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EVALUATION OF SOME PRE- AND POST- EMERGENCE HERBICIDES FOR WEED CONTROL ON GROUNDNUT (*Arachis hypogea L.*) IN NORTHERN NIGERIA

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ABSTRACT

Field trials were conducted in the wet seasons of 2014 and 2015 to evaluate the effect of Pre- and Post-Emergence herbicides for weed control and performance of groundnut to address the problem of low yield due to weed interference in the crop. Among the ten weed control treatments evaluated in a Randomized Complete Block Design (RCBD) replicated three times, the mixtures of metolachlor + prometryn at 2.5 + 1.5 kg a.i/ha, metolachlor + terbutryn at 3.34 + 1.68 kg a.i/ha and ametryn + terbutryn at 3.2 + 2.0 kg a.i/ha gave better growth and pod yield of the crop. However, application of metolachlor + metobrumuron at 1.5 + 1.0 kg a.i/ha and ametryn + terbutryn at 2.4 + 1.5 kg a.i/ha gave lower crop vigour, higher crop injury score, high weed infestation and lower pod yield. It can be concluded that the first three promising herbicide mixtures above (metolachlor + prometryn at 2.5 +1.5 Kg a.i./ha, metolachlor +terbutryn at 3.34 +1.68Kg a.i./ha and ametryn +terbutryn at 3.2 + 2.0 Kg a.i./ha), can be adopted by farmers instead of hoe-weeding for weed control in groundnut in Northern Guinea savanna of Nigeria

Keywords: Evaluation, Pre-emergence, Post- emergence herbicides, Weed and Groundnut

INTRODUCTION

Groundnut (*Arachis hypogea* L.) is one of the world's principal oil seed crops. It is a legume cultivated throughout the tropics and beyond (FAO, 2009). Major producers of groundnut in the world are China, India, USA, Indonesia and Sudan. Present annual world production of unshelled nuts is about 36.8 million tonnes from 26.9million hectares. (FAO, 2013)

In Nigeria, groundnut is produced in almost every state in the country especially in northern Nigeria. The annual groundnut production in the country is up to 3.8million tones from 2.2million hectares of land (2013). Although groundnut is one of the leading cash crops and foreign exchange earner in Nigeria, its pyramids in northern Nigeria are fast disappearing due to lower average yield of about 300kg/ha compared with the 1.27million tonnes/ha , West African average. This low yield is mainly as a result of severe weed infestation especially during the early growth stage of the crop. This is because groundnuts yield losses due to weed interference during the growth of the crop in Nigerian Savannah ranges between 40 – 80% (Lagoke *et al.,* 1998).

The traditional manual hoe weeding which is the commonest method of weed control in Nigeria, has become increasingly expensive and labour is mostly unavailable at the time of need. The method is also tedious and is always associated with serious drudgery. These limitations have generated an intense desire to develop and adopt alternative weed control measures especially under large scale groundnut production.

Application of herbicides may be the appropriate alternative to the hoe-weeding and hand pulling of weeds in groundnut. This work was therefore initiated with the objective of evaluating some Pre- and post-emergence herbicides for long season weed control and also to evaluate their effect on the growth and yield of the crop at Samaru northern Guinea savanna of Nigeria.

MATERIALS AND METHOD

Two field trials were conducted in the raining seasons of 2014 and 2015 at the Institute for Agricultural Research, Samaru-Zaria (11°11'N Latitude and 07°38'E Longitude and 680M above sea level) in the northern Guinea savannah ecology of Nigeria.

The soil was Sandy-Loam with 5.6pH, 0.74% organic carbon, 0.18% of total Nitrogen and 5.5meq/100g soil cat ion exchange capacity.

The total annual rainfall received during the cropping seasons was 1,066mm and 1,258mm in 2014 and 2015, respectively.

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replicates. The treatments consisted of eight mixtures of herbicides, a hoe-weeded control and a weedy check making a total of ten treatments. The ten treatments consisted of Galex 400EC (metolachlor + metobrumuron) at 1.5 + 1.0kg a.i./ha, Codal 500EC (metolachlor + prometryn) at 2.0 + 1.0 and 2.5 + 1.5 kg a.i/ha, Pendilin 750g/L (pendimenthalin) at 1.5kg a.i./ha , Igran combi 500EC (metolachlor + terbutryn) at 2.6 + 1.34 kg a.i./ha and 3.35 + 1.68 kg a.i./ha, amigan 65WG (ametryn + terbutryn) at 2.4 + 1.5kg a.i./ha and 3.2 + 2.0.kg a.i/ha. All herbicides mixtures were applied at pre-emergence (one day after sowing the crop) but Pendimenthalin was applied two weeks after sowing to the crop at post-emergence. The herbicide treatments were all compared with a hoe-weeded control at 3, 6 and 9 weeks after sowing (WAS) and a weedy check which received no application of herbicides or hoe-weeding.

