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EFFECTS OF EXPIRED, NON-EXPIRED PENDIMETHALIN AND HAND WEEDING ON THE BIO- PRODUCTIVITY AND SEED QUALITY OF GROUNDNUT (ARACHIS HYPOGAEA L.)

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ABSTRACT:
The use of expired herbicides to suppress weeds growth is becoming prevalent among farmers. Hence the need to investigate and compare the effect of expired and non-expired pendimethalin and hand weeding on weed suppression, growth, yield and composition of groundnut. The experiment was carried to investigate seven weed treatments during the rainy season in 2020. These were sole pendimethalin non-expired at 0.75 kg ai/ha (T_1), pendimethalin non-expired at 0.75 kg ai/ha + one hand weeding at 6 weeks after sowing (T_2), pendimethalin expired at 0.75 kg ai/ha (T_3), pendimethalin expired at 0.75 kg ai/ha + one hand weeding at 6 WAS (T_4), two hand weeding at 3 and 6 WAS (T_5), weed free check (T_6) and weedy check (T_7). *Desmodium trifolium*, *Amaranthus spinosus* and *Commelina benghalensis* were the most preponderant weed species. Both expired or non-expired pendimethalin and their integration with one hand weeding reduced weed population than other treatments. Pendimethalin non-expired + one hand weeding at 6WAS and two hand weeding at 3 and 6 WAS significantly increased the growth parameters and yield when compared with other treatments. There was marked increase in protein, fat and ash contents of the seeds in all the weed control treatments than the weedy check. Also, the mineral elements (Fe, Ca, K and N) with the exception of zinc (Zn) were significantly higher in weed control treatments compared with the weedy check. The study established in spite of positive influence of all weed control treatments on seed quality, two hand weeding at 3 and 6 WAS and non-expired pendimethalin + one hand weeding 6 WAS, should be reinforced for weed control and the use of expired pendimethalin should be discouraged..

KEYWOR[1]DS: Groundnut, Growth, Pendimethalin, Weeds, Yield,

1. INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an oil seed crops (Yol *et al*., 2018) with natural distribution confined to Southern American (Ramanatha *et al*., 2012). During 2010-2011, approximately 35 million metric tons of groundnuts were harvested worldwide, 4.39% came from Nigeria (USDA, 2020). Groundnut (*Arachis hypogaea* L.) has secured a degree of relevance as a cash crop because of its domestic and industrial applications (Guchi, 2015; Kombiok *et al*., 2012). Asia and Sub-Saharan Africa produced 56% and 40% of global production, respectively. (Angelucci and Bazzucchi, 2013). Its seeds are rich source of edible oils and provide a more valuable source of balanced diet than any other nut, yet they are often the least expensive (Reddy *et al*., 2003).
Weed infestation is one of the major production constraints of groundnut. Weed infestation has been found to reduce production by 31% to 70% (Chauhan, 2020), with loss of about 51 % in Nigeria (Etejere *et al*., 2013). This is due to the fact that, smaller crop canopy is formed during the first 6 weeks of development, which encourages intense weed competition, significantly lowers crop production (Akobundu, 1987). Small-scale farmers in sub-Saharan Africa, especially Nigeria, experience reductions in yield of about 57.3% compared to research fields, primarily as a result of ineffective and tardy weed and disease management techniques (Tanzubil and Yahaya, 2017) as well as shortage of skilled labour. Pre-emergent herbicides are employed by these small-scale farmers to manage weeds, and they are mostly used on peanut, soybean, rice, cotton, and vegetable crops.
This investigation's backdrop problem-solving goal is to relieve farmers' fears about how to deal with expired herbicides. Pendimethalin herbicides with expiration dates of 1 year, was used to study the impact of expired herbicides on mango (*Mangifera indica*) seed germination and seedling development. With the exception of the herbicide that reached its expiration date in 2011, the germination rate was continuously greater in the control treatment. (Olorunmaiye *et al.*, 2014).
As most of these farmers get rid of expired herbicides after harvest and then start to look for means to get another one when a new season comes around, the pertinent decision arises whether or not to use expired herbicides as weed control agent. Hence, it is important to identify the best and cheapest way to suppress weeds, and also find a way to make something out of the expired pre-emergent herbicides. This study aims at investigating the effects of expired herbicide on the growth, yield, mineral content and proximate composition of groundnut (*Arachis hypogaea*)

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2. MATERIALS AND METHODS

The present investigation was conducted in Ilorin between June and September of 2020 to study the growth and yield responses of groundnut variety Samnut 21 under the use of expired and non-expired pendimethalin and hand weeding methods.

2.1. Study site

The field experiment was conducted in Gbagba, Airport Road in the Ilorin West Local Government Area of Kwara State, Nigeria.

2.2. Seed collection and description

The variety of the groundnut seed used for this study was Samnut 21. They were obtained from the Department of Plant Biology, University of Ilorin, Nigeria.

