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Reproductive performance of two Cowpea (*Vigna unguiculata* (L)Walp) varieties Ife brown and TVX3236 as influenced by Imidazolinone and Dinitroaniline herbicides

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Abstract

Weed control management was carried out in plots of two cowpea (*Vigna unguiculata* (L) Walp) varieties Ife brown and TVX3236 at the University of Ilorin main Campus during 2004 and 2005 cropping seasons. Imidazolinone (Imazaquin, and Imazethapyr) and Dinitroaniline (pendimethalin) herbicides were used as weed control agents. Results of this study revealed that these herbicides were adequate both as pre and early post emergence applications for weed control in cowpea without serious set back on the reproductive parameters such as number of pods per plant, pod weight per plant, seed number per plant, pod length, seed number per pod and pod filling potential. Seed number per pod was higher in herbicide treatments than the weedy control in both cowpea varieties. However, reduction in seed number per pod was noticed in higher concentration of 0.375 kg a.i./ha in the pre-emergence application of pendimethalin, pursuit plus and the early post emergence application of pursuit plus. There was no reduction in the pod length of both varieties by any of the herbicide treatments.

keywords: Imidazolinone, Dinitroaniline,Imazaquin,Imazethapyr,Pendimethalin, *Vigna unguiculata (L)*(Walp)

Introduction

Cowpea is an annual herbaceous plant with stems varying in erectness and bushiness. Depending on the varieties, stem may be erect, creeping or climbing (Awonaike *et al.*, 1990; Peksen *et al*., 2004). Leaves are trifoliate with petioles green and 2.5-12.5cm long. A more recent and reliable statistics by FAO reported that about 7.56 million tonnes of cowpea were produced annually on about 12.75 million hectares of land (IITA, 2007). Sub-Saharan Africa was reported to account for about 70% of total world production (IITA, 2007). Nigeria is still said to be the world largest cowpea producer where about 2.1 million tonnes are produced per annum. This is followed by Niger (650,000 tonnes) and Mali with 110,000 (IITA, 2001).

Cowpea is of great nutritional value and readily add to the dietary protein need. It is rich in proteins and mineral elements (Ayodele and Yalwa, 2004, 2005; Kay, 1979; Mullen, 2005; Onwugbuta-Enyi, 2004). Cowpea is an important food legume crop in the tropics and subtropics providing a less expensive source of protein in many diets (Kay, 1979, Okafor and Adegbite, 1991). In Africa, cowpeas are the most economically important indigenous food legume (Geonaga *et al.*, 2008). They are consumed in different forms, with many local variations in their preparation.

Most frequently, they are cooked together with vegetables (Valenzuela and Smith, 2002), spices and often palm oil to produce a thick bean soup, which accompanied the basic staple food, such as cassava, yams and plantain. They are also ground into flour and mixed with sliced onion, spices and made into cakes, which are either deep-fried (akara balls), or steamed (moinmoin) among the Yoruba ethnic group in Nigeria (Kay, 1979). Fresh immature seeds and pods are sometimes boiled and eaten as vegetable (Valenzuela and Smith, 2002).

Weed competition has the capability of lowering the quality of vegetative growth, flowering, fruiting and seed production as well as the quality of the fruit and seed yield. Weed also interferes with harvesting thus increasing the time and costs involved in crop production. The aim of weed management is to tilt the crop-weed balance in favour of the crop. Whenever possible, several weed control methods which include, cultural, biological or chemical could be used separately or in combination to give the desired result (Kay, 1979; Poku and Akobundu, 1985, Pal and Singh, 1990, Olorunmaiye and Ogunfolaji, 2002, Gibson *et al.*, 2007). Weed reduces crop yield by interfering with crop growth. Hand weeding limits agricultural productivity because there is a limit to the amount of land area that can be weeded even when the labour is free (Akobundu, 1987). Hand weeding requires over 50% of the farmer`s time, leaving him and his family with little or no time for other activities (Akobundu, 1987). Use of herbicides may therefore, provide a timely and adequate alternative to hand weeding as this will not only remove the drudgery involved but also lower the cost of weeding and provide protection for the crops against early weed

competition when pre-emergence herbicides are used (Akobundu, 1987).

The report of this study dwells on the adequacy of both imidazolinone and dinitroaniline herbicides on fruit and seed production in Cowpea. Chemical structures of herbicides used in this study are shown in (Figs.1-3).

Materials and methods

Land preparation and planting

In each of the planting seasons, cowpeas were planted on freshly hand cultivated ridges. Each ridge has a size of 1 by 3 square metre. Planting was done in August (6/08/2004) and June (1/06/2005). Seeds of Ife brown and TVX3236 were planted by direct seeding at two seeds per hole and 25cm intra-row spacing**.** The experiments were designed as complete randomized blocks with the treatments in three replicates.

