grow with the crop for an increasing length of time as listed above and subsequently the plots remained weed-free (weedy then weed-free, WD-WF) to determine the period at which weeds emerging with the crop began to suppress the growth of the crop and reduce its yield. Season-long weed-free (WD-0-WF) and weedy (WF-0-WD) treatments served as checks to compare weed competition and yield losses with other treatments. Season-long weed interference with okra resulted in 42.3% and 33.3% reduction in plant height, 54.9% and 45.5% reduction in stem diameter and 71.2% and 79.5% reduction in okra shoot dry weight in 2006 and 2007, respectively. Weeds that interfered with okra from 2 WAP resulted in 79.8% and 72.5% fresh fruit yield reduction in 2006 and 2007 respectively, and weed interference with okra from 8 WAP resulted in 19.8% and 19.6% yield losses in 2006 and 2007, respectively. Thirty one (31) weed species were enumerated in the study area with dicotyledons being the most prevalent (80.7%). The most important of the weed species among the dicotyledons was *Synedrella*

*nodiflora* (RIV=12.5%) and among the monocotyledons was *Panicum repens* (RIV=9.5%). The Shannon-Wiener Index and Equitability index for the community was 2.804 and 0.817, respectively. In 2006, weeds that interfered with okra for the first 2 WAP resulted in 17% yield reduction while the season-long interference resulted in a 90.2% yield reduction. Also in 2007, competition between weeds and okra for the first 2 WAP and season-long interference resulted in 16.4% and 92.2% fresh fruit yield reduction, respectively. Results in the two cropping seasons showed that, to prevent >10% fruit yield losses in okra, the field must be kept free of weeds throughout the entire growing cycle.

**Keywords:** Competition, critical period, diversity indices, okra, weed-crop interference, yield losses.

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## Introduction

The critical period of weed interference (CPWI) is one of the baseline information necessary to evolve effective weed management strategies. CPWI is the portion of the life cycle of a crop during when it must be kept free of weeds to prevent unacceptable yield loss (Acker *et al*, 1993; Martin *et al*, 2001). It helps to determine the sensitivity of a crop to early competition from weeds, and the period of weed control in the crop necessary to prevent yield loss from late emerging weeds (Webster *et al*, 2007).

The CPWI is essential in the timing of weed control and in labour management. For example, in hand pulling weed control method in which weeds must be large enough to provide good grip for uprooting, information on CPWI will guide on the latest time that application can be delayed to avoid competition with crop. Also, information on CPWI is essential in order to develop efficient herbicide application (pre-emergence and post-emergence) and to provide a logical basis for the development of an integrated weed management system (Hall *et al.*, 1992). The study of CPWI involves two components, weed-free-weedy (wf-wd) and weedy-weed-free (wd-wf) components. The wf-wd component determines the duration that weed control efforts must be maintained to prevent crop yield loss from weeds emerging later. It is essential on the choice of pre-emergence herbicide for weed control in a particular crop. The component also helps in timing of cover crop seeding and cultivations (Hall *et al.*, 1992). The cover crop seeding should be timed to ensure that emerging seedlings do not interfere with the crop performance. The wd-wf component determines the length of time that weeds emerging with a crop can remain before reducing its yield. It is essential in the timing of application of post-emergence herbicides and manual hand-weeding.

Okra [*Abelmoschus esculentus* (L.) Moench] is a member of the plant family Malvaceae cultivated in all agro-eco zones in Nigeria for its immature fruits and leaves consumed as vegetable. The immature fruits and leaves, utilized in soup as thickener, are rich sources of vitamins and minerals. One of the major constraints to okra production is weeds, which must be controlled up to 9 weeks after planting (Adejonwo *et al*, 1989). Yield loss as a result of uncontrolled weeds in okra fields was reported to be up to 91% in the Nigerian northern guinea savanna (Adejonwo *et al*, 1989). Comparing fruit yield on uncontrolled weed plot to plastic mulch plot, Olabode *et al* (2006) reported 85% loss in the southern guinea savanna.