2.3. Treatment details and experimental layout

The field layout consisted of three replicates and it followed randomized block design and the plot measuring 2×2 m each. Seven weed control methods were employed with the herbicide used at the pre-emergence stage. These were sole pendimethalin non-expired at 0.75 kg ai/ha (T_1), pendimethalin non-expired at 0.75 kg ai/ha + one hand, weeding at 6 WAS (T_2) pendimethalin expired at 0.75 kg ai/ha (T_3), pendimethalin expired at 0.75 kg ai/ha + one hand weeding at 6 WAS (T_4), two hand weeding at 3 and 6 WAS (T_5), weed free check (T_6) and weedy check (T_7).

2.4. Data collection

At two weeks interval, morphological parameters were determined except stem girth that was determined at three weeks interval. The leaf area was calculated as the product of the total length and breadth at the broadest point of the longest leaf on the plant i.e. Leaf Area = lamina length x maximum width x k (where k is the coefficient) (Musa and Usman, 2016). The above ground matter and relative growth rate were also determined. Afterwards, yield attributes were measured per plant.

2.5. Weed Identification

Weeds encountered in the field were identified with the use of Handbook of West Africa Weeds by Akobundu and Agyakwa (1998) and confirmed at the herbarium unit of the Department of Plant Biology, University of Ilorin, Ilorin Nigeria.

2.6. Weed Count

2.6.1. Relative frequency

Individual weed species was counted in each plot at 2, 4, 8, 12 and 14 weeks after initiation of the experiment. To achieve this, a 1 m^2 quadrat was placed within the 4.8 m^2 weed management zone in three random locations along the rows as shown in Plate 4. Thereby giving a total of nine quadrats per experimental unit. The weed count was used to determine the relative frequency of individual weed species in the main experimental plot. This was achieved by counting and recording the number of times each species appeared in the plots covered by the quadrats. Thereafter, the relative frequency expressed in percentage (RF) per treatment was estimated using equation 1. (Mueller-Dombois and Ellenberg (1974) and adopted by Pragada, *et al*. (2011)

$$\text{Relative frequency (RF)} = \frac{\text{Frequency of each species}}{\text{Total number of all species}} \times 100 \quad 1$$

2.6.2. Relative abundance

Relative abundance of weeds with respect to all treatments expressed in percentage in each experimental year was calculated following the principle of Mueller- Dombois and Ellenberg (1974) and adopted by Pragada, *et al*. (2011) as shown in equation 2:

$$\text{Relative abundance (RB)} = \frac{\text{Abundance of individual weed species}}{\text{Abundance of all the species}} \times 100 \quad 2$$

2.7 Proximate analysis

Proximate and mineral analysis were carried out on the harvested groundnut samples (Samnut 21). The proximate analysis carried out include moisture content, ash content, crude fat, protein, crude fiber and carbohydrate using the standard methods of the Association of Official Analytical Chemists (AOAC, 2000), which was carried out at the Nigerian Stored Product Research Institute, (NSPRI), Ilorin Nigeria.

2.8. Mineral analysis

Mineral contents of cinnamon were determined by atomic absorption spectrometry, flame photometry and spectrophotometry according to the methods of Association of Analytical Chemists (AOAC, 2005).

2.9. Data analysis

The data recorded were subjected to Univariate Analysis of Variance (ANOVA) using Statistical Package for Social Science (SPSS). Treatment means were separated using Duncan Multiple Range Test at $P < 0.05$ level of significance

3. RESULTS AND DISCUSSION

3.1. Morphological growth parameters

Results on morphological parameters are shown in Figures 1, 2, 3, 4 and 5 respectively. The growth performance of Samnut 21 in terms of plant height, number of leaves, and primary branches, stem girth and leaf area were significantly higher in all the weed control treatments. Two hand weeding at 3 and 6 WAS had the lowest plant height at harvest which could be the reason for also having the lowest number of leaves as it had limited access to factors that enhance leaf production in plant. Pendimethalin non-expired + one hand weeding at 6 WAS had the highest number of primary branches especially at 12WAS which could have been the reason behind its high number of leaves.There was steady increase in stem girth from the first sampling (3 WAS) till the final sampling day (15 WAS).there was only slight differences between the treatment from the first sampling day (2 WAS) to 4 WAS but pendimethalin non-expired + one hand weeding at 6 WAS showed the highest leaf area followed by pendimethain expired + one hand weeding at 6 WAS and weedy check. In all, pendimenthalin non-expired + one hand weeding at 6 weeks after sowing and two hand weeding at 3 and 6 WAS significantly increased the growth parameters compared to other treatments. The result obtained in this study aligned with the study of Adhikary *et al*. (2016), who reported that application of herbicide affect the growth parameters of groundnut treated with different herbicides post- and pre-emergence.