Herbicide application

Three herbicides: Imazaquin (Scepter), Pendimethalin (Stomp or Prowl) and Pursuit Plus (Pursuit(Imazethapyr) + Stomp) were applied as pre-emergence treatment immediately after planting while early post-emergence treatment was carried out within 10-14 days after planting using a 15litre CP15 Knapsack sprayer, fitted with a green deflector nozzle, which was calibrated to deliver a spray volume of 200L/ha.Three concentrations (0.125, 0.250 and 0.375 kg.a.i/ha) were used both for Pre and early post-emergence application. Quantities of herbicides used were calculated using the formular Q= R x A/C. where, Q=Quantity,R = Rate of herbicide to be used, A = Area of Land or Plot, C = Concentration of the herbicide formulation (Akobundu,1987).

Plant protection

Cowpea plants were protected against insect pests by regular spraying with emulsifiable concentrate 250EC of Karate (Lambdacyhalothrin) at two weeks interval before flowering and weekly from flowering to mature fruit stage.

Harvesting

Cowpea pods were harvested manually at 12WAP when the pods were sufficiently dried on the parent plants. Thereafter, the following reproductive parameters were taken: number of pods per plant by direct counting, pod weight per plant by weighing the total pods per plant (g), number of seeds per plant by direct counting, seed weight per plant by weighing the total number of seeds per plant, pod length by direct measuring of pods using a metre rule and filling potential was determined by dividing the total number of seeds in a pod by the length of that pod (number of seeds per pod length). Filling potential was determined using the method of Remison, (1978).

Data analysis

All data collected were subjected to analysis of variance (ANOVA) using SPSS package. Means were separated

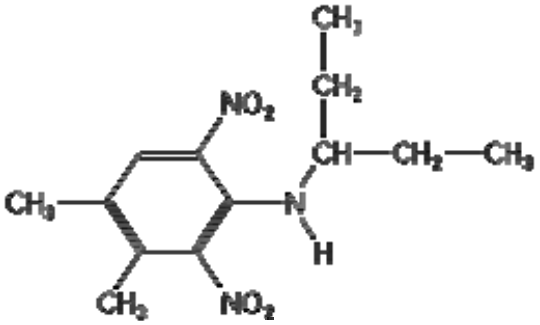

Fig 1. Chemical structure of Pendimethalin: N – (1-ethylpropyl)-3, 4-dimethyl-2, -6-dinitrobenzenamine (CA)

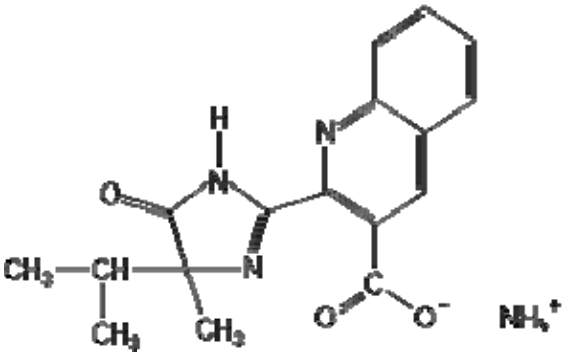

Fig 2. Chemical structure of Imazaquin: 2-(4-isopropyl-4-methyl (-5-oxo-2-imidazolin-2-3 quinoline)carboxylic acid

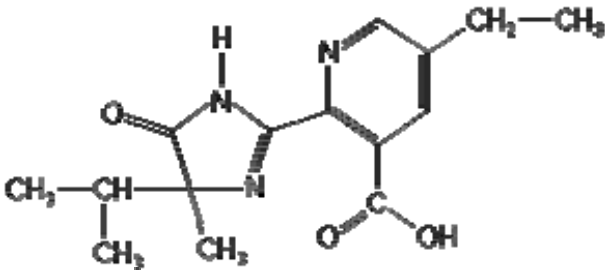

Fig 3. Chemical structure of Imazethapyr: 5-ethyl-2-[(*RS*)-4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl]nicotinic acid.

using Duncan`s Multiple Range Test at 5% probability level.