The objective of this study was to define the period at which okra [*Abelmoschus esculentus* (L.) Moench] is most sensitive to weed competition in a mixed weed species farm environment to facilitate the planning and implementation of weed management strategies.

## Materials & Methods

The study was carried out during the wet seasons (July – September) of 2006 and 2007 in the crop garden (latitude 7°27.076<sup>1</sup>N; longitude 3°53.824<sup>1</sup>E; elevation 218 m asl) of the Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan, in the rainforest-savanna transition ecological zone of Nigeria. The vegetation is a mosaic vegetation of fire tender trees and secondary grassland. The field used had a natural occurring population of mixed weed species of both dicots and monocots. The soil in the garden is sandy-loam, slightly acidic (pH 6.7) and quite low in organic matter and various nutrients (Awodoyin *et al.*, 2007). The total annual rainfall in 2006 and 2007 were 1038.95 mm and 1341.82 mm, respectively, but the total rainfalls during the experimental period in the two years were 438.50 mm and 423.25 mm, respectively. The rainfall:evaporation (R:E) ratios in the two years were 0.88 and 1.09, respectively, and during the experimental period the ratios were 2.46 and 2.15, respectively.

The study was made of two sets of treatments carried out in a randomized complete block design replicated three times. In the first set of treatments, the crop was kept free of weeds for the first 2, 4, 6 and 8 weeks after planting (WAP) and subsequently weed-infested (weed-free-weedy, **WF-WD**) till harvest to determine when emerging weeds would no longer reduce the crop performance. In the second set of treatments, weeds were permitted to grow with the crop for an increasing length of time as listed above and subsequently weed-free (weedy-weed-free, **WD-WF**) to determine when weeds emerging with the crop began to suppress the growth of crop and reduce its yield. Season-long weed-free (WD-0-WF) and weedy (WF-0-WD) treatments served as checks to compare other treatments and assess the crop yield loss due to uncontrolled associated weeds.

The seeds of okra variety NHAe47-4 used for the study was obtained from the National Horticultural Research Institute, Ibadan. The variety is day neutral and early maturing. In the two years the variety commenced flowering at about 45 days after planting. At 12 WAP, three randomly selected plants of okra were assessed for plant height using meter rule. The plants were cut at soil level, packed in envelopes, dried in a Gallenkemp oven at 80°C to a constant weight and weighed using model P1210 top-loading mettler balance to determine the shoot dry weight. The fruits of okra were collected at maturity twice every week from August 7 to September 15 in 2006 and August 6 to September 21 in 2007. The cumulative total number of marketable fruits per plant and fresh fruit weight per plant were used to assess the effects of treatments on yield. The yield in each treatment was compared to the weed-free check (wd-0-wf) to obtain the relative yield. These were plotted against duration of interference to obtain the ‘critical period’, which was taken to be the period in between the two components when yield reduction was less than 10%. The yield loss caused by each treatment was calculated as:

$$\{[(\text{Yield on weed-free plot} - \text{Yield on Treatment}) / \text{Yield on Weed-free}] \times 100\} \%$$

For the weed species assessment, a 25 cm square quadrat was laid at the centre of each plot on September 4 in 2007 when the last set of treatments were applied. In which case plots that received the treatments wf-2-wd, wf-4-wd, wf-6-wd, wf-8-wd and wd-0-wf (weed-free) had been re-infested by weeds for 8, 6, 4, 2 and 1 week(s), respectively and those that received treatments wd-2-wf to wd-8-wf and wf-0-wd (weedy) were re-infested for 2 and 10 weeks, respectively. In 2007 the weeds that rooted within the quadrat were identified up to species level and the number of each counted and recorded. These were used to determine the relative importance value (RIV) for each species in each treatment as follows:

RIV (%) =  $[(RD + RF)/2]$ ; where RD = relative density, RF = relative frequency.

The density, relative density, frequency and relative frequency for each weed species were calculated following Kent and Coker (1996).

Data were analysed by ANOVA to compare the treatments and the means were separated using the least significant (LSD) at 5% level of probability.