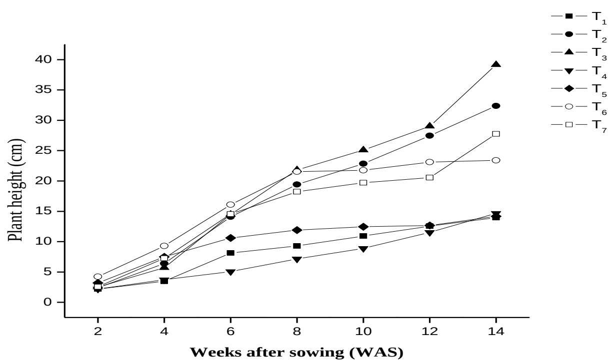

Fig. 1: Mean plant height (cm) as affected by expired, non-expired pendimethalin and hand weeding in Groundnut (Samnut 21).

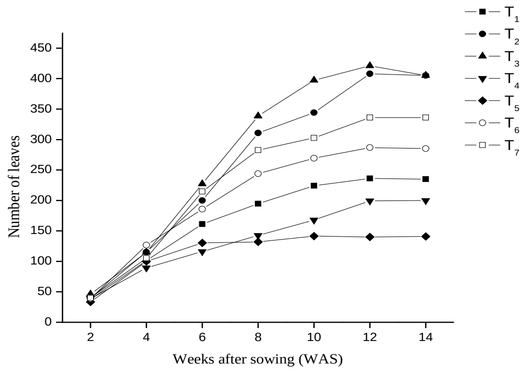

Fig. 2: Mean number of leaves as affected by expired, non-expired pendimethalin and hand weeding in Groundnut (Samnut 21)

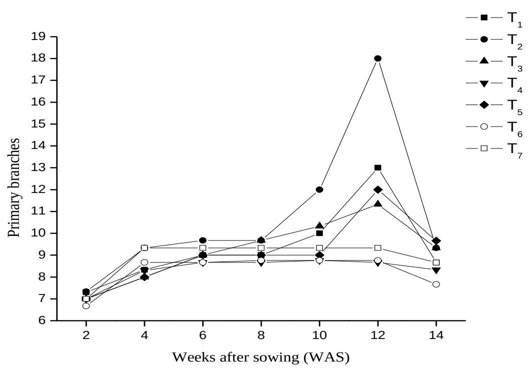

Fig. 3: Mean number of primary branches as affected by expired, non-expired pendimethalin and hand weeding in Groundnut (Samnut 21)

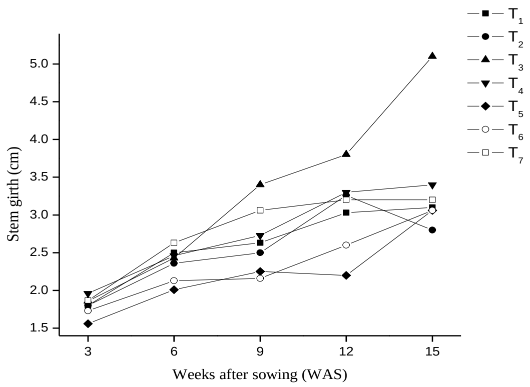

Fig. 4: Mean stem girth (cm) as affected by expired, non-expired pendimethalin and hand weeding in Groundnut (Samnut 21)

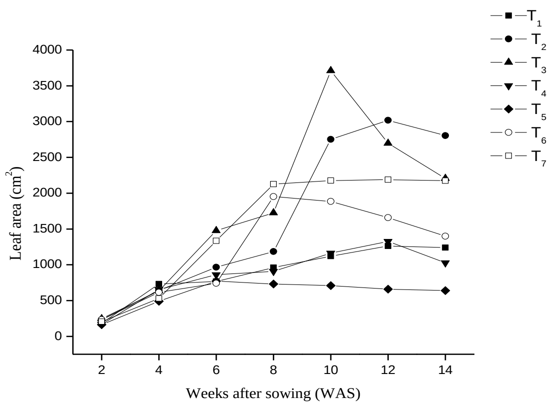

Fig. 5: Mean leaf area (cm^2) as affected by expired, non-expired pendimethalin and hand weeding in Groundnut (Samnut 21)

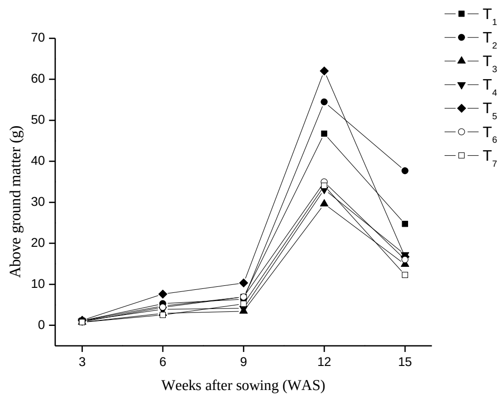

Fig. 6: Mean above ground matter (g) as affected by expired, non-expired pendimethalin and Hand weeding in Groundnut (Samnut 21)

