



**CRITICAL PERIOD FOR CROP-WEED COMPETITION IN GROUNDNUT
(*Arachis hypogaea* L.) UNDER WET SEASON IN THE NORTHERN GUINEA AND
SUDAN SAVANNA OF NIGERIA**

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ABSTRACT

Field experiment was conducted during 2019 wet season to determine the critical period of weed control and its effects on the crop growth, yields, and yield components of groundnut at the Institute for Agricultural Research (IAR) Farm Ahmadu Bello University, Samaru and the Irrigation Research Kadawa, Nigeria. Two series of treatments with six weed-free (WF) and weed-infested (WI) periods were employed in the study. From the emergence of groundnut to maturity, the plots were kept weed-free for 2, 4, 6, 8, 10 weeks after sowing (WAS) and weeds were allowed to grow until harvesting of the groundnut and vice-versa before weeding. The treatments were laid out in a Randomized Complete Block Design with 3 replications. The weed density and biomass, growth and yield attributes and yield were recorded. The result showed that weed free period did not significantly influence shelling %, 100-seed weight and stand count of groundnut. Total dry matter, plant height, canopy spread and leaf number per plant were observed to increase with removal of weeds but decreased with delay in removal of weeds. The depletion of resource by weed resulted in scarcity of resources and ultimately crop plants had less number of pod per plant, pod weight and seed yield per hectare. The highest percent weed accumulation, weed removal, pod yield loss and pod yield gain all were observed between 4 and 8 WAS, suggesting the period to be the stage that is critical to avoid competition with weeds. In conclusion, the critical weed removal for maximum yields was found to be 4 weeks, beginning 4 weeks after sowing and ending 8 weeks after sowing.

Keywords: Critical, Period, Weed, Competition, Groundnut

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is one of the major important oil seed and legume crop cultivated extensively in the world. It is valued for its high oil content and edible seeds as well as essential minerals and vitamins. It is consumed by almost all countries, despite the differences in food synthesis preparation. It contains about 49 – 50% oil and 25 – 28% protein in the kernels and 100g of kernels provide 567 Kcal energy. (Haruna and Ahmed 2018). It is one of the legume crops extensively grown in Nigeria particularly in the northern states. Groundnut is a warm season crop, growing over 150 m of altitude above sea level with a rainfall of 308 – 1000mm (FAO 2020). Nigeria is endowed with suitable climatic and edaphic condition for its production, and has possibly the highest potential than any country in Africa. The crop is one of the important staple food in Nigeria. All part of the crop is valuable. They play a role in dietary requirement of resource poor women and children and its haulms are used in livestock feeds. Groundnut production has the capability to provide employment and increase the income level of farmers in Nigeria. However the productivity of the crop under farmers field conditions is low (800 kg/ha⁻¹ of groundnut seed on the average) compared to its yield level under farmers condition in other part of the world.

Groundnut production depends on several factors. Among which lower yield as a result of weed interference is of supreme importance (Nadeem *et al* 2013). They interfere with crop growth if not regulated resulting in a decrease in production and, in severe cases, crop failure (Liewellyn *et al* 2016). The yield losses due to weeds have been reported to vary from 16 to 68 percent in cultivated crops under different agro-climatic conditions (Santosh Korav 2018). In Nigeria groundnut yield loss could be as high as 51% (Etejere *et al* 2013). There are certain stages in crop growth period when weeds are more harmful to crop growth and yield. The critical weed crop competition period is very



important for planning efficient weed control strategy. Removal of weeds throughout the crop season may not be economical. The exact critical period of crop weed competition during the growing period of groundnut has to be determined in order to avoid extravagant expenses on weed management. Timely control of weeds is very essential (Adhikary *et al* 2016) not only to check the yield loss caused by weeds but also to increase the resources used efficiency and thereby productivity of groundnut. Critical weed competition period varies with season and nature of crops and weeds. The competition for moisture, nutrient and sunlight between the weeds and the crops affect crop yield unless a good control of weeds is achieved sustainable yield loss may occur which are more in rainfed than in irrigated condition (Jat *et al* 2011). Experimental evidence indicating precise and accurate information on crop growth stage at which weed must be removed to maximize groundnut use and the periods when weeds may be allowed to grow without any adverse weed effect on the yield are lacking in this guinea and sudan savannah regions of Nigeria. Hence the present investigation was undertaken.