## Results

### Growth and Yield

The mean plant height growth ranged from 50.9 cm in weedy till harvest to 82.1 cm in weedy for only 2 WAP (Table 1). The treatments were significantly different ( $P < 0.05$ ) with regards to plant height, however the weedy for only 2 WAP (wd-2-wf) and weed-free throughout (wd-0-wf) were not significantly different in the two years. Competition of weeds with okra from 4 – 8 WAP significantly reduced the height. Weed-free for only 2 WAP (wf-2-wd) and weedy for the first 6 and 8 WAP were not significantly different.

Plants on the weed-free plots had the highest (37.0g/plant) shoot dry weight that was not significantly different from those on plots that were weed-free from 2 WAP, but both were significantly ( $P < 0.05$ ) better than other treatments (Table 2). Weeds that emerged at 8 WAP and delaying weed removal until 4 WAP reduced the shoot dry weight by 17.84% and 19.46%, respectively.

The differences between treatments with regards to total number of fruits per plant were highly significant ( $P < 0.001$ ) between treatments. The number of fruits per plant ranged from 9.3 in weedy throughout to 30.4 in weed-free throughout (Table 3). Weeds that emerged as late as 8 WAP (wf-8-wd) and delaying weeding for as early as 4 WAP (wd-4-wf) significantly ( $P < 0.05$ ) reduced the number of marketable fruits harvested per plant.

Among the duration of interference, the fruit fresh weight ranged from 17.5 g/plant in weedy throughout to 198.5 g/plant in weed-free throughout. The latter was significantly ( $P < 0.05$ ) better than all other treatments.

### Weed interference with okra fruit yield, Weed biomass and species spectrum and Critical Period of Weed Interference

In 2006, interference of weeds with okra from 2 WAP (wf-2-wd) resulted in 79.8% yield reduction and interference from 8 WAP (wf-8-wd) had 19.6% yield reduction (Table 4). In 2007, weeds that were permitted to interfere with okra from 2 WAP resulted in 72.5% yield decline and when permitted to interfere with the crop from 8 WAP, a 34.3% yield loss was obtained. In 2006, weeds that interfered with okra for only 2 WAP (wd-2-wf) resulted in 17% yield reduction and season-long interference of weeds with okra (wf-0-wd) had 90.2% yield loss. However, in 2007 weeds that grew with okra for only 2 weeks resulted in 16.4% yield reduction and season-long infestation resulted in 92.2% yield reduction (Table 5).

From this study, the critical time for removal of weeds in okra in the two years was at less than 2 WAP and the critical weed-free period is at beyond 8 WAP (Figure 1). Therefore, to avoid fruit yield loss  $> 10\%$  due to mixed weed interference, the field must be kept free of weeds throughout the entire growing cycle.

A total of thirty one (31) weed species was enumerated in all the plots, with 25 (80.7%) dicotyledon species and six (19.3%) monocotyledon species. *Synedrella nodiflora* Gaertn had

the highest relative importance value (RIV=12.5%), followed by *Oldelandia corymbosa* L. (RIV=11.2%), *Laportea aestuans* (L.) Chew (RIV=11.0%), *Panicum repens* L. (RIV=9.5%) and *Tridax procumbens* L. (RIV=9.4%) (Table 6).

**Table 1.** Effect of period of weed interference on the height growth (cm) per plant of okra at Ibadan, Nigeria in 2006 and 2007 growing seasons. (Values for each year are mean±SE; n=3).