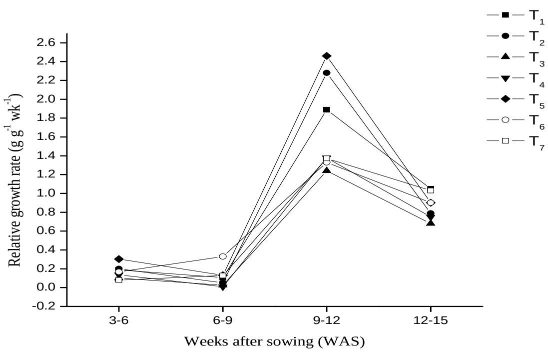

Fig. 7: Mean relative growth rate as affected by expired, non-expired pendimethalin and hand weeding in Groundnut (Samnut 21)

N.B: sole pendimethalin non-expired at 0.75 kg ai/ha (T_1), pendimethalin non-expired + one hand weeding at 6 weeks after sowing (T_2), pendimethalin expired at 0.75 kg ai/ha (T_3), pendimethalin expired at 0.75 kg ai/ha + one hand weeding at 6 WAS (T_4), two hand weeding at 3 and 6 WAS (T_5), weed free check (T_6) and weedy check (T_7)

3.2. Physiological growth parameters

Total dry matter accumulation (Fig. 6) differed significantly due to weed control methods except at 3, 6 and 9 WAS, it rose steadily to the peak at 12 WAS before it started to decline right before harvest. Pendimethalin expired (sole) had the lowest dry matter accumulation at 12 WAS while weedy check had the lowest dry matter accumulation at harvest. This could be as a result of weed competition for limited resources in these two treatments that had higher dry matter accumulation. The result agreed with the study of Jhala *et al*. (2005), who observed that minimum weed dry matter accumulation (70 kg/ha) with higher weed control efficiency (90.70%) was recorded in pendimethalin at 1.0 kg/ha + hand weeding at 30 DAS. Relative growth rate (Fig. 7) was maximum between 9 and 12 WAS and declined towards the harvest. Generally, all the weed control treatments had higher RGR compared to the pendimethalin expired (sole). The decline in RGR towards crop physiological maturity could be due to ageing, leaves shedding, as well as shadow of lower leaves by the upper leaves which reduces the photosynthetic capacity of the lower leaves. Similar trend in RGR was also reported in blackgram, rice and tomato (Rahman *et al*., 1994; Biswas *et al*., 2002; Nicknejad *et a*l., 2009; Olayinka *et al*., 2009).

3.3. Yield and yield components

During the course of the study, all the weed control treatments significantly increased the yield components (Table 1), such as number of matured pods per plant, pod weight per plant, number of seeds per plant and seed weight per plant as it is known that several weed control treatments had been found to increase yield components over the control in groundnut (Shanwad, *et al*., 2010; El Naim *et al*., 2010; 2011). Pendimethalin non-expired + one hand weeding done at 6 WAS, was found to yield the highest number of pods, number of seeds and pods weight per plant, it was only exceeded in terms of seeds weight per plants by two hand weeding at 3 and 6 WAS and pendimethalin non-expired (sole) which aside that, two hand weeding at 3 and 6 WAS followed by pendimethalin non-expired + one hand weeding at 6 WAS in all other yield components. Pendimethalin non-expired (sole) had higher values too in the yield components while expired pendimethalin non-expired (sole) had the lowest in all. The observed differences could be due to differential photosynthetic capacity and partition into various parts of the plant which to a large extent is limited by factors such as weed density, leaf area development and its index, microclimate and the soil condition under which the crop thrives (Liliane and Charles, 2020). The foregoing factors could sufficiently be ascribed to the variation in trend of growth and yield components recorded under various weed control treatments. The observed phenomenon agreed with the position of Bhoi *et al*. (2010) who reported that the yield or productivity of any field crop is governed by net photosynthetic efficiency as well as microclimate and edaphic factors of the area in which the crop is grown. Generally, yield components were enhanced in treatments where integrated weed management were carried out compared to weed control practices alone.

