PERFORMANCE OF COWPEA [*Vigna unguiculata* (L.) Walp.] VARIETIES AS INFLUENCED BY WEED CONTROL TREATMENTS IN THE SUDAN SAVANNA OF NIGERIA.

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ABSTRACT: A field experiment was carried out during 2014 and 2015 rainy season at the Research Farm of Kano University of Science and Technology, Wudil, (11^0 52'N, 9^0 20'E and 430m above sea level) to find out the Performance of Cowpea [*Vigna unguiculata* (L.) Walp.] Varieties as Influenced by Weed Control Treatments in the Sudan Savanna of Nigeria. The experiment consisted of two cowpea varieties (IT97K-499-35 and IT93K-452-1) and weed control treatments (Metolachlor at 2 levels of 1.0 and 2.0kg a.i. /ha, at pre-emergence, or combined with hoe weeding at 14 days after sowing or supplementary hoe weeding at 30 days after sowing while weed free check at 14 and 30 days after sowing and weedy check were included as control). The treatments were factorially combined and laid out using split plot design with variety assigned to the main plot and weed control treatments to the sub plots. The result showed that IT93K-452-1 out yielded IT97K-499-35 and exhibits superior growth and yield components such as canopy spread, number of leaves, pod weight per plant and 100 grain yield. The application of Metolachlor at 1.0 and or 2.0 kg a.i./ha followed by supplementary hoe weeding at 30 days after sowing produced significantly higher number of pods per plant, and grain yield per hactare This weed control treatment recorded superior weed control efficiency and also had low weed dry weight and weed index. Hence this treatment when combined with IT93K-452-1 can be recommended for weed control in cowpea for the study area.

Key word: Cowpea, pre- emergence herbicides, weeds, growth, yield and yield components.

INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) walp) is an important and versatile crop cultivated between 35^0N and 30^0S of equator, covering Asia and Oceania, the middle east, southern Europe, Africa southern USA, central and south America (Fery, (1990) however, being a drought tolerant crop with better growth in warm climate, cowpea is most popular in the semi-arid region of the tropic where other food legume does not perform as well. Cowpea has the ability to fix nitrogen even in a very poor soil with pH range 4 - 9.0, Organic matter < 0.2% and a Sand content of > 85%. It is the most important grain legume grown in the tropical savanna zone of Africa; Cowpea is an important grain legume for over 200 million people on the dry savanna of tropical Africa.

The largest production of cowpea is in Africa with Nigeria and Niger predominating with over 9.3 million metric tons of annual production while the grain is a good source of human protein while the haulms are valuable source of livestock protein (Chattha *et al.*, 2007). It is also source of income from many small holder farmer is sub Saharan Africa and contributes to the sustain ability of cropping system and soil fertility improvement in marginal land through provision of ground cover and plant residue, nitrogen fixation and others (Tripathi and Singh 2001). All part of cowpea is useful for food and is nutritious, providing protein, vitamin and mineral. The protein in cowpea seed is richer in amino acid, lysine and others compared to cereal grain (Anonymous, 2010,) the cowpea haulm is also great value to farmers it is also use as cover crop, green manure crop, used for feeding Animals and for erosion control. Weeds serve as the main constraint to its production which resulted in low yield, poor quality of the crop and also low income to the farmer. The objective of this paper was to evaluate the performance of cowpea varieties under different weed control treatments and its tolerance to different levels of herbicides.

MATERIALS AND METHODS

Field trials were conducted during the 2014 and 2015 cropping seasons (June to October) on the Teaching and Research Farm of the Department of Crop science, Faculty of Agriculture, Kano University of Science and Technology Wudil situated at Gaya town (latitude 11^0 52'N; 9^0 20'E) located in the Sudan Savanna Ecological Zone of Nigeria. (Table 1) presents the soil type of the experimental site which was Sandy clay with high proportion of sand (81%) and low proportion of silt and clay, (12%) and (7%) respectively. The soil also had medium organic carbon (0.67%) and a pH of 7.10.

The area had been cropped with cowpea, sorghum and groundnut in the previous years. The experimental site was harrowed, leveled properly using a tractor, and marked out. The gross plots consist of six ridges, 0.75m apart and 3m long given a total area of 13.5m^2, while the net plot consisted of two inner rows, given a total area of 4.5m^2 each, an alley of 0.5m was left between the plots and 1m between the replications respectively. Compound fertilizer, N.P.K (15:15:15) was applied to each plot to provide 20kg N, 54kg P_2O_5 and 20kg K_2O and was incorporated into the soil with a hand rake before ridges were made.