MATERIALS AND METHODS

Experimental Sites

The field experiments were conducted under rainfed condition during the rainy season of 2019 to determine the critical period of weed control and the effect of weed on growth and yield component of groundnut at the research farm of the institute for Agricultural Research (IAR) Samaru, Zaria (Latitude 11° 11'N, Longitude 07° 38'E, 686M above sea level) in the northern guinea Savanna Zone and irrigation Research Station of the IAR at Kadawa (Latitude, 11° 39' N, Longitude 08° 27'E, 500m above sea level) in the Sudan Savanna Zone of Nigeria. The experimental sites in these regions were both characterized by a unimodal rainfall pattern which have their peak in the month of August. The data on rainfall distribution, temperature, sunshine, and relative humidity in 2019 wet season were collected (Table 1). The experimental lands in both locations are high in topography and soils were sandy loam in texture (Table 2).

Table 1: Physico-Chemical Properties of Soils (0-15 cm) of the Experimental Sites at Both Locations

Description	Value	
	Samaru	Kadawa
Soil Texture	Loamy Sand	Loamy Sand
Sand (%)	81.700	87.200
Silt (%)	12.900	11.400
Clay (%)	5.400	1.400
pH (1:2:5)	6.410	6.600
Carbon Exchange Capacity (CEC)	5.860	3.600
Total Nitrogen (%)	0.928	0.047
Extractable phosphorus (ppm)	43.000	29.000
Exchangeable potassium (ppm)	91.000	41.000
Organic matter (%)	0.590	0.560

Treatments, Experimental Design and Procedures

The experiment consisted of two sets of treatments. One set comprised of plots from which weeds are removed using West African hand hoe at bi-weekly intervals for 2, 4, 6, 8, 10 weeks after sowing (WAS) and thereafter kept weed-infested until harvest and at harvest. The other set of treatments consisted of plots initially kept weed-infested for corresponding periods and thereafter kept weed-free until harvest. Two treatments of weed infested and weed free plots throughout the crop life cycle were also included as the checks. Apart from the treatment kept as checks are six treatment laid out in a Randomized Complete Block Design (RCBD) replicated three times. The lands were ploughed, harrowed to a fine tilth and ridged at 75 cm spacing using on ox-drawn ridger. The gross plot size consisted of six ridges, measuring 4 m in length (6 x 4m x 0.75m = 18m²). The four inner ridges constitute the net plot each measuring 4 x 4m x 0.75 m = 12m².



Sowing was done on the 20 June in Samaru and on 22 June in Kadawa using treated seeds of groundnut variety of SAMNUT 24. SAMNUT 24 is a semi-erect, medium maturing variety (90 – 100 days) sourced from the seed unit of the Department of Agronomy ABU Zaria. Three seeds per hole was sown at a depth of 2cm using intra-row spacing of 20cm along the row and the resultant seedling was thinned to 2 seeds per hole. The recommended dose of fertilizer for groundnut was 20 kg N, 40 kg P and 20 kg K per hectare. The application of nutrient at the rate of 40 kg P₂O₅ ha⁻¹ as single super phosphate (SSP 18%) and 20 kg MOP ha⁻¹ using muriate of potash (MOP) and 20kgN using Urea was done at sowing by opening top of the ridges besides the sown seeds using drilling method to insert the fertilizer.

Data Collection and Analysis

To account for the general weed flora of the experimental fields specy wise, weeds observed in the un-weeded control plots were recorded at the period of maximum appearance of crop growth stage at 6, 9 and 12 WAS. Weed density (no/m²) was sampled from a quadrant of 1m x 1m size placed at two different spots to avoide boarder rows before any weeding was done. The data were recorded at 6, 9 and 12 WAS sampled periods by physically counting the number of weeds in the quadrant before weeding at 2, 4, 6, 8, 10 WAS and at harvest when competition period was completed.

The weed dry matter was determined before weeding at 2, 4, 6, 8, 10 WAS and at harvest from the weed biomass initially sampled for weed density determination by cutting weed biomass from the 2 randomly located 1m² quadrant in each experimental plot for weighing. A sensitive balance after washing and oven drying was used. The average weight in grams was converted to kilogram per hectare for each plot.