Period of Interference	Plant Height (cm/plant)		Treatment Mean
	2006	2007	
Wf-2-Wd	56.7±2.6	60.5±0.6	<b>58.6</b>
Wf-4-Wd	60.3±3.5	64.8±1.9	<b>62.5</b>
Wf-6-Wd	66.8±3.7	69.5±4.1	<b>68.2</b>
Wf-8-Wd	68.4±4.5	66.5±5.9	<b>67.4</b>
Weed-free till harvest (Wd-0-Wf)	84.3±2.7	79.2±10.5	<b>81.8</b>
Wd-2-Wf	78.3±3.4	85.8±5.8	<b>82.1</b>
Wd-4-Wf	66.9±2.8	72.8±4.4	<b>69.8</b>
Wd-6-Wf	50.3±2.4	65.2±2.3	<b>57.8</b>
Wd-8-Wf	49.4±3.1	54.2±5.1	<b>51.8</b>
Weedy till harvest (Wf-0-Wd)	48.6±3.2	52.8±2.4	<b>50.9</b>
<b>Year Mean</b>	<b>63.0</b>	<b>67.1</b>	

The LSD<sub>(0.05)</sub> to compare Year means = 2.3; Overall Treatment means = 9.0; Treatment means (in year) = 12.77. CV (year) = 3.2%; CV(treatment) = 11.8%.

Wf-n-wd = weed-free for n weeks after planting and subsequently weedy till harvest;

Wd-n-wf = weedy for n weeks after planting and subsequently weed-free till harvest.

**Table 2.** Effect of period of weed interference on the shoot dry weight per plant of okra at Ibadan, Nigeria in 2006 and 2007 growing seasons. (Values for each year are mean±SE; n=3).

Period of Interference	okra shoot dry weight (g/plant)		Treatment Mean
	2006	2007	
Wf-2-Wd	14.7±1.1	13.2±0.6	<b>14.0</b>
Wf-4-Wd	21.9±2.9	25.4±1.2	<b>23.6</b>
Wf-6-Wd	23.7±1.8	27.5±0.4	<b>25.6</b>
Wf-8-Wd	31.3±2.1	29.4±0.9	<b>30.4</b>
Weed-free till harvest (Wd-0-Wf)	37.8±2.7	36.2±2.1	<b>37.0</b>
Wd-2-Wf	35.3±2.8	34.6±2.9	<b>35.0</b>
Wd-4-Wf	29.6±2.6	30.4±0.5	<b>29.8</b>
Wd-6-Wf	23.4±2.7	21.1±2.3	<b>22.2</b>
Wd-8-Wf	14.6±2.6	10.6±1.3	<b>12.6</b>
Weedy till harvest (Wf-0-Wd)	10.9±1.4	7.4±0.7	<b>9.2</b>
<b>Year Mean</b>	<b>24.3</b>	<b>23.5</b>	

The LSD<sub>(0.05)</sub> to compare Year means = 3.3; Overall Treatment means = 4.1; Treatment means (in year) = 5.8. CV (year) = 12.3%; CV(treatment) = 14.7%.

Wf-n-wd = weed-free for n weeks after planting and subsequently weedy till harvest;

Wd-n-wf = weedy for n weeks after planting and subsequently weed-free till harvest.

**Table 3.** Effect of period of weed interference on the total number of marketable fruits per plant of okra at Ibadan, Nigeria in 2006 and 2007 growing seasons. (Values for each year are mean±SE; n=3).

Period of Interference	Total number of marketable fruits (No./plant)		Treatment Mean
	2006	2007	
Wf-2-Wd	8.3±1.2	9.1±0.7	<b>8.7</b>
Wf-4-Wd	11.6±1.9	12.4±0.9	<b>12.0</b>
Wf-6-Wd	20.7±2.4	22.1±1.0	<b>21.4</b>
Wf-8-Wd	23.0±2.8	23.2±1.9	<b>23.1</b>
Weed-free till harvest (Wd-0-Wf)	30.3±2.8	30.5±2.4	<b>30.4</b>
Wd-2-Wf	29.0±2.5	25.3±2.8	<b>27.2</b>
Wd-4-Wf	18.3±3.7	18.5±2.3	<b>18.4</b>
Wd-6-Wf	13.7±2.4	16.1±2.1	<b>14.9</b>
Wd-8-Wf	11.7±0.6	11.3±1.9	<b>11.5</b>
Weedy till harvest (Wf-0-Wd)	9.3±2.1	9.3±1.2	<b>9.3</b>
<b>Year Mean</b>	<b>17.6</b>	<b>17.8</b>	

The LSD<sub>(0.05)</sub> to compare Year means = 1.4; Overall Treatment means = 4.3; Treatment means (in year) = 6.1. CV (year) = 6.2%; CV(treatment) = 20.7%.