The experiment consisted of six treatments which include a pre-emergence herbicide that was applied as spray to two cowpea varieties (IT97K-499-35 it is an early maturing variety matures between 65 - 75 days it is also an erect type with yellow peel pigmentation, and IT93K-452-1 is an extra early maturing variety which matures between 60-70 days it is an erect types with brown peel pigmentation). The experiment was laid out using split plot design. The cowpea varieties were allocated to the main plots while weed control treatments to the sub plot they were then replicated three times. The herbicides was applied a day after planting using CP15 knapsack sprayer with a green nozzle calibrated to deliver 220 L/ha spray volume at a pressure of 1.5 kg/cm^2. Harvesting cowpea was done on 21 and 28 November 2014 and 2015 respectively, and was harvested when majority of the pods turned yellow. The harvested pods were spread on the mat for two weeks to allow the pods to be well dried before threshing. This was followed by winnowing to separate the seeds from the chaff.

RESULTS AND DISCUSSION

Table 2 presents number of leaf of cowpea varieties which indicated that it is significantly different at all sampling stages in the two years trails with IT97K- 499-35 having higher number of leaf compared with the IT93K-452-1 variety. These supported the finding of Singh *et al.* (2011) reported that spreading and semi-spreading cowpea varieties differ in their potential growth and development which can positively affect the yield of the crop and that of Haruna, and Usman, (2013) who observed a significant variation in growth and yield characters of some improved varieties of cowpea at the same location and attributed it to genetic make up of the varieties examined were spreading varieties produced more number of leaf and this means more photosynthetic area; higher radiation interception and dry matter accumulation for utilization and production of the yield.

The effect of weed control treatment was significant at all sampling stages in which Metolachlor at 2.0 kg a.i.$^{-1}$ followed by supplementary hoe weeding was statistically higher across all the sampling stages in all the tears of the trails and is also statistically similar with Metolachlor at 1.0 kg a.i.$^{-1}$ followed by supplementary hoe weeding at 10WAS sampling stage at 2014 and statistically different at 4 and 8WAS sampling stages in the second year of the trail. The results are in agreement with the finding of Taru *et al.* (2008) who reported that pre-emergence application of Metolachlor at 2.0 kg a.i.$^{-1}$ followed supplementary hoe weeding resulted in significantly higher number of leaf which could probably be attributed to the ability of Metolachlor in preventing weed emergence at early stage. However, weedy check recorded the least number of leaves across all the sampling stages and years, and also produced the lowest mean values. These findings confirm the report of Dadari *et al.* (2005) that, weedy check had significantly lower number of leaf in all sampling stages in both years and this could be due to above and below ground competition of weed with crop which might have retarded the crop growth by reducing the amount of nutrients available in the soil.

The number of branches of cowpea varieties was significantly different at 6 and 8WAS sampling stage in 2014 and all sampling stages in 2015 trail (Table 3). In all cases IT97K–499–35 had the higher number of branches than IT93K-452-1. These supported the findings of Singh *et al*, (2011) that variations in growth and yield of cowpea varieties is largely due to differences in inherent genetic composition of the varieties under consideration.

Similarly, the effect of weed control treatment was significant at all sampling stage (Table 3). Metolachlor at 1.0 kg a.i./ha followed by supplementary hoe weeding, Metolachlor at 2.0 kg a.i./ha followed by supplementary hoe weeding, Weed free check at 14 and 30DAS produced statistically similar and higher number of branches across the sampling stages and years of the trails, The result obtained was similar to the findings of Taru *et al.* (2008). Who indicated that application of Alachlor at 1 - 2kg a.i./ha plus one hand weeding at 30 days after sowing effectively controlled weeds in rainfed groundnut compared to weedy check control plots.

While weedy check significantly recorded the least number of branches which is statistically the same with Metolachlor at 1.0 & 2.0 kg a.i./ha at all sampling stage of the two year trails. The interaction between the treatments was not significant at both sampling stages and years of the trails.