Field data other than dry weight of weeds, weed density and stand count of crop was obtained by selecting in each plot three tagged plants for recording the observations of the growth, yield attribute and yield. The width of three tagged plants per plot was measured using a meter rule from the main stem of the plant to the tip of the youngest leaf of the longest branch. Total dry weight per plant were recorded from another set of three tagged plant excluding boarder rows randomly selected for destructive sampling in each plot. Each time samples were uprooted and washed with water, they were oven dried to a constant weight and then their dry weights were recorded.

Apart from growth attributes recorded at 3 week intervals from 3 tagged plants selected from each plot, number of pods per plant, pod weight per hectare, shelling %, stand count, 100-seed weight and seed yield of groundnut per hectare was recorded at the time of harvesting. Based on the observations made at end of each weed-free period or period without weed control, the pattern of growth and development of a completely weed-free crop and of a crop without weed control at all and of the weeds were analyzed and compared. All parameters taken were subjected to statistical analysis of variance (ANOVA). Groundnut data were processed separately.

RESULTS AND DISCUSSION

Weed Species Present at the Experimental Sites

Details of type of weed species and the level of occurrence at the sites of the experiment are presented in Table (3). Twenty two weed species were recorded during the period of crop growth in Samaru and Kadawa. The weed species comprised eleven types of broad lead weeds, nine types of grasses and two types of sedges. However there were differences in the level of weed infestation between the two locations. The level of infestation of some weed species such as *Andropogon Schiraenchis*, *Amaran thus spinosus*, *Boerhavia diffusa*, *Euphorbia heterophylla* *Axonopus compressus*, *Cynodon dactylon*, *Eleusine indica* and *Paspalun Scrobiculatum* was moderate in Kadawa but increased to a higher level in Samaru (Table 3). No species of *Chamaerista rotundi* folia was recorded in Samaru because this appeared only in Kadawa, also no species of *Paspalum. scrobiculatum* (Linn) appeared in Kaduna. Variation in the level of weed infestation between the two locations may be attributed to rainfall differences. The rainfall was generally more abundant and evenly distributed in Samaru than in Kadawa. It has been reported that rainfall affects weed species distribution and their competitiveness within a crop community (Shaidul *et al.*, 2011).

Table 2: Common Weed Species on the Experimental Sites during the Study and their Level of Infestation

		Level of infestation	
Weed species	Plant family	Kadawa	Samaru
Broad leaves			
<i>Andropogon Schiraenchis</i>	Poaceae	**	***
<i>Alysicarpus Vaginalis</i>	Fabaceae	**	**
<i>Amaranthus spinosus</i> (Linn)	Amaranthaceae	**	***
<i>Ammophila Breviligulata</i>	Poaceae	**	**
<i>Azadirachta Indica</i>	Meliaceae	**	**
<i>Boerhavia diffusa</i> (Linn)	Nyctaginaceae	**	**
<i>Chamaerista rotundi folia</i>	Fabaceae	*	*
<i>Tridas Procumbens</i> (Linn.)	Asteraceae	**	**
<i>Euphorbia heterophylla</i> (Linn.)	Euphorbiaceae	**	***
<i>Gomphrena celosoides</i> (Mart.)	Amaranthaceae	**	**
<i>Hypercom Prolificum</i>	Clusiaceae	**	**
Grasses			
<i>Axonopus compressus</i> (Sw.) P Beauv	Poaceae	**	***
<i>Bopriochloa Ischeamum</i>	Poaceae	**	**
<i>Cynodon dactylon</i> (L) Gaertn ``	Poaceae	**	***
<i>Digitatia Horizontalis</i> (Willd)	Poaceae	*	*
<i>Eleusine Indica</i> (Gaertn)	Poaceae	**	***
<i>Hordium Murinum</i>	Poaceae	*	*
<i>Panicum Maximum</i> (Jaeq.)	Poaceae	**	**
<i>Themeda Triandra</i>	Poaceae	*	*
<i>Paspalum scrobiculatum</i> (Linn)	Poaceae		**
Seedges			
<i>Cyperus rotundus</i> (Linn)	Cyperaceae	*	*
<i>Cyperus esculentus</i> (Linn)	Cyperaceae	*	*