Wf-n-wd = weed-free for n weeks after planting and subsequently weedy till harvest;

Wd-n-wf = weedy for n weeks after planting and subsequently weed-free till harvest.

**Table 4.** Effect of period of weed interference on the cumulative fresh fruit weight per plant of okra

at Ibadan, Nigeria in 2006 and 2007 growing seasons. (Values for each year are mean±SE; n=3).

Period of Interference	Cumulative fresh fruit weight (g/plant)		Treatment Mean
	2006	2007	
Wf-2-Wd	41.5±5.9	52.8±10.7	47.2
Wf-4-Wd	81.4±7.2	73.7±7.7	77.5
Wf-6-Wd	140.8±17.5	96.3±7.2	118.6
Wf-8-Wd	164.9±15.0	126.1±15.0	145.5
Weed-free till harvest (Wd-0-Wf)	205.2±20.3	191.8±19.8	198.5
Wd-2-Wf	170.3±20.9	160.3±22.4	165.3
Wd-4-Wf	160.4±18.5	106.2±5.8	133.3
Wd-6-Wf	94.4±11.2	66.2±6.3	80.3
Wd-8-Wf	65.6±12.1	31.2±4.5	48.4
Weedy till harvest (Wf-0-Wd)	20.1±6.6	15.0±2.7	17.5
<b>Year Mean</b>	<b>114.5</b>	<b>92.0</b>	

The LSD<sub>(0.05)</sub> to compare Year means = 18.0; Overall Treatment means = 28.1; Treatment means (in year) = 39.8. CV (year) = 15.7%; CV(treatment) = 23.3%.

Wf-n-wd = weed-free for n weeks after planting and subsequently weedy till harvest;

Wd-n-wf = weedy for n weeks after planting and subsequently weed-free till harvest.

**Table 5.** Effect of period of weed interference yield reduction per plant of field-grown okra relative to weed-free plots at Ibadan, Nigeria in 2006 and 2007 growing seasons. (n=3).

	Wf-2- wd	Wf-4- wd	Wf-6- wd	Wf-8- wd	Weed- free	Wd-2- wf	Wd-4- wf	Wd-6- wf	Wd-8- wf	weedy
<b>% Yield Reduction</b>										
<b>2006</b>	79.8	60.3	31.4	19.6	0.0	17.0	21.8	54.0	68.0	90.2
<b>2007</b>	72.5	61.6	49.8	34.3	0.0	16.4	44.6	65.5	83.7	92.2

Wf-n-wd = weed-free for n weeks after planting and subsequently weedy till harvest;

Wd-n-wf = weedy for n weeks after planting and subsequently weed-free till harvest.

**Table 6.** The species richness and relative importance values (RIV%) of the weed species identified under the various period of weed interference treatments in 2007.