3.4. Weed floral composition and abundance

The study indicated that the experimental fields were infested with three different types of weeds (Table 2), these were broad-leaved weeds, grass weeds and sedge. Broad-leaved weeds comprising 6 species accounted for highest percentage (93.24%) of the infestation followed by grass weed comprising 2 weed species (3.76%) while sedge with only one species had the lowest (2.94%). The greater abundance of broad-leaved weeds had been reported in southern Guinea savanna (Takim and Fadayomi, 2010). They reported greater abundance of broad-leaved weeds than grasses in southern Guinea savanna ecological zone of Nigeria. Similarly, Olorunmaiye and Afolayan (2012) in their studies on Citrus trees intercropped with some arable crops in Ibadan-a rainforest savanna transition ecological zone of Nigeria affirmed that broad-leaved weeds accounted for the highest percentage of weed infestation followed by grasses and sedge in their experimental sites. The relative abundance indicated that 3 out of the 9 weed species encountered were the most abundant. The three species are *Desmodium triflorum*, *Amaranthus spinosus* and *Commelina benghalensis* Linn with the three belonging to the broad-leaved category. Amongst all the 9 weed species encountered in the study, annual weed species were abundant compared to perennial weed species. Similar reports have also been observed in rice growing area of Kedar coast in Peninsular Malaysia (Hakim *et al*., 2010). The result disagreed with the study of Olayinka *et al*., 2020, who reported higher perennial weed species than annual weed species.

3.5. Weed relative frequency

The different control methods used in this study had differential effects on weeds frequencies at different sampling periods. At 2 WAS, the average rate of occurrence of weed species under the various treatments in the groundnut varieties was less than 50 % except *Cyperus esculentus* which had 59.29% frequency in weed free check but kept having a lower frequency afterwards. During most of these samplings periods especially at 8, 10 and 12 WAS, treatments such as expired pendimethalin (sole), expired pendimethalin + one hand weeding at 6 WAS, and weed free check had relatively lower number of weeds on their plots compared to pendimethalin (sole), two hand weeding at 3WAS and 6 WAS; and weedy check which had the highest number of weeds throughout the course of the study.

3.5. Proximate analysis

3.5.1. Moisture content

The moisture content (Table 4) of air dried groundnut seeds were significantly affected due to different treatments, the pendimenthalin expired + one hand weeding at 6 WAS, pendimethalin expired (sole) and the weedy check, had significantly the highest moisture contents. It is then followed by weed free check and followed in decreasing order with pendimethalin non-expired (sole) > pendimethalin nonexpired + one hand weeding at 6 WAS, and two hand weeding at 3WAS and 6 WAS having the lowest moisture content. In summary, statical difference indicated that the expired pendimenthalin + one hand weeding at 6 WAP has the highest moisture content.

In all the treatments, the moisture content ranged between 12.18-19.65% which differed from that of Musa *et al*. (2010) which ranged between 6.6-8.9% among different varieties studied. However, they are slightly close to that of Olayinka *et al.*, 2015 which ranged between 10.67-11.30%. The variation could be attributed to varietal difference, agronomic practices used to raise the crop, condition under which it was dried, as well as number of days used to dry the seeds before subjecting the seeds to proximate analysis (Olayinka and Etejere, 2013).

3.5.2. Ash content

The ash content of air-dried groundnut (Samnut 21) seeds were significantly affected due to different weed control methods as indicated in Table 4. Pendimethalin non-expired (sole) and pendimethalin non-expired + one hand weeding at 6 WAS both had significantly highest ash content as indicated in table 4 and was slightly followed by pendimethalin non-expired + one hand weeding at 6 WAS followed by other treatments in the order; pendimethalin expired + one hand weeding at 6 WAS > weedy check > pendimethalin expired (sole) > two hand weeding at 3WAS and 6 WAS, with weed free check showing the lowest ash content of 2.47%

The percentage ash content was significantly affected due to the different weed control methods and. In all the treatments, the ash content ranged from 2.47-2.99% and it is similar to the results reported by Atasie e*t al*. 2009 which indicated that ash content among 29 cultivars of groundnut was between 2.4-3.08% and that of Aslam Shad *et al*. (2009) who reported 2.70-3.03%. The ash contents reported in this study are higher compared to the report of Olayinka *et al.* (2015) and somewhat lower when compared with that of Musa *et al*. (2010) who recorded ash content of 3.0-7.4%.

3.5.3. Crude fiber

As shown in Table 4, pendimethalin non-expired (sole) and pendimethalin nonexpired + one hand weeding at 6 WAS treatments show the highest crude fibre content significantly with 5.52% and 5.08% respectively, followed by pendimethalin non-expired + one hand weeding at 6 WAS with slightly lower fibre content. Pendimethalin non-expired (sole), followed by the weed free check and two hand weeding at 3WAS and 6 WAS while the weedy check had the lowest crude fibre. This shows that the treatments where pendimethalin were applied had the highest crude fibre content while the weedy check had the lowest fibre content.

The fibre content in all of the different weed control methods ranged from 4.32-5.52% which lower than those reported by Olayinka *et al.* (2015) but it is higher than 2.76-3.07 reported by Shokunbi *et al.* (2012), 3.7% reported by Atasie *et al*. (2009) and 3.3-4.4% reported by Campos-Mondragon *et al*. (2009).