The groundnut seeds variety SAMNUT 23 were sown by hand at an intra-row spacing of 20cm and inter-row spacing of ridges 75cm apart. The seeds were dressed with Apron Star (Metaxyl) at the rate of 2.5kg of seed per 10g (one sachet) of the seed dressing chemical. The sub-plot measured 6.0m by 4.5M (six ridges) while, the net plot area was 6.0m by 3.0M (the four inner ridges).

All pre-emergence herbicides were applied one day after sowing while the post-emergence herbicides were applied at two weeks after sowing (2 WAS), using a conventional CP15 knapsack sprayer at a pressure of 2.1kg /cm^2 and a discharge rate of 240L/ha spray volume. The hoe-weeded control was weeded using hand hoe at 3, 6 and 9 WAS after sowing (WAS). The weedy

check plot received no application of herbicides or hoe weeding.

Application of 20kg N/ha as a starter dose, Phosphorus at 23.6kg P and Potassium at 25kg K per hectare were all done. The N was applied at 3WAS while the P and K were applied during planting using Urea, Single super phosphate and Muriate of Potash (MOP). A fungicide/insecticide mixture 25g lambda cyhalothrin (Karate 25EC) with benlate was used to control both insect pests and fungal diseases. This was applied three times at 20days intervals at the rate of 30g per 15L of water.

Manual harvesting was done using a hand hoe by digging out the whole plants including the pods when the plants reached physiological maturity i.e. when the leaves turned brown and the inner ribs of the groundnut pods have pronounced brown colour. Thereafter, the pods were picked from the main branch and allowed to air and Sun-dry for several days. The dried pods from the net plots were then collected and weighed.

Observations and data collection: -

Crop vigour score: - This was assessed visually using a scale of 1 to 9 where 1 was scored for completely dead plants and 9 were scored for the most vigorous plants. The features of the plants used for scoring were leaf size, colour, stem thickness and size of the plants.

Crop injury score: - This was assessed using a scale of 1 to 9, where 1 represented the least injured plants and 9 the most injured plants.

Weed cover score: - This was taken using a scale of 1 to 9 where 1 represented no weed cover and 9 completely weed infested plots.

Weed dry weight: This was measured by uprooting the weeds in a $1m^2$quadrant, cleaning them free of soils and oven drying them in an oven. The dry weight was recorded using a Mettler balance.

The vine length: - This was taken by measuring the longest vine of five randomly tagged plants from the base to the tip of the stem using a meter rule. The average was then recorded per plant.

Total dry matter weight: - This was taken as the weight of the whole plants after harvesting and drying the crop plants. This represents biological yield plus the economic yield of the crop.

Pod yield of groundnut (kg/ha): - This was recorded after the dry pods from each net plot were weighed and the weights were converted to per hectare.

Data were subjected to analysis of variance (ANOVA) and the treatments were separated by Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Table 1 showed that the application of the herbicides mixtures had significant influence on the crop vigour score of groundnut. Application of all herbicide mixtures resulted in significantly higher crop vigour score than the weedy check in 2014 while in 2015 and the mean, application of all herbicides mixtures with the exception of metolachlor + metobrumuron at 1.5 + 1.0 kg a.i/ha and ametryn + terbutryn at 2.4 + 1.5kg a.i./ha gave in significantly higher crop vigour score of groundnut than the weedy check. These later two herbicides mixtures gave crop vigour score that was statistically at par with that of the weedy check in 2011 and the mean (Table 1).

It was also clear from the results that, the application of herbicides significantly influenced the crop injury score of groundnut at 9WAS (Table 1).

Application of all herbicides and the hoe-weeded control treatment resulted in significantly lower crop injury score than the weedy check except in 2010 were the application of ametryn + terbutryn at 2.4 + 1.5kg a.i./ha gave statistically the same crop injury score with the weedy check.

Among the herbicide treatments evaluated, application of all other herbicides resulted in significantly lower crop injury score of the crop than ametryn + terbutryn at 2.4 + 1.5kg a.i._/ha in both the years and the mean (Table 1).