*= Low infestation 1-29%, **=Moderate infestation 30-59%

***= High infestation 60 – 90%

Weed Density and Weed Dry Weight

From table 4 it was observed that in both locations, the duration of weed interference significantly affected weed density and weed dry weight per m². There was no significant difference in weed density and cumulative weed dry matter production during first 2 and 4 weeks in plots kept weed infested for 2 and 4 weeks only compared to weed free in same periods which agrees with report by Sathya *et al* (2012) in groundnut. Generally at all the sampling periods and at both locations plots kept weed-infested until 6, 8 10 an 12 WAS had similar and significantly higher weed density and weed dry weight than those weed-infested until 2 and 4 WAS or those kept weed-free for the various mentioned period. The least weed density and dry matter production was obtained from plots kept initially weed-free for up to harvest. The differences in the density of weeds (Table4). The completion in weed-free was because weeds were eradicated from the weed-free plots repeatedly Smitchger *et al*. (2012) has reported that the weed density and total dry weight of weeds are inversely proportional to the increase of removal periods. Those plots weed-infested initially for 2 and 4 WAS only did not differ significantly from those kept weed free initially for 6, 8, 10 and 12 WAS in weed density and weed dry weight, (Table 4).

Table 3: Effect of Duration of Weed Interference on Weed Density of Groundnut at 6, 9, and 12 WAS Sampling Periods in both Locations in 2019 Wet Season

Treatment	Weed density (no. per m ²)					
	Samaru			Kadawa		
	6 WAS	9 WAS	12 WAS	6 WAS	9 WAS	12 WAS
WF Period (WAS)						
2	39.0a	63.7a	64.4a	37.5a	53.7a	56.3a
4	37.0a	56.0a	58.8a	35.3a	53.0a	55.8a
6	26.9b	41.7b	44.2b	22.4b	34.5b	36.6b
8	22.0b	33.9b	35.7b	19.2b	29.7b	31.4b
10	17.7b	27.5b	29.0b	14.3b	22.1b	23.4b
12	25.8b	27.3b	28.7b	14.0b	21.6b	22.9b
WI Period (WAS)						
2	17.5b	27.3b	29.0b	14.5b	22.5b	23.7b
4	36.4b	56.1b	56.2a	35.5b	52.1b	55.0b
6	42.5a	66.0a	69.9a	40.0a	59.0a	62.2a
8	44.5a	69.0a	73.0a	38.7a	59.9a	63.0a
10	44.0a	68.4a	72.1a	39.9a	62.1a	65.1a
12	43.1a	66.9a	71.0a	40.1a	61.8a	64.4a
SE (±)	2.61	3.85	4.07	1.99	3.08	3.26

Means within a column followed by the same letter(s) do not differ at (0.05) level of probability using to Duncan's multiple Range Test (DMRT), WF = Weed-Free, WI = Weed Infested, WAS = Weeks after sowing

Table 4: Effect of Duration of Weed Interference on Weed Dry Weight of Groundnut at 6, 9, and 12 WAS in Both Locations in 2019 Wet Season

Treatm.	Weed dry weight (kg ha ⁻¹)					
	Samaru			Kadawa		
	6 WAS	9 WAS	12 WAS	6 WAS	9 WAS	12 WAS
WF Period (WAS)						
2	1202.9a	1784.6a	1806.5a	968.1a	1496.1a	1516.0a
4	1160.7a	1753.0a	1766.7a	950.7a	1480.0a	1512.2a
6	843.9b	1410.1b	1438.0b	592.3b	909.6b	931.0b
8	648.2b	973.1b	998.7b	428.4b	654.5b	672.3b
10	645.9b	966.9b	990.7b	427.1b	650.9b	669.0b
12	646.3b	960.4b	983.5b	421.8b	644.4b	663.4b
WI Period (WAS)						
2	663.9b	992.6b	1016.7b	445.2b	684.6b	700.3b
4	691.1b	1032.8b	1056.7b	450.8b	686.9b	706.0b
6	1206.1a	1802.8a	1849.9a	964.5a	1305.1a	1528.4a
8	1211.2a	1815.6a	1866.2a	964.5a	1519.1a	1558.2a
10	1215.1a	1804.6a	1849.4a	960.5a	1574.9a	1612.7a
12	1200.2a	1820.0a	1832.0a	966.0a	1577.5a	1625.0a
SE (±)	83.51	124.43	127.55	61.50	94.38	96.81

Means within a column followed by the same letter(s) do not differ at (0.05) level of probability using to Duncan's multiple Range Test (DMRT), WF = Weed-Free, WI = Weed Infested, WAS = Weeks after sowing



Effect of Weed Competition on Groundnut Performance

The results depicted in Table 5 - 7 showed that growth parameters of groundnut such as the canopy spread, total dry matter of groundnut/ plant and yield attributes like the number of pods / plant, pod weight / hectare and seed yield / hectare that were significantly affected by periods of weed interference.