3.5.4 Crude fat

Pendimethalin expired + one hand weeding at 6 WAS significantly had the highest fat content, slightly followed by pendimethalin non-expired + one hand weeding at 6 WAS while pendimethalin non-expired (sole), weed free check, two hand weeding at 3WAS and 6 WAS and pendimethalin expired (sole) all have almost the same percentage which is around 39% as shown in table 4. Weedy check showed the lowest fat content. This shows that pendimethalin expired + one hand weeding at 6 WAS and pendimethalin non-expired + one hand weeding at 6 WAS both had the highest fat content.

The fat contents of groundnuts have been reported as 33.6-54.95% (Asibuo *et al.,* 2008), 45.09-51.63% (Aslam Shad *et al*., 2009), 49.8-53.4% (Campos-Mondragon *et al*., 2009) and 32.7-53.1% (Musa *et al.,* 2010), 44.17-48.86% (Olayinka *et al*., 2015). This shows that our values (37.27-42.92%) are within the ranges found in the literature.

3.5.5. Crude protein

Significant variations were observed in air dried groundnut seed crude protein due to different weed control methods. Two hand weeding at 3WAS and 6 WAS has the highest protein content followed by pendimethalin expired (sole). Weed free check with 22.01%, which is slightly higher than that of pendimethalin non-expired + one hand weeding at 6 WAS. Pendimethalin expired + one hand weeding at 6 WAS then followed before pendimethalin non-expired (sole) with weedy check showed the lowest crude protein

The crude protein content was significantly influenced due to different weed control methods. The protein content ranged from 17.84-23.76% which within the range 19.02-27.16% reported by Asibuo *et al*., (2008), 23.5-26.6% reported by Campos-Mondragon *et al*., (2009) and 19.7-31.3% reported by Musa *et al*. (2010). However, the protein content reported in this study is slightly lower than the values (30.2432.37%) reported by Aslam Shad *et al.* (2009). The observed difference is as a result of genetic constitution (Musa *et al*., 2010)

3.6.6 Carbohydrate

All the treatments significantly influenced air dried groundnut seeds carbohydrate contents. As shown in table 4, highest carbohydrate content was recorded in weedy check which was slightly followed by two hand weeding at 3WAS and 6 WAS, pendimethalin non-expired (sole), pendimethalin + one hand weeding at 6 WAS. Little variations were recorded as Weed free check and pendimethalin expired (sole) followed with 12.71% and 12.49% respectively. Pendimethalin expired + one hand weeding at 6 WAS showed the least carbohydrate.

The percentage carbohydrate recorded by difference was significantly affected due to different weed control methods. The carbohydrate content ranged from 9.66-18.06% which is similar to 17.03-18.51% reported by Shokunbi *et al.* (2012) but higher compared to the value (5.89-9.59%) reported by Olayinka *et al.* (2015), and lower compared to Asibuo *et al*. (2008) and Campos-Mondragon *et al*. (2009) studies who reported 19.02-27.16% and 18.9-23.4% respectively.

3.7. Mineral analysis

As shown in Table 5, significantly higher amount of Fe was observed in pendimethalin expired (sole) followed by pendimethalin + one hand weeding at 6 WAS, expired pendimethalin + one hand weeding at 6 WAS; two hand weeding at 3WAS and 6 WAS, pendimethalin (sole), weed free check and weedy check.

Two hand weeding at 3 and 6 WAS showed the highest zinc composition with as shown in table 5, followed by weed free check, pendimethalin non-expired + one hand weeding at 6 WAS, pendimethalin non-expired (sole), weedy check, pendimethalin expired + one hand weeding at 6 WAS as pendimethalin expired (sole) showed the lowest composition of zinc.

Pendimethalin + one hand weeding at 6 WAS showed the highest potassium as inscribed in table 5, followed in a decreasing order of magnitude by two hand weeding at 3WAS, pendimethalin expired (sole), pendimethalin non-expired (sole), weed free check, pendimethalin expired + one hand weeding at 6 WAS, while weedy check showed the lowest K content.

Pendimethalin non-expired + one hand weeding at 6 WAS showed the highest Ca content followed in decreasing order of magnitude by weed free check, pendimethalin non-expired (sole), weedy check, pendimethalin expired (sole), two hand weeding at 3WAS and 6 WAS while pendimethalin expired + one hand weeding at 6 WAS had the lowest Ca content with 16.41mg/100g.

As showed in table 5, two hand weeding at 3WAS and 6 WAS had the highest values of 37739.93 ppm slightly followed by and pendimethalin non-expired (sole) while weedy check showed the lowest nitrogen content with a relatively value of 28650.37 ppm.

Minerals serve as cofactors for many physiological and metabolic functions. Irons contained in different treatments ranged from 3.24-6.52 mg/100g which is in range compared to Asibuo *et al,* (2008) (0.2-3.7mg/100g) and higher compared to Shokunbi *et al,* (2012) (1.33-1.67 mg/100g).