The effect of canopy spread on cowpea varieties is presented in Table 4. Which indicated significantly different at 4WAS in 2014 were IT93K–452–1 variety had significantly wider canopy spread than IT97K – 499 – 35 variety while, IT97K–499–35 variety had significantly wider canopies at 4 and 8WAS in 2015 were, IT93K–452–1 variety recorded superiority canopy spread at 10WAS sampling stage in 2015. The results supported the finding of Ahmad *et al.* (2007) that spreading and semi-spreading cowpea varieties differ in their potential growth and development.

The effect of weed control treatment was significant at all sampling stages (Table 4). Metolachlor at 2.0 kg a.i./ha followed by supplementary hoe weeding was statistically superior and have wider canopies across all the sampling stages and years. It was also similar to the work of **Akobundu (1980**) and that of Lagoke *et al.* (1981) and Taru *et al.* (2008). That Metolachlor is more effective and control annual grasses and some broad leaved weeds in cowpea, peanut crops, soya beans, sunflowers maize, sorghum and potatoes, and also application of Metolachlor with supplementary hoe weeding gave well to excellent weed control and was also supportive for better growth. However, the narrowest canopies were recorded with weedy check plot which was statistically similar with Metolachlor 1.0 & 2.0 kg a.i./ha at most of the sampling stages during the two year trails. the results is also in conformity with the findings of Chikoye and Ekeleme (2001) who pointed out that a total of 263 weed species belonging to 38 families were found in crop fields in West Africa while the highest weed dry weight per hectare was observed in the weedy check was due to the severe uncontrolled weed infestation.

The effect of varieties on crop vigour scores of cowpea is presented in Table 5 which indicated that it is significant at 8 and 10WAS in 2014 and 8WAS in 2015 trail with IT93K–452–1 being superior to IT97K–499 – 35 while at 4WAS IT97K–499–35 cowpea variety recorded superior growth attributes than IT93K–452–1. Similar reports were made by Krasilnikoff *et al.* (2003) and Singh *et al.* (2003), adding that varieties differ in their genetic make up and this could have reflected in their yield potentials.

The effect of weed control treatment was significantly different at all sampling stages with the application of Metolachlor at 1.0 & 2.0 kg a.i./ha followed by supplementary hoe weeding at 4 and 6WAS in 2014 trail and 6WAS in 2015 trail having the highest growth attributes at all sampling stages. In a related study Taru *et al.* (2008) reported that combination of cultural with chemical method offers opportunities for integrated weed control by reducing the number of weeding in legumes crops and improving plant performance. They added that application of chemicals (herbicides) at early stage of crop growth to control weeds enable the way to utilize the available soil nutrients thus giving opportunities to grow faster.

Weedy check statistically recorded the least vigour plants across all the sampling stages and years of the trails which are statistically similar with application of Metolachlor at 1.0 and 2.0 kg a.i./ha at all sampling stages in both years. The result is in accordance with findings of Dadari *et al.* (2005), which showed that, the weedy check had significantly least vigour and could be due to above and below ground competition between weed and crop which might have retarded the vigour of the crop.

Table 6 presents the effect of weed control treatments on weed index of cowpea varieties, IT93K–452–1 had significantly higher weed index than IT97K–499 – 35 in 2014 while in 2015 the two varieties did not differ significantly. Application of Metolachlor at 1.0 & 2.0kg a.i./ha followed by supplementary hoe weeding had statistically the lower weed index. The results are in agreement with the findings of Ishaya *et al.* (2008) that Metolachlor at 3.0 kg a.i./ha and Galex at 1.2 kg a.i./ha (Metolachlor +Metobrumuron) pre emergence. According to them the mixture of Metolachlor and Galex was better in controlling annual grasses and broad leaf weeds. However, weedy check recorded the highest weed index among all the treatments in both years of the trails.

The effect of weed control treatment on weed dry weight of cowpea varieties are presented in Table 6. The result indicated that the two varieties differ significantly in respect to weed dry weight during 2014 cropping season with IT97K – 499 – 35 having heavier weed dry weight than IT93K – 452 – 1 while in 2015 the effect was not significant. Weed control treatment was significantly different with weedy check producing the higher weed dry weight while Metolachlor at 1.0 and 2.0kg a.i./ha followed by supplementary hoe weeding statistically having similar and lower weed dry weight across the two year trails. These results were in support of Logoke *et al.* (1981) who reported that chemical weed control combine with other cultural practices may practically help in reducing weed competition, crop losses and labour cost.