Canopy Spread (cm):

The canopy spread which was only observed to be significant at 9 and 12 WAS in samaru, 6 and 9 WAS in Kadawa showed that weed infested crops until 6, 8, 10 and 12 WAS and the weed-free plots for 2 and 4 WAS were at par but resulted in lower canopy spread than all the other weed treatments, except at 9 WAS at Samaru where canopy spread and weed free plots at 2 and 4 WAS were statistically same. implying a longer weed free period sufficed to avoid loss. Khaliq *et al* (2012) reported reduction in leaf area due to limited use of resources from increased weed competition. Crops are known to form better canopy vis-à-vis the number of leaves and size in a less competitive situation than in weedy environment, which reflected in plots where weeds were removed. This is because growth factors such as nutrient, light, water and space were more available to crops in weed free situation that ensures good leaf formation both in number and in size.

Table 5: Effect of Weed Interference on Canopy Spread of Groundnut (cm) in Both Locations

Treatment	Canopy spread (cm)					
	Samaru			Kadawa		
	6 WAS	9 WAS	12WAS	6 WAS	9 WAS	12 WAS
WF Period						
2WAS	24.30 ^b	29.57 ^b	41.11	23.71	21.48 ^b	35.45 ^b
4WAS	26.42 ^a	31.81 ^b	42.60	17.94	27.93 ^b	37.01 ^b
6 WAS	28.76 ^a	41.81 ^a	43.90	24.62	34.89 ^b	40.08 ^a
8 WAS	32.17 ^a	48.07 ^a	51.00	27.75	44.19 ^a	46.92 ^a
10 WAS	32.0 ^a	51.0 ^a	53.55	29.31	45.05 ^a	49.37 ^a
Harvest	33.42 ^a	51.84 ^a	54.4	29.88	45.91 ^a	50.31 ^a
WI Period						
2WAS	32.66 ^a	50.84 ^a	53.90	29.82	45.61 ^a	49.0 ^a
4WAS	25.72 ^b	39.80 ^b	52.30	29.45	42.85 ^a	47.39 ^a
6 WAS	24.38 ^b	38.27 ^b	44.00	26.98	36.10 ^a	36.23 ^b
8 WAS	23.29 ^b	38.70 ^b	42.30	25.21	29.29 ^b	35.83 ^b
10 WAS	22.48 ^b	33.92 ^b	41.61	24.81	26.30 ^b	35.42 ^b
Harvest	23.26 ^b	33.96 ^b	41.81	24.11	27.30 ^b	35.38 ^b
SE (±)	2.512	3.831	4.702	2.311	3.514	4.257 ^b

Means within a column followed by the same letter(s) do not differ at (0.05) level of probability using to Duncan's multiple Range Test (DMRT), WF = Weed-Free, WI – Weed Infested, WAS = Weeks after sowing

Total Dry Matter Accumulation

At Samaru at 6, 9 and 12 WAS and at 9 and 12 WAS in Kadawa plots kept weed-free for 6, 8, 10 and 12 WAS and weed-infested until 2 and 4 WAS resulted in comparable but significantly higher total dry matter than the weed infested plots until 6, 8, 10 and 12 WAS and weed free plots for 2 and 4 WAS, except at 9 and 12 WAS at Kadawa where plots kept weed-free for 4 and 6 WAS were not significantly different (Table 6). This indicated that, a shorter weed-free period sufficed to avoid loss at Kadawa. The lower TDM/plant produced by weed-infested plots until 6 WAS up to 12 WAS and weed free for 2 and 4 WAS might have resulted from greater weed density and biomass and increased competition for available growth factors, that led to reduction in TDM/plant. The higher TDM shown by the weed free plot at increased competition periods compared with the weed infested plots could have resulted from enhanced vegetative growth by increased cell division. This was attributed to better use of available growth factors for better growth and maximum photosynthetic activities

(assimilate production). Pabitra *et al* (2016) also reported appreciable improvement in total dry matter per plant due to less weed competition attributed to lower weed density and weed dry weight.