Weed species	Wf- 2- wd	Wf-4- wd	Wf-6- wd	Wf-8- wd	Weed- free	Wd- 2-wf	Wd- 4-wf	Wd- 6-wf	Wd- 8-wf	weedy	Overall
<b>Relative Importance Value (%)</b>											
<b>Dicotyledon species</b>											
<i>Ageratum conyzoides</i> L.	18	11.23	5.4	6.1				13		5.9	<b>6.3</b>
<i>Amaranthus spinosus</i> L.						5.3					<b>0.45</b>
<i>Asystasia gangetica</i> (L.) T. Anders			3.9		8.2		4		13		<b>1.4</b>
<i>Celosia leptostachyus</i> L.			3.9							2.4	<b>1.4</b>
<i>Chromolaena odorata</i> (L.) R.M. King & Robinson			5.5							2.4	<b>0.45</b>
<i>Cleome ruidospermum</i> DC.		4.05					7			2.4	<b>1.2</b>
<i>Corchorus olitorius</i> L.			6.6				7				<b>1.7</b>
<i>Crotalaria retusa</i> L.	3.9									2.4	<b>0.9</b>
<i>Cyathula prostrata</i> (L.) Blume			7.7			7.3					<b>1.1</b>
<i>Desmodium scopiurus</i> (Sw.) Desv.				11				6		5.1	<b>2.6</b>
<i>Euphorbia heterophylla</i> L.	3.9				8.2	5.3				2.4	<b>1.35</b>
<i>Euphorbia hirta</i> L.				4.4			4	16			<b>2.8</b>
<i>Gomphrena celosioides</i> Mart.				4.4							<b>0.45</b>
<i>Laportea aestuans</i> (L.) Chew		11.23	24	8.6	8.2	19	17	21		3.4	<b>11</b>
<i>Oldelandia corymbosa</i> L.	11	11.23	11	6.1		10	6	9		15	<b>11.2</b>
<i>Peperomia pellucida</i> (L.) H.B. & K.								4			<b>0.45</b>
<i>Phyllanthus amarus</i> Schum et Thonn.				4.4				4			<b>0.9</b>
<i>Pouzolzia guineensis</i> Benth		4.05						6		22	<b>2.5</b>
<i>Sclerocarpus africanus</i> Jacq	12	8.62									<b>3.7</b>
<i>Senna obtusifolia</i> (L.) Irwin & Barneby					13				5		<b>0.9</b>
<i>Synedrella nodiflora</i> Gaertn.	18	11.23	13	8.6		10		7	18	13	<b>12.5</b>
<i>Talinum fruticosum</i> (L.) Juss.			3.9					10	7		<b>2.8</b>
<i>Tithonia diversifolia</i> (Hemsl.) A. Gray			3.9	4.4				4	7	13	<b>3.5</b>
<i>Trianthema portulacastrum</i> L.	3.9			6.1	8.2	5.3					<b>2.05</b>
<i>Tridax procumbens</i> L.	15	17.32		16		8.7		9	22	3.4	<b>9.4</b>
<b>Monocotyledon species</b>											
<i>Acroceras zizanioides</i> Dandy		4.05		8.8		7.3			5		<b>2.2</b>
<i>Commelina benghalensis</i> L.		4.05	3.9	5.9					13		<b>2.2</b>
<i>Cyperus rotundus</i> L.								4			<b>0.45</b>
<i>Mariscus alternifolius</i> Vahl.					34						<b>0.45</b>
<i>Panicum repens</i> L.	16	12.97					16	6	13	16	<b>9.5</b>
<i>Setaria barbata</i> (Lam.) Kunth	3.9			6.1	21						<b>1.6</b>
<b>Species Richness (S)</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>14</b>	<b>7</b>	<b>10</b>	<b>15</b>	<b>10</b>	<b>6</b>	<b>19</b>	<b>31</b>
<b>Shannon-Wiener Index (H<sup>1</sup>)</b>											<b>2.804</b>
<b>Equitability Index (J)</b>											<b>0.817</b>
<b>Dominance Index (D)</b>											<b>0.084</b>

Wf-n-wd = weed-free for n weeks after planting and subsequently weedy till harvest;

Wd-n-wf = weedy for n weeks after planting and subsequently weed-free till harvest.