The zinc content of different treatments ranged from 17.21-26.67 mg/100g which was generally higher than the results of other workers (Asibuo *et al,* 2008; Shokunbi *et al*., 2012), but lower compared to Farhana *et al*, 2015 (42.18-66.96) Zinc is a cofactor for most of the dehydrogenases that require the coenzymes NAD and NADP. This mineral also supports our immune systems, helps in wound healing and is involved in building proteins. Zinc is an essential mineral for normal growth and development during pregnancy, childhood and adolescence.

Zinc also helps the cells in human body communicate by functioning as a neurotransmitter. Potassium content in all the treatments showed little significant difference as it ranged between 432.40443.51 mg/100g, this range is lower compared to Shokunbi *et al*. (2012) (575.24-611.21 mg/ 100g) and relatively lower compared to results from other works (Asibuo *et al,* 2008 and Amarteifio *et al*., 2006).

The result showed that the calcium content in all the treatments ranged from 16.14-54.43 mg/100g which is in range with Shokunbi *et al*. (2012) (43.71-62.58 mg/100g). The presence of a substantial amount of Ca in all the treatments is a good indication that they are rich in minerals that play a role in bone formation, blood coagulation and muscle contraction along with other metabolic processes. (Shokunbi *et al*., 2012).

The nitrogen content in all the treatments ranged from 28650.37-37739.93 ppm which showed a very high level of nitrogen across all treatments, this could be because of the high availability of nitrogen in the soil. However, most of the minerals are lower compared with those reported by Asibuo *et al*. (2008) from 20 improved varieties of groundnut. This further calls for the need to invest resources in the development, production and distribution of improved groundnut varieties for Nigerians

Table 1: Yield components of groundnut as affected by different weed control treatment

Treatment	Number of pods/plants	Number of seeds/plant	Pods weight/plants (g)	Seeds weight/plant (g)	Harvest index
T1	46.33±15.85^{b}	85.33±31.66^{ab}	63.87±22.61^{abc}	53.93±21.52^{ab}	0.68^{b}
T_2	83.00±36.37^{a}	148.66±62.10^{a}	97.36± 34.43^{a}	48.56±17.36^{ab}	0.56^{c}
T_3	23.00±8.54^{ab}	37.00±13.05^{b}	21.26± 6.80^{bc}	17.40±6.03^{ab}	0.53^{cd}
T_4	27.33±10.52^{ab}	49.33±18.31^{ab}	29.96± 11.11^{bc}	23.53±8.67^{ab}	0.57^{c}
T_5	56.66±9.68^{ab}	107.00±18.33^{ab}	76.26± 9.49^{ab}	59.13±6.45^{a}	0.77^{a}
T_6	32.33±11.66^{ab}	60.00±23.00^{ab}	35.53± 13.90^{bc}	29.03±11.64^{ab}	0.64^{b}
T_7	13.33±7.42^{b}	22.33±12.91^{b}	14.23±10.94^{c}	10.76±7.94^{b}	0.48^{d}
Mean	40.28	72.80	48.35	34.62	0.60
P-value	0.145	0.116	0.043	0.095	0.002

Values followed by the same superscripts along the column are statistically the same at $p \leq 0.05$.

N.B: sole pendimethalin non-expired at 0.75 kg ai/ha (T_1), pendimethalin non-expired + one hand weeding at 6 weeks after sowing (T_2), pendimethalin expired at 0.75 kg ai/ha (T_3), pendimethalin expired at 0.75 kg ai/ha + one hand weeding at 6 WAS (T_4), two hand weeding at 3 and 6 WAS (T_5), weed free check (T_6) and weedy check (T_7)

Table 2: Composition of weed species and their relative abundance in the experimental plots.

S/N	Weed Species	Life cycle	Relative abundance (%)	Family
1	*Amaranthus spinosus* Linn.	ABL	20.17	Amaranthaceae
2	*Commelinabenghalensis* Linn.	PBL	19.40	Commelinaceae
3	*Cyperus esculentus*	PS	2.94	Cyperaceae
4	*Desmodium triflorum* (L.) DC	ABL	35.42	Fabaceae
5	*Digitariahorizontalis*	AG	2.42	Poaceae
6	*Phyllantus amarus* Schum. &Thonn.	ABL	1.65	Euphorbiaceae
7	*Sagina procumbens*	PG	1.34	Caryophyllaceae
8	*Sida acuta*Burm F.	PBL	2.75	Malvaceae
9	*Tridax procumbens* Linn.	ABL	13.85	Asteraceae

PBL (Perennial broad leaf); ABL (Annual broad leaf); AG: (Annual Grass); PG (Perennial grass), PS (Annual sedge).

Table 3: Relative frequencies of weeds species encounter in groundnut plot.