The application of the herbicides also significantly influences the weed cover score of groundnut at 9WAS in both the years (Table 2). Application of all herbicide treatments and the hoe-weeded control resulted in significantly lower weed cover score of ground nut than the weedy check in 2010 and the mean. In 2011 however, application of metolachlor + prometryn at 2.0 + 1.28kg a.i./ha gave weed cover score that was statistically at par with all other herbicide treatments and the weedy check. The weedy check gave higher weed cover score compared with all other treatments evaluated in 2010 and the mean (Table 2).

Similarly, result was obtained from the application of metolachlor + prometryn 2.5 + 1.5 kg a.i./ha, metolachlor + terbutryn at 3.34 + 1.68 kg a.i./ha, ametryn + terbutryn at 2.4 + 1.5kg a.i/ha, ametryn + terbutryn 3.2 + 2.0kg a.i./ha and the hoe-weeded control which gave resulted in significantly lower weed dry weight than the weedy check but was statistically comparable to all other herbicide treatments. All other herbicide treatments also gave statistically similar weed dry weight compared with the weedy check (Table 2).

Application of the herbicides had significant effect on the stem length of groundnut (Table 3). Among the herbicide treatments evaluated, application of metolachlor + terbutryn at 2.60 + 1.34 kg a.i./ha resulted in significantly longer stem than all other herbicide treatments and the hoe-weeded control in 2010 and the mean, except in the mean where application of metolachlor + terbutryn at 3.34 + 1.68 kg a.i./ha gave statistically similar vine length with the hoe-weeded control, ametryn + terbutryn at 2.4 + 1.5 kg a.i./ha, pendimenthalin at 1.5kg a.i./ha and metolachlor + prometryn at 2.5 + 1.5 kg a.i./ha.

Application herbicide treatments resulted in significantly higher total dry weight of the crop than metolachlor + metobrumuron at 1.5 + 1.0 kg a.i./ha and ametryn + terbutryn at 3.2 + 2.0kg a.i./ha in both the years and the mean. However, the weedy check treatment resulted in significantly lower total dry weight of the crop than all the herbicide treatments evaluated and the hoe-weeded control (Table 3).

All the weed control treatments evaluated significantly influenced the pod yield of Groundnut at harvest in both years and the mean (Table 4). Among the herbicides evaluated, the application of metolachlor + terbutryn at 3.34 + 1.68 kg a.i./ha resulted in significantly higher pod yield of groundnut than all other herbicide treatments and the weedy check but was statistically comparable with metolachlor + terbutryn

both at 2.6 + 1.34 and at 2.4 + 1.5 kg a.i./ha and the hoe-weeded control in both 2011 and the mean. The weedy check treatment however, gave the least pod yield compared with all other weed control treatments evaluated (Table 4).

It was obvious from the results that application of all herbicide treatments except ametryn + terbutryn at 2.4 + 1.5kg a.i./ha and metolachlor + metobrumuron at 1.5 + 1.0 kg a.i./ha gave higher crop vigour score and lower crop injury score. This was a clear indication that the initial phytotoxicity induced by all other herbicides at the early growth period of the crop was overcome at a later stage of the crop growth except those induced by these two herbicides mentioned above. It may also be probably due to the fact that these two herbicides rates were more phytotoxic than all other rates evaluated, hence, the crops could not overcome the phytotoxicity induced by them even at a later stage of the it's growth. The result is also in line with the earlier report of (Ado, 2005) who reported that, ametryn + terbutryn when applied at 3.2 + 2.0kg a.i./ha to Bambara groundnut resulted in significantly lower crop vigour score and higher crop injury score than all other herbicides evaluated in the trial. It also corroborates the earlier report of (Anonymous, 2003) that ametryn + terbutryn (amigan) is a poorly degraded herbicide in cultivated legumes that always accumulates in the apical regions of the plants and thus resulting in serious injury and death of the plants.

The results also showed that application of all herbicide treatments suppressed weed cover score than the weedy check and so also the highest rates of metolachlor + prometryn at 2.5 + 1.5 kg *a.i.*/ha, also highest rates of metolachlor + terbutryn at 3.34 + 1.68 kg a.i./ha as well as highest rates of ametryn + terbutryn at 3.2 + 2.0kg a.i./ha all suppressed weed dry weight of groundnut than all other weed control treatments. This was a clear indication that the highest rates of all the herbicides mixtures suppressed weeds more than their corresponding lower rates. It also in line with the earlier report of (Kotula and Syka, 1989) that Metolachlor is a weed germination inhibitor and if mixed with other herbicides like Prometryn or Terbutryn is very active on weeds with a broader spectrum of weed control especially on grasses which are the dominant type of weeds in northern Nigeria. Also, (Fatokun, 2010) reported similar weed suppression due to these herbicides in "Egusi" melon than all other herbicides rates evaluated.