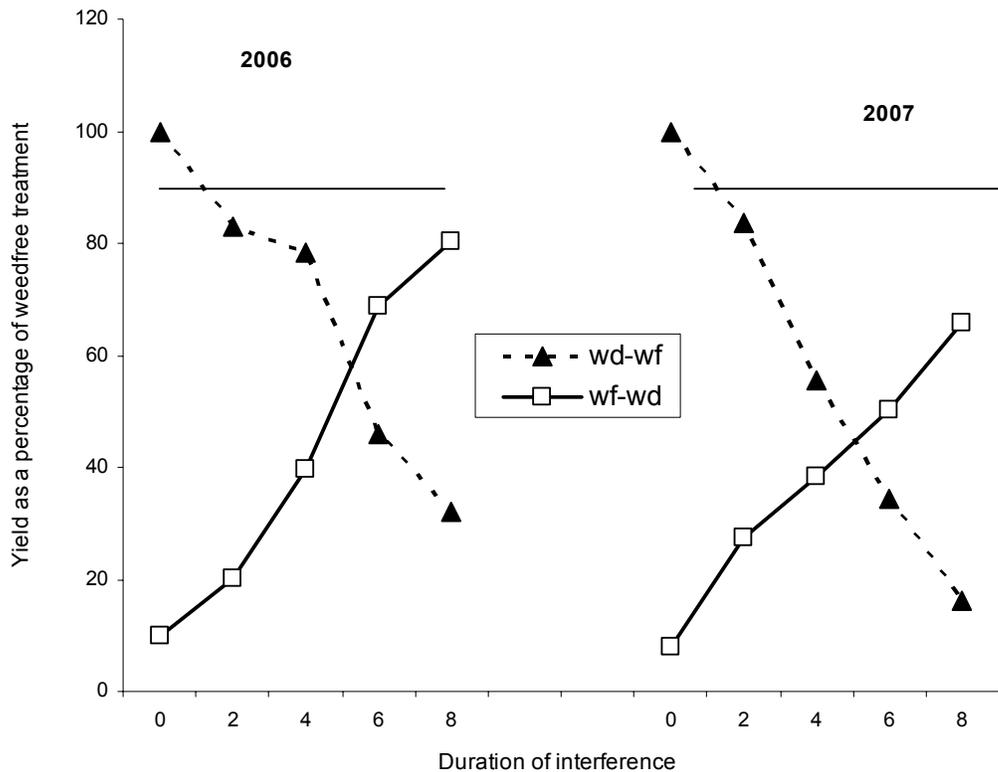


Figure 1. The critical period of weed interference in field-grown okra at Ibadan, Nigeria in 2006 and 2007 - percentage fruit yield relative to the yield on weed-free control [w d-w f = weedy and subsequently weed-free; w f-w d=weed-free and subsequently weedy]

## Discussion

The response of okra to the varying duration of weed competition followed the same trend in the two years. Though weed re-infestation from 8 WAP and delaying weeding for only 2 WAP were not significantly different from weed-free in respect of the weed dry weight, the fruit yields in the two treatments were significantly less than weed-free. This may explain the high sensitivity of okra to weed infestation in this agro-ecosystem. Therefore, it can be inferred that the critical period for removal of weeds in okra in the agro-ecosystem was at less than 2 WAP and the critical weed-free period was at beyond 8 WAP. Hence, to avoid fruit yield loss >10% due to mixed weed interference, the okra fields must be kept free of weeds throughout the entire growing cycle.

The implication of the results is that adequate provision must be made for a consistent weed control in okra fields in the rain-forest, and that if post-emergent herbicide will be used, application must not be delayed up to 2 WAP. Applying herbicide at this early stage of growth may be a threat to the young okra seedlings, therefore pre-planting application method may be adopted. In this case, the crop planting will be delayed for at least two weeks after field preparation. The weeds that will have emerged will be killed by a post-emergent herbicide at planting. This may give the crop a good start with minimal weed interference. However, other weed control measures that will delay weed re-infestation, like mulching, will indeed benefit okra plants. Olabode *et al.* (2006) reported that plastic and grass (*Panicum maximum*) mulches

significantly enhanced the performance of rain-fed okra in the southern guinea savanna of Nigeria. Also, the results inform that inter-planting okra with a cover crop or mulch plant for *in-situ* generation of mulch may not be appropriate as the interplants, even if introduced as late as 8 WAP, will interfere with okra performance.

## Conclusion

In the dry rainforest ecological zone of Nigeria, okra fields must be kept weed-free for almost the entire growing cycle. As a result of this high sensitivity of okra to weed competition, mulching may be integrated with other weed control strategies to reduce the rate of weed re-infestation. Mulch materials can only be sourced *ex-situ*, as interplanting with a green manure plant to generate mulch *in-situ* at the spacing used in this study will interfere with okra performance.

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