The influence of weed control treatments on cowpea varieties in respect to weed control efficiency is presented in Table 6. Varieties did not significantly differ in this respect at all years of the trails. The influence of weed control treatment were significantly different with application of Metolachlor at 1.0 and 2.0 kg a.i./ha followed by supplementary hoe weeding having statistically the higher percentage of weed control efficiency, and these supported the finding of Chikoye *el al.* (2001) who observed that weed competition is most serious when the crops are young, keeping the crop free of weeds for the first one-third to one-half of the life cycle of the crop offers effective control and also keeping the crop free from weed for the first one third of its life cycle usually assures maximum production (Mani *et al.*, 1979). Weedy check recorded the lowest value of weed control efficiency.

The pod weight of the varieties per plant of cowpea was presented in Table 6 and it was significantly different with IT97K-499-35 being superior over IT93K – 452 – 1. This finding is in conformity with that of Richburg *et al.* (2006) who observed significant difference between two varieties of groundnut which he attributed to variations in their genetic make up as well as response to soil and water use efficiency, and which he noticed across seasons and location.

The effect of weed control treatment on pod weight was significantly different at all seasons with Metolachlor 2.0 kg a.i./ha followed by supplementary hoe weeding having the higher pod weight per plant in 2014l. While in 2015 application of Metolachlor at 1.0 and 2.0 kg a.i./ha followed by supplementary hoe weeding produced statistically the highest pod weight per plant. This finding is in conformity with that of Akobundu, (1987) who observed that Metolachlor is likely to be effective against annual grasses in cowpea production and producing higher pods per plant. Weedy check recorded the lowest pod weight per plant in all the trails as described earlier by Akobundu, (1987).

The effect of the variety on hundred grain weight of cowpea was presented in Table 7. Indicating significant different between the two varieties with IT93K – 452 – 1 out yielding and been superior over IT97K – 499 – 35 in all the trails. The effect of weed control treatment was significantly different with Metolachlor at 2.0 kg a.i./ha followed by supplementary hoe weeding having the higher grain weight in the 2014 trail which is statistically the same with Metolachlor at 1.0 kg a.i./ha followed by supplementary hoe weeding in 2015 trail, the results is in accordance with the finding of Agoola, (1994) who reported that Metolachlor at 1.2 kg a.i./ha attributed to the significant increase in seed yield by 45% and 80% respectively as compared to the unweeded check. Weedy check recorded the least hundred grain weight which is statistically similar with some other treatments in all the seasons. The results was in agreement with the finding of Aliyu and Lagoke, (2000) that weeds compete with crops for limited environmental resources and habour diseases and pests that are harmful to the crop are more severe in unweeded plots and there by producing lower weight of the grains in that plots.

The effect of varieties on shelling percentage of cowpea is presented in Table 7. And found that it was not significantly different in the 2014 season while in the 2015 season it was significantly different with IT97K – 499 – 35 been superior and having higher shelling percentage compared to IT93K – 452 – 1.

The effect of weed control treatment was also significantly different with application of Metolachlor at 1.0 and 2.0kg a.i./ha followed by supplementary hoe weeding having statistically the higher shelling percentage in both seasons (Table 7). these is in

accordance with the finding of Ishaya *et al*, 2008 that un controlled weed growth accounted for 40-81% reduction in yield attributes such as the pod weight, shelling percentage and consequently lower grain yield. While weed free check at 14 and 30DAS recorded an intermediate shelling percentage in all the season, which agreed with finding of Olorunmaiye (2010), that the practices produced reasonable yield but were hard laborious and expensive due to increasing cost of labour as such were un-economical. Weedy check resulted in the lowest shelling percentage which is statistically similar with the some other treatments in the two seasons. While in a related development by Ahmed *et al*, (2007) they pointed out that weeds reduces both quality and quantity of harvested product, increase the incidence of pest and diseases and at end resulted in lost to the farmers.

The effect of variety on grain yield of cowpea was presented in Table 7. Significant different were observed with IT93K – 452 – 1 having higher grain yield than IT97K – 499 – 35 in 2014 season while not significant in 2015 season.

The effect of weed control treatment was significantly different and showed that Metolachlor at 1.0 and 2.0kg a.i./ha followed by supplementary hoe weeding having statistically the higher grain yield compared to the other treatments in the 2014 season, while Metolachlor at 1.0 kg a.i./ha followed by supplementary hoe weeding produced statistically the higher grain yield compared to the other treatments in the 2015 season, the result is in conformity with the finding of Olorunmaiye, (2010) that, weed also deteriorate the quality of farm products and consequently reduce yield and market value of the cowpea. Weedy check resulted in the lowest grain yield all of the seasons examined.