Total dry weight of groundnut was also higher, with the application of all other treatments except these two herbicide mixtures metolachlor + terbutryn at 1.5 + 1.0 kg a.i._/ha and ametryn + terbutryn at 3.2 + 2.0kg a.i/ha. Similar result was also reported by [Ado, 2005] that ametryn + terbutryn gave lower biomass of Bambara nut than all other herbicide treatments evaluated.

The results also indicated that application of the highest rates of metolachlor + terbutryn at 3.34 + 1.68 kg a.i./ha gave pod yield of groundnut that was higher than all other herbicide treatments but similar to both rates of metolachlor + terbutryn at 2.6 + 1.34 and 2.4 + 2.5kg a.i./ha. These treatments were consistent in giving higher growth of crops, weed suppression and increased biomass, so

this was a clear manifestation of what was obtained during the growth of the crop due to application of these herbicides.

Similar results of higher fruit yield of Egusi melon was also reported with the application of metolachlor + terbutryn at 3.34 + 1.68 kg a.i./ha than all other herbicide treatments evaluated (Fatokun, 2010).

CONCLUSION

From the results of this study, it can be concluded that the highest rates of metolachlor + prometryn at 2.5 + 1.5 kg a.i./ha, metolachlor + terbutryn at 3.34 + 1.68 kg a.i/ha and the highest rates of ametryn + terbutryn at 3.2 + 2.0kg a.i./ha can be adopted by groundnut farmers in northern Nigeria as an alternative to manual hoe-weeding in groundnut since they resulted in better growth, weed suppression and pod yield.

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Table 1: Effect of Pre- and Post -Emergence Application of Herbicides on Crop Vigour and Crop Injury Score of Groundnut at 9WAS at Samaru, Northern Nigeria

Treatment	Rate in kg a.i./ha	Crop Vigour Score			Crop Injury Score		
		2014	2015	MEAN	2014	2015	MEAN
Metolachlor + Metobrumuron	1.5 + 1.0	7.33ab[2]	8.66a	7.99ab	2.67b	2.00c	2.34c
Metolachlor + Prometryn	2.0 + 1.28	8.00a	9.00a	8.50a	2.00b	2.00c	2.00c
Metolachlor + Prometryn	2.5 + 1.50	7.66a	8.33a	7.99ab	2.33b	2.33c	2.33c
Pendimenthalin	1.5	8.00a	8.66a	8.33a	2.00b	2.00c	2.00c
Metolachlor + Terbutryn	2.6 + 1.34	8.00a	9.00a	8.50a	2.00b	2.00c	2.00c
Metolachlor + Terbutryn	3.34 + 1.68	8.00a	9.00a	8.50a	2.33b	1.67c	2.00c
Ametryn + Terbutryn	2.4 + 1.5	4.00b	5.00ab	4.50bc	5.00a	4.67b	4.84b
Ametryn + Terbutryn	3.2 + 2.0	7.33ab	8.66a	7.99ab	2.00b	2.67c	2.34c
Hoe- weeded control at 3, 6 and 9WAS[1]	—	9.00a	9.00a	9.00a	1.00b	1.00c	1.00c
Weedy check	—	2.00c	3.33b	2.67c	7.33a	8.00a	7.67a
S E ±		1.114	1.401	1.258	0.712	0.608	0.512

1➔ WAS=weeks after sowing

2➔ means a column of any set of treatments followed by unlikely letters are significantly different at P≤0.05.