Table 6: Effect of Weed Interference on Total Dry Matter of Groundnut in both Locations

Treatments	Total dry matter/plant (g/plant)					
	Samaru			Kadawa		
	6 WAS	9 WAS	12WAS	6 WAS	9 WAS	12 WAS
WF Period						
2WAS	22.97 ^b	23.52 ^b	30.83 ^b	16.11	23.39 ^b	28.84 ^b
4WAS	23.60 ^b	27.32 ^b	60.14 ^a	20.06	29.32 ^b	38.42 ^b
6 WAS	25.75 ^a	38.61 ^a	67.25 ^a	22.33	32.28 ^b	49.19 ^b
8 WAS	30.36 ^a	47.42 ^a	77.25 ^a	29.19	42.35 ^a	67.48 ^a
10 WAS	31.82 ^a	48.65 ^a	78.91 ^a	27.65	43.53 ^a	68.25 ^a
12 WAS	31.82 ^a	48.65 ^a	78.61 ^a	27.23	43.35 ^a	69.00 ^a
WI Period						
2WAS	30.16 ^a	48.73 ^a	78.94 ^a	29.40	43.07 ^a	68.24 ^a
4WAS	28.42 ^a	45.92 ^a	56.28 ^b	26.39	39.55 ^a	63.20 ^a
6 WAS	23.04 ^b	35.29 ^b	55.63 ^b	21.49	32.56 ^a	49.81 ^a
8 WAS	22.38 ^b	31.47 ^b	53.47 ^b	23.21	30.92 ^b	47.62 ^b
10 WAS	22.00 ^b	27.66 ^b	50.87 ^b	22.33	28.10 ^b	44.61 ^b
12 WAS	23.88 ^b	27.06 ^b	50.91 ^b	22.90	29.04 ^b	43.08 ^b
SE±	2.789	4.25	7.445	2.562	3.882	6.779

Means within a column followed by the same letter(s) do not differ at (0.05) level of probability using to Duncan's multiple Range Test (DMRT), WF = Weed-Free, WI – Weed Infested, WAS = Weeks after sowing

Yield Components of Groundnut

Pods/Plant, Pods yield (kg/ha), and Seed Yield (kg/ha)

Result as Presented in Table 7 showed that, increasing weed free periods did not influence shelling %, stand density and the 100 - seed weight. The crop performance shown by the data on yield characters such as mean number of pods/plant, mean pod weight / ha and mean seed yield / ha of groundnut at harvest observed with the weed-free plots at 6, 8, 10 and 12 WAS as well as the weed-infested at 2 and 4 WAS were more and heavier compared to all the others treatments. The non-significant effect of weed density and weed dry weight on growth and yield of groundnut in plots kept weed infested for 2 and 4 weeks only agrees with report by Sathya *et al* (2012) in groundnut, that provided weeds were subsequently removed infestation for the first 4 weeks did not have adverse effect on the growth and yield of the crop. In contrast, both the crop growth parameters, yield and yield attributes of groundnut were depressed by increasing period without weed removal until 6 WAS and more. The cumulative weed dry production from the plots was significantly high and thus depressed growth and yield with increase in the period of weed infestation in both locations. The better performance of the weed-free crops can be attributed to the increase in the number of pods/plant at kept weed free for 6, 8, 10, and 12 WAS and weed infested until 2 and 4 WAS only. The productivity of groundnut is determined by the number of pods/plant. The pods is an end product which obviously depend on dry matter production and is partitioning into reproductive parts. The role of weed removal promoted rapid growth which allowed the crops to develop more and larger leaves with consequent high light interception for increased dry matter accumulation per plant per unit area of land. A decrease in fruit bearing ability of groundnut with intensification in competition period has also been discovered by Mubeen et al 2009 in fennel plants. Weed removal until 8 WAS in weed free plots increased groundnut seed yield by 91% compared to weed removal until 4 WAS and, by 63% compared to weed removal until 6 WAS in Samaru. Whereas 87.1% increase in seed yield was observed by removal of weed until 8 WAS compared to 4 WAS and by 48.3% compared to 6 WAS in Kadawa. No significant yield increase was observed in weed removal after 8 WAS in both locations.