Conclusively, it can be recommended that IT93K – 452 – 1 cowpea variety can planted in the study area for improving cowpea production. Similarly, pre-emergence application of Metolachlor at 1.0 and or 2.0 kg a.i./ha followed by supplementary hoe weeding can lead to higher weed control efficiency and Grain yield of cowpea. Moreover, this method of using chemicals will help in reducing the scarcity of labour during weeding periods and improved farmer's income at the end of the season in the study area.

Table 1: Physico-chemical Properties of the soil at Experimental site 2014 and 2015.

Soil Properties	0 – 30cm
Physical (%)	
Sand	81
Clay	7
Silt	12
Textural Class	Sandy clay
Chemical	
pH (H_2O)	7.10
Organic Carbon (gkg^{-1})	8.23
Total Nitrogen (gkg^{-1})	0.11
Available P ($mgKg^{-1}$)	14.10
Exchangeable base (cmol (+) kg^{-1})	
Ca	4.30
Mg	0.36
K	0.31
Na	0.30
CEC	6.29

Table 2: Effect of weed control treatment on number of leaves of cowpea varieties at KUST Wudil, 2014 and 2015.

Treatment	2014 WAS				2015 10WAS			
	4	6	8	10	4	6	8	10
Varieties								
IT97K- 499-35	32.11a	42.7a	56.4a	137.8a	26.89a	43.2a	57.2a	119.2a
IT93K- 452-1	29.83b	36.5b	49.8b	113.3b	23.83b	38.2b	55.3b	109.4b
SE ±	1.73	2.26	1.85	7.23	0.49	1.70	2.35	2.85
Weed Control Treatment								
Metolachlor 1.0 kg $a.i.^{-1}$	27.67b	37.5bc	49.7b	117.8abcd	16.83c	30.5b	41.3c	89.2b
Metolachlor 2.0 kg $a.i.^{-1}$	31.17b	36.0bc	45.3b	109.5cd	17.17c	32.7b	38.3c	82.7b
Metolachlor 1.0 kg $a.i.^{-1}$+SHW	35.17b	39.7b	56.0b	142.7ab	33.00b	47.7a	73.7b	148.7a
Metolachlor 2.0 kg $a.i.^{-1}$+SHW	42.67a	53.5a	79.0a	142.5abc	42.00a	57.0a	87.0a	142.5a
Weedy checks	15.83c	28.7d	33.2c	92.3e	10.50c	24.0b	32.7c	68.8b
WFC at 14 & 30DAS	33.33b	42.2b	54.2b	148.5a	32.67b	52.3a	64.7b	153.8a
SE ±	2.02	2.57	3.71	8.73	1.89	2.66	4.35	7.53
Interaction								
V X WCT	NS	NS	NS	NS	NS	NS	NS	NS

Means with the same letter(s) in the same column are not significantly different (P < 0.05%) using SNK = Student-Newman-Keuls test, NS = not significant, WFC = Weed free checks, SHW = Supplementary hoe weeding, WAS = weeks after sowing, WCT = weed control treatment.

Table 3: Effect of weed control treatment on number of branches of cowpea varieties at KUST Wudil, 2014 and 2015.

Treatment	2014WAS				2015WAS			
	4	6	8	10	4	6	8	10
Varieties								
IT97K-499-35	6.56	22.2a	29.4a	40.6	6.78a	23.44a	29.17a	38.20a
IT93K-452-1	5.61	19.6b	27.2b	38.5	6.11b	20.89b	27.56b	36.20b
SE ±	0.38	1.31	1.72	2.55	0.29	0.63	0.46	0.24
Weed Control Treatment								
Metolachlor 1.0 kg a.i./ha	5.83b	13.8b	18.2b	24.5d	5.00b	14.83b	20.33b	24.50b
Metolachlor 2.0 kg a.i./ha	5.17b	16.0b	21.3b	32.8cd	5.17b	15.00b	19.17b	27.50b
Metolachlor 1.0 kg a.i./ha+SHW	6.83a	24.5a	31.2a	43.7ab	9.00a	29.17a	35.83a	44.70a
Metolachlor 2.0 kg a.i./ha+SHW	7.67a	28.8a	41.2a	51.5a	8.33a	32.50a	42.67a	53.70a
Weedy checks	3.50c	14.8b	21.3b	30.5cd	3.17c	11.50b	13.33c	23.70b
WFC at 14 & 30DAS	7.50a	28.0a	36.7a	54.2a	8.00a	30.00a	38.83a	49.00a
SE ±	0.31	2.65	2.90	4.18	0.44	1.65	1.92	2.85
Interaction								
V X WCT	NS	NS	NS	NS	NS	NS	NS	NS