Table 2: Effect of Pre- and Post-Emergence Application of Herbicides on Weed Cover Score and Weed Dry Weight of Groundnut at 9WAS at Samaru, Northern Nigeria

Treatment	Rate in kg a.i./h	Weed cover score			Weed dry weight (g/m^2)		
		2014	2015	MEAN	2014	2015	MEAN
Metolachlor + Metobrumuron	1.5 + 1.0	2.34b	4.00b	3.17b	28.00abc	31.33ab	29.67abc
Metolachlor + Prometryn	2.0 + 1.28	1.00b	4.64ab	2.82b	32.00ab	32.00ab	32.00ab
Metolachlor + Prometryn	2.5 + 1.50	1.66b	2.00b	1.83b	12.00bc	28.67b	14.84bc
Pendimenthalin	1.5	1.00b	2.00b	1.50b	18.00abc	21.00ab	19.50abc
Metolachlor + Terbutryn	2.6 + 1.34	1.66b	2.00b	1.83b	20.00abc	18.33b	19.17abc
Metolachlor + Terbutryn	3.34 + 1.68	1.00b	2.00b	1.50b	12.00bc	10.00b	11.00bc
Ametryn + Terbutryn	2.4 + 1.5	2.67b	4.00b	3.34b	16.33bc	18.33b	17.33abc
Ametryn + Terbutryn	3.2 + 2.0	1.00b	2.00b	1.50b	12.66bc	16.67b	14.67bc
Hoe- weeded control at 3, 6 and 9WAS	—	1.00b	1.00b	1.00b	7.34c	6.67b	7.01c
Weedy check	—	6.67a	7.67a	7.17a	40.67a	46.67a	43.67a
S E $\pm$		1.168	1.361	1.265	7.69	9.113	8.402

1➔WAS= weeks after sowing
2➔ means a column of any set of treatments followed by unlikely letters are significantly different at $P \leq 0.05$.

Table 3: Effect Of Pre- and Post-Emergence Application of Herbicides on Vine Length (cm) and total Dry Matter (kg/ha) of Groundnut at 9WAS at Samaru, Northern Nigeria

Treatment	Rate in kg a.i./ha	Vine Length (cm) at 9WAS			Total Dry Weight (kg/ha)		
		2014	2015	MEAN	2014	2015	MEAN
Metolachlor + Metobrumuron	1.5 + 1.0	32.34d	36.33b	34.34c	2102e	3002e	2552e
Metolachlor + Prometryn	2.0 + 1.28	27.33d	34.33b	30.83c	3100c	3881d	3491d
Metolachlor + Prometryn	2.5 + 1.50	42.33c	67.60a	54.97b	5313b	6030c	5672c
Pendimenthalin	1.5	41.67c	63.20a	52.44b	6118a	6199c	6159b
Metolachlor + Terbutryn	2.6 + 1.34	66.14a	68.70a	67.42a	6130a	6999a	6565a
Metolachlor + Terbutryn	3.34 + 1.68	54.34b	69.33a	61.84ab	6110a	6878a	6494a
Ametryn + Terbutryn	2.4 + 1.5	44.14c	61.34a	52.74b	6106a	6771ab	6439a
Ametryn + Terbutryn	3.2 + 2.0	24.00d	33.06b	28.53c	2400d	3004e	2702e
Hoe- weeded control at 3, 6 and 9WAS	—	52.67b	61.32a	56.99b	5887b	6677ab	6282b
Weedy check	—	11.11e	14.67c	12.89d	132f	205f	169f
S E ±		2.980	3.114	3.047	43.681	51.127	47.704

1➔ WAS= weeks after sowing
2➔ means a column of any set of treatments followed by unlikely letters are significantly different at P≤0.05.

Table 4: Effect of Pre- and Post-Emergence Application of Herbicides on Crop Pod Yield (kg/ha) of Groundnut Harvested at Samaru, Northern Nigeria

Treatment	**Rate in kg a.i/ha**	**Pod yield of ground nut (kg/ha)**		
		2014	2015	MEAN
Metolachlor + Metobrumuron	1.5 + 1.0	1403h	1611f	1507f
Metolachlor + Prometryn	2.0 + 1.28	1800f	1827e	1818e
Metolachlor + Prometryn	2.5 + 1.50	3777e	3707c	3742d
Pendimenthalin	1.5	4628d	4811b	4720c
Metolachlor + Terbutryn	2.6 + 1.34	4566d	4999a	4783b
Metolachlor + Terbutryn	3.34 + 1.68	4992a	4902ab	4947a
Ametryn + Terbutryn	2.4 + 1.5	4774c	4900ab	4837ab
Ametryn + Terbutryn	3.2 + 2.0	1673g	2086d	1880d
Hoe- weeded control at 3, 6 and 9WAS	—	4863b	4994a	4929a
Weedy check	—	108g	126g	117g
S E ±		27.811	34.262	31.037

1➔ WAS=weeks after sowing
2➔ means a column of any set of treatments followed by unlikely letters are significantly different at P≤0.05.