Table 7: Effect of Weed Interference on Number of Pods, Pod Yield, and Seed Yield of Groundnut in both Locations

Treatments	Number of Pods/plant			Pod yield/ha. (kg/ha)			Seed yield/ha. (kg/ha)		
	Samaru	Kadawa	Mean	Samaru	Kadawa	Mean	Samaru	Kadawa	Mean
WF Period (WAS)									
2	20.18 ^b	16.74 ^b	18.46 ^b	575.3 ^b	530.9 ^b	553.1 ^b	259.7 ^b	274.8 ^b	534.5 ^b
4	25.56 ^b	22.13 ^b	23.85 ^b	755.5 ^b	701.9 ^b	728.7 ^b	341.0 ^b	317.0 ^b	329.0 ^b
6	39.47 ^a	35.90 ^a	37.69 ^a	1254.6 ^a	1004.4 ^a	1129.5 ^a	556 ^a	470.0 ^a	513.0 ^a
8	40.81 ^a	37.27 ^a	39.04 ^a	1469.5 ^a	1206 ^a	1337.8 ^a	652 ^a	593.1 ^a	622.6 ^a
10	41.47 ^a	37.62 ^a	39.55 ^a	1455.6 ^a	1225 ^a	1340.3 ^a	657 ^a	592.1 ^a	624.6 ^a
12	40.88 ^a	37.36 ^a	39.12 ^a	1400.2 ^a	1229 ^a	1314.6 ^a	653 ^a	582.1 ^a	617.6 ^a
WI Period (WAS)									
2	42.00 ^a	35.50 ^a	38.75 ^a	1423.9 ^a	1221.9 ^a	1322.9 ^a	679.7 ^a	570.6 ^a	610.2 ^a
4	41.91 ^a	33.76 ^a	37.84 ^a	1419.1 ^a	1096.6 ^a	1257.9 ^a	638.6 ^a	530.0 ^a	584.3 ^a
6	34.00 ^b	26.68 ^b	33.1 ^b	1090.7 ^b	892.9 ^b	1017.1 ^b	480.8 ^b	431.6 ^b	461.2 ^b
8	32.99 ^{bc}	21.37 ^b	27.18 ^b	880.0 ^b	715.4 ^b	797.1 ^b	396.0 ^b	345.8 ^b	370.9 ^b
10	27.31 ^c	19.03 ^b	23.27 ^b	675.5 ^b	693.2 ^b	706.3 ^b	309.5 ^b	307.9 ^b	308.7 ^b
12	27.51 ^c	19.61 ^b	23.46 ^b	687.9 ^b	707.1 ^b	675.6 ^b	314.0 ^b	320.5 ^b	317.3 ^b
SE ±	1.97	1.711	1.840	131.048	96.687	113.75	59.140	53.692	56.426

Means within a column followed by the same letter(s) do not differ at (0.05) level of probability using to Duncan's multiple Range Test (DMRT), WF = Weed-Free, WI – Weed Infested, WAS = Weeks after sowing.

With regards to the start of the period for crop weed competition. The number of pods/plant was mainly determined before 10 WAS in both locations. Potential yield loss can apparently although not entirely be recovered by the removal of weed before this period. Delaying weed control until 6 WAS in Kadawa caused only a small reduction in the seed yield/ha. It was more longer periods without weed control that significantly reduced the seed yield. Thus a relatively longer period of absence of weed control after sowing could be tolerated by groundnut seed yield loss in Kadawa compared to Samaru. Significant weed growth was found in crop kept weed infested until 6 WAS to be 1438 kg/ha at Samaru while at Kadawa this was 931kg/ha. And therefore Samaru recorded more yield loss than Kadawa. With regards to the start of the period for weed-crop competition. However variation in competitive effects occurred between the two locations at growth stages and may be due to the differences in the periods of the start and end of the rains (Shaidul *et al.*, 2011) but did not clearly express in the yield at harvest.