Means with the same letter(s) in the same column are not significantly different (P < 0.05%) using SNK = Student-Newman-Keuls test, NS = not significant, WFC = Weed free checks, SHW = Supplementary hoe weeding, WAS = weeks after sowing, WCT = weed control treatment.

Table 4: Effect of weed control treatment on canopy spread of cowpea varieties at KUST Wudil, 2014 and 2015.

Treatment	2014WAS				2015WAS			
	4	6	8	10	4	6	8	10
Varieties								
IT97K-499-35	13.50b	22.61	47.5	54.9	12.06b	20.62	42.40b	57.80a
IT93K-452-1	13.97a	22.71	47.2	52.0	12.76a	20.56	44.20a	52.30b
SE ±	0.28	0.61	2.10	3.77	0.23	0.93	1.58	2.06
Weed Control Treatment								
Metolachlor 1.0 kg a.i.$^{-1}$	11.75c	19.32c	35.2c	39.6d	8.83c	14.44c	24.79c	30.40c
Metolachlor 2.0 kg a.i.$^{-1}$	11.30c	20.42c	37.7c	40.1d	7.10c	15.95c	26.17c	28.90c
Metolachlor 1.0 kg a.i.$^{-1}$ + SHW	15.72b	26.23b	59.3b	70.5b	16.42b	26.29b	59.77b	83.78a
Metolachlor 2.0 kg a.i.$^{-1}$ + SHW	19.97b	31.73a	74.6a	90.4a	20.63a	31.65a	74.89a	93.55a
Weedy checks	6.95d	13.83d	25.9c	22.8e	4.75d	10.29d	18.77c	21.00c
WFC at 14 & 30DAS	16.73b	24.57b	51.6b	57.4c	16.73b	24.92b	55.26b	72.72b
SE ±	0.63	1.14	3.31	3.60	0.79	1.34	3.74	3.40
Interaction								
V X WCT	NS	NS	NS	NS	NS	NS	NS	NS

Means with the same letter(s) in the same column are not significantly different (P < 0.05%) using SNK = Student-Newman-Keuls test, NS = not significant, WFC = Weed free checks, SHW = Supplementary hoe weeding, WAS = weeks after sowing, WCT = weed control treatment.

Table 5: Effect of weed control treatment on crop vigour scores of cowpea varieties at KUST Wudil, 2014 and 2015.

Treatment	2014WAS				2015WAS			
	4	6	8	10	4	6	8	10
Varieties								
IT97K-499-35	7.39	6.00	5.00b	4.78b	7.67b	8.89	7.72a	4.50
IT93K-452-1	7.72	5.61	5.61a	5.22a	8.22a	9.06	6.94b	4.78
SE ±	0.36	0.51	0.28	0.87	0.17	0.63	0.31	0.34
Weed Control Treatment								
Metolachlor 1.0 kg a.i.$^{-1}$	6.33cd	4.50b	3.17c	3.50cd	5.83c	5.83b	4.00c	1.83c
Metolachlor 2.0 kg a.i.$^{-1}$	6.67cd	4.33b	2.87c	2.67cd	6.17c	6.83b	4.00c	2.17c
Metolachlor 1.0 kg a.i.$^{-1}$ + SHW	8.17ab	6.50a	7.67b	7.33ab	10.83a	12.67a	12.50a	7.83a

Metolachlor 2.0 kg a.i.$^{-1}$ + SHW	9.67a	9.17a	9.33a	9.33a	11.33a	13.00a	12.17a	8.50a
Weedy checks	5.67e	2.67c	2.33c	1.83d	4.17d	4.67b	2.50c	1.00c
WFC at 14 & 30DAS	8.83a	7.67a	6.50b	5.33bc	9.33b	10.83a	8.83b	6.50b
SE ±	0.53	0.38	0.43	0.79	0.59	1.10	0.43	0.45
Interaction								
V X WCT	NS	NS	NS	NS	NS	NS	NS	NS

Means with the same letter(s) in the same column are not significantly different (P < 0.05%) using SNK = Student-Newman-Keuls test, NS = not significant, WFC = Weed free checks, SHW = Supplementary hoe weeding, WAS = weeks after sowing, WCT = weed control treatment.