S/N		2	4	6	8	10	12	14	TOTAL
1	*Amaranthus spinosus*Linn.	324	269	213	201	247	231	234	1719
2	*Commelinabenghalensis*	225	204	264	226	219	252	264	1654
3	*Cyperus esculentus*	3	6	12	27	50	71	82	251
4	*Desmodiumtriflorum*(L.) DC	13	83	155	537	587	810	834	3019
5	*Digitariahorizontalis*	-	4	8	33	41	56	65	207
6	*Phyllantusamarus*	-	7	10	18	27	37	42	141
7	*Sagina procumbens*	4	5	11	29	25	20	21	115
8	*Sida acuta* Burm F	1	9	14	29	43	65	74	235
9	*Tridax procumbens* Linn.	78	82	147	130	173	280	291	1181
TOTAL		648	669	834	1230	1412	1822	1907	8522

Table 4: Proximate composition of groundnut (Samnut 21)

Treatments	Moisture (%)	Fat (%)	Protein (%)	Ash (%)	Fibre (%)	Carbohydrate (%)
T_1	16.85±0.19^{c}	40.20±0.15^{c}	18.63±0.19^{e}	2.99±0.07^{a}	5.52±0.13^{a}	15.80±0.27^{b}
T_2	15.27±0.29^{d}	41.66±0.28^{b}	20.80±0.13^{c}	2.99±0.08^{a}	5.08±0.11^{b}	14.20±0.67^{c}
T_3	18.79±0.18^{a}	39.34±0.05^{c}	21.80±0.36^{b}	2.79±0.04^{bc}	4.80±0.03^{bc}	12.49±0.58^{d}
T_4	19.98±0.25^{a}	42.92±0.36^{a}	19.51±0.31^{d}	2.94±0.04^{ab}	4.99±0.11^{b}	9.66±0.32^{e}
T_5	12.18±0.16^{e}	39.34±0.12^{c}	23.76±0.13^{a}	2.71±0.01^{c}	4.49±0.09^{cd}	17.51±0.10^{a}
T_6	18.33±0.28^{b}	39.88±0.26^{c}	22.01±0.97^{b}	2.47±0.06^{d}	4.59±0.11^{cd}	12.71±0.53^{d}
T_7	19.65±0.49^{a}	37.27±0.33^{d}	17.84±0.63^{f}	2.85±0.05^{bc}	4.32±0.16^{d}	18.06±0.37^{a}
Mean	17.29	40.08	20.62	2.82	4.82	14.34
P-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Values followed by the same superscripts along the column are statistically the same at $p \leq 0.05$

Table 5: Mineral Composition of Groundnut (Samnut 21)

Treatments	Fe (mg/100 g dry weight)	Zn (mg/100 g dry weight)	K (mg/100 g dry weight)	Ca (mg/100 g dry weight)	N (ppm)
T_1	4.76±0.17[bc]	23.32±0.09[bc]	436.12±0.33[b]	35.25±0.15[c]	37728.13±0.12[a]
T2	6.41±0.11[a]	24.34±0.11[b]	443.51±0.17[a]	54.43±0.36[a]	35194.73±0.09[b]
T_3	6.52±0.12[a]	17.21±0.33[d]	437.63±0.26[b]	31.26±0.33[d]	34855.80±0.09[c]
T_4	5.21±0.09[ab]	18.41±0.36[d]	433.45±0.21[ab]	16.14±0.19[e]	32158.73±0.36[e]
T_5	5.08±0.08[ab]	26.67±0.12[a]	439.02±0.17[a]	16.78±0.21[e]	37739.93±0.13[a]
T_6	4.52±0.03[bc]	26.52±0.13[a]	435.21±0.29[b]	38.12±0.28[b]	35422.83±0.10[b]
T_7	3.24±0.03[c]	21.55±0.26[c]	432.40±0.36[bc]	32.13±0.33[d]	28650.37±0.38[g]
Mean	4.90	22.19	430.67	31.67	33207.21
P-value	0.002	<0.001	<0.001	<0.001	<0.001

Values followed by the same superscripts along the column are statistically the same at $p \leq 0.05$.

N.B: sole pendimethalin non-expired at 0.75 kg ai/ha (T_1), pendimethalin non-expired + one hand weeding at 6 weeks after sowing (T_2), pendimethalin expired at 0.75 kg ai/ha (T_3), pendimethalin expired at 0.75 kg ai/ha + one hand weeding at 6 WAS (T_4), two hand weeding at 3 and 6 WAS (T_5), weed free check (T_6) and weedy check (T_7)

4. CONCLUSION

The study showed that both expired and non-expired pendimethalin were effective in decreasing weed growth and they all improved yield in Samnut 21, except that the treatments where pendimethalin expired were used had lower yield compared to the pendimethalin non-expired. Also, the treatment that showed the highest output was pendimethalin non-expired + one hand weeding at 6 WAS, this is an indication that integrated weed management is not only effective in weed suppression but enhances higher yield compared to other treatments.. (Amare *et* al., 2014; Olorunmaiye *et al*., 2014).

CONFLICT OF INTEREST

The Authors declared no conflict of interest

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