It was observed that the weed density and cumulative weed dry matter production in plots where weeds were allowed to remain in the crop until 6 and 8 WAS did not differ significantly from those where weeds were allowed to remain in the crop until 8 and 10 WAS or throughout the crop life cycle (Table 4). Hence subsequent weed removal was therefore not expected to alleviate crop growth and there was no significant increase in the number of pods / plant in this experiment beyond 9 WAS sampling periods. And the weeds at this period probably reduced competition. Minimum reduction in pod yield of groundnut due to least weed competition was found after 8 WAS. This result has corroborated the report of Ekeleme *et al.* (2009) that there is little or no benefit of subsequent weed removal after 9 weeks of crop growth provided the crops were initially kept weed-free. And Daramola *et al.* (2019 a, b) who reported that weed growth and aggressiveness decreased during the final stage of their life cycle.

The highest percent weed accumulation when weeds were not controlled weed removal when weed were controlled, pod yield loss under unweeded control and pod yield gain under weed control all occurred between 4 and 8 WAS. This period is within 35 – 60 days after sowing of the crop life cycle, during which the number of pods per plant of groundnut was determined and the period of

maximum growth and the most significant difference in total dry matter/plant, canopy spread, number of pods / plant and pod weight / ha between weed-free and weed-infested plots in the groundnut. This result is in corroboration with report by Jat *et al.* (2011).

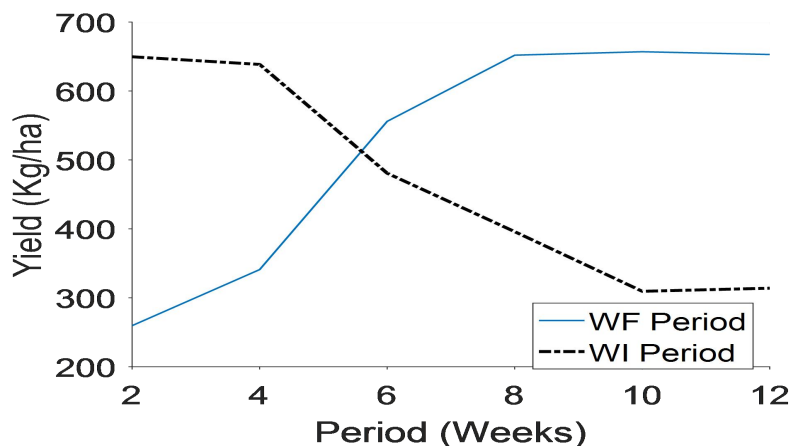


Figure 1: Effect of weed interference on seed yield) of groundnut at Samaru

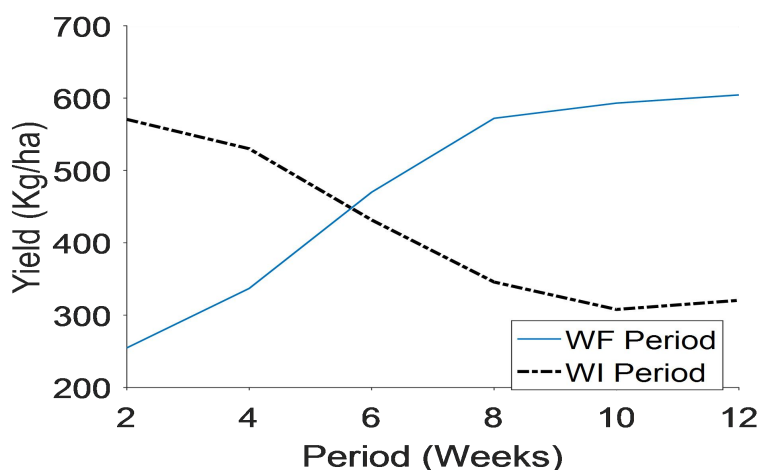


Figure 2: Effect of weed interference on seed yield) of groundnut at Kadawa

CONCLUSION AND RECOMMENDATION

The result of this study have shown that groundnut can tolerate weed infestation initially for the first 4 weeks and that the minimum period that it should be kept weed free was 8 WAS without causing any significant reduction in growth and yield. Hence, weed removal between 4 and 8 weeks after sowing was sufficient to maintain optimum grain yield. This period coincided with the period of maximum weed growth and is recommended for effective weed controls, optimum growth and higher yield of groundnut.

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