Table 6: Effect of weed control treatment on weed index, weed control efficiency and weed dry weight of cowpea varieties at KUST Wudil, 2014 and 2015.

Treatment	2014			2015		
	WI	WCEF	WDDWT	WI	WCEF	WDDWT
Varieties						
IT97K-499-35	16.1b	39.4a	1328.00a	22.50	37.50a	1598.00
IT93K-452-1	24.8a	37.1b	1268.00b	23.40	35.80b	1442.00
SE ±	7.53	0.11	66.7	3.61	1.53	178.8
Weed Control Treatment						
Metolachlor 1.0 kg a.i.$^{-1}$	42.8b	19.2c	1694.00b	45.70b	11.70c	1865.00b
Metolachlor 2.0 kg a.i.$^{-1}$	43.7b	19.5c	1563.00b	56.60b	15.10c	1920.00b
Metolachlor 1.0 kg a.i.$^{-1}$ + SHW	-11.0c	69.0a	621.00d	-28.50d	74.50a	635.00d
Metolachlor 2.0 kg a.i.$^{-1}$ + SHW	-26.9c	88.1a	342.00d	-13.70c	72.00a	548.00d
Weedy checks	73.8a	0.00d	2482.00a	77.50a	0.00d	2933.00a
WFC at 14 & 30DAS	0.00c	33.6b	1087.00c	0.00c	46.50b	1221.00c
SE ±	7.68	2.93	138.3	4.86	3.30	139.50
Interaction						
V X WCT	NS	NS	NS	NS	NS	NS

Means with the same letter(s) in the same column are not significantly different (P < 0.05%) using SNK = Student-Newman-Keuls test, WI = weed index, WCEF = weed control efficiency, WDDWT = weed dry weight, NS = not significant, WFC weed free checks, SHW = Supplementary hoe weeding, WAS = weeks after sowing, WCT = weed control treatment.

Table 7: Effect of weed control treatment on pods weight, 100 seed weight, shelling percentage and grain yield of cowpea varieties at KUST Wudil, 2014 and 2015.

Treatment	2014				2015			
	PWP	HGW	S (%)	GY	PWP	HGW	S (%)	GY
Varieties								
IT97K-499-35	119.5a	25.3b	42.2	1209.00 b	117.30a	66.60b	43.20a	1071.00
IT93K-452-1	112.8b	27.8a	45.5	1311.00a	108.40b	69.70a	38.60b	1115.00
SE ±	6.03	1.80	3.70	66.6	5.13	0.81	2.40	55.00
Weed Control Treatment								
Metolachlor 1.0 kg a.i.$^{-1}$	83.10c	19.3bc	25.15c	14.00bc	64.20c	23.80c	16.40c	751.00c
Metolachlor 2.0 kg a.i.$^{-1}$	100.3c	23.1b	17.37c	981.00bc	73.80c	28.40c	16.60c	714.00c
Metolachlor 1.0 kg a.i.$^{-1}$+SHW	139.9b	31.9b	72.10a	1817.00a	190.50a	127.60ab	76.40a	1759.00a
Metolachlor 2.0 kg a.i.$^{-1}$+SHW	173.9a	44.3a	79.72a	1808.00a	170.70ab	113.00a	70.30a	1490.00b
Weedy checks	52.7d	11.3c	15.46c	732.00c	32.50d	16.90c	9.50c	482.00c
WFC at 14 & 30DAS	146.9b	29.4b	53.36b	1307.00b	145.30b	99.30b	56.20b	1362.00b
SE ±	8.27	3.19	4.65	112.9	10.59	5.76	2.65	79.70
Interaction								
V X WCT	NS	NS	NS	NS	NS	NS	NS	NS

Means with the same letter(s) in the same column are not significantly different (P < 0.05%) using SNK = Student-Newman-Keuls test, NS = not significant, WFC = Weed free checks, PWP = Pod weight/plant (g), HSW = hundred seed weight, S% = Shelling (%), GY = Grain yield, SHW = Supplementary hoe weeding, WAS = weeks after sowing, WCT = weed control treatment.

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