Results

Effect of herbicides on reproductive performance of Ife brown and TVX 3236 in 2004 and 2005

Reproductive parameters were significantly different in Ife brown and TVX3236 during 2004 trial except in the pod weight and seed number per plant in TVX3236 and seed number per plant in Ife brown under pre emergence application of pursuit plus (purspre) (Table 1). Highest pod number, pod weight (g), seed number and seed weight (g) per plant (18.00±2.65, 24.97±13.06g, 121.67±43.15 and 17.33±6.37g) were obtained in the weedy control of pre-

Table1. Effect of herbicides on reproductive parameters of Ife brown and TVX3236 in 2004

	Pod No/plt		Pod Wt/plt		Seed No/plt		Seed wt/plt	
Herbcides (Kg.a.i/ha).	IFB	TVX3236	IFB	TVX3236	IFB	TVX3236	IFB	TVX3236
Imazapre								
Cont	10.00e-j	7.67g-j	16.33a-f	9.17c-f	75.67a-h	54.00c-h	14.83ab	5.67f-j
0.125	6.67ij	13.33b-j	7.83ef	15.67a-f	38.33h	106.67a-f	4.33j	10.83a-j
0.250	13.33b-j	12.00c-j	24.97a	13.50b-f	121.67ab	89.00a-h	17.33a	9.33b-j
0.375	9.67e-j	17.67a-f	13.17b-f	20.50ab	82.33a-h	121.00ab	8.67b-j	12.67a-f
Imazapost								
Cont	10.00e-j	15.67a-h	16.33a-f	15.83a-f	75.67a-h	104.33a-g	11.50a-i	10.50b-j
0.125	6.67ij	9.33f-j	10.33b-f	10.33b-f	50.00d-h	54.67c-h	6.67d-j	6.33d-j
0.250	10.33d-j	9.00f-j	12.33b-f	11.33b-f	62.67b-h	76.33a-h	7.67c-j	7.83c-j
0.375	9.67e-j	9.33f-j	12.33b-f	13.67b-f	80.33a-h	59.00b-h	8.33b-j	6.27e-j
Pendipre								
Cont	18.00a-e	13.67a-j	20.50ab	11.17b-f	118.00a-c	81.00a-h	13.00a-e	7.50c-j
0.125	11.67c-j	16.00a-h	19.50a-c	13.50b-f	102.33a-h	113.33a-d	14.00a-c	8.50b-j
0.250	12.00c-j	11.67c-j	18.17a-e	10.00b-f	82.33a-h	70.33a-h	12.33a-g	6.33d-j
0.375	12.33c-j	19.67a-b	18.17a-e	19.00a-d	84.33a-h	120.67ab	11.33a-j	11.67a-h
Pendipost								
Cont	9.67e-j	8.67g-j	12.00b-f	8.50d-f	70.33a-h	53.67c-h	7.83c-j	5.33g-j
0.125	7.33h-j	13.67a-j	9.83b-f	12.67b-f	42.33f-h	95.67a-h	5.83f-j	5.00h-j
0.250	6.33j	12.67c-j	8.33d-f	16.50a-f	42.00gh	109.33a-e	4.50ij	9.67b-j
0.375	9.00f-j	16.33a-g	9.00c-f	17.33a-e	53.67c-h	105.33a-g	4.67h-j	10.00b-j
Purspre								
Cont	9.00f-j	11.67c-j	14.33b-f	14.17b-f	83.00a-h	92.67a-h	9.33b-j	9.17b-j
0.125	9.00f-j	15.33a-i	10.50b-f	12.17b-f	59.33b-h	91.00a-h	7.00c-j	6.67d-j
0.250	12.33c-j	14.00a-j	14.67a-f	13.00b-f	73.67a-h	96.33a-h	9.00b-j	9.00b-j
0.375	12.00c-j	14.33a-j	15.33a-f	12.50b-f	87.67a-h	78.00a-h	10.67a-j	7.17c-j
Purspost								
Cont	5.67j	14.3a	6.50f	17.0a-f	45.67e-h	120.67ab	5.50h-j	12.33a-g
0.125	13.67a-j	21.67ab	20.17ab	19.00a-d	107.67a-e	129.67ab	13.33a-c	11.50a-i
0.250	12.33c-j	22.00a	13.83b-f	16.67a-f	70.67a-h	122.33ab	11.50a-i	10.33b-j
0.375	10.00e-j	18.67a-d	13.17b-f	16.00a-f	64.33b-h	122.33ab	8.83b-j	10.17b-j

Values in the same group carrying the same letter/s are not significantly different at (p=0.05).Imazapre=pre-emergence application of Imazaquin; Imazapost = post-emergence application of Imazaquin; Pendipre=pre-emergence application of Pendimethalin; Pendipost=post-emergence application of Pendimethalin; Purspre=pre-emergence application of Pursuit plus; Purspost = post-emergence application of Pursuit plus; Cont = weedy control

emergence application of pendimethalin (pendipre) treated plot and at 0.250kg.a.i/ha pre emergence application of imazaquin (imazapre) respectively (Table1). Highest TVX3236 pod number, pod weight, seed number and seed weight per plant (22.00±7.81,20.50±10.04g, 129.67±45.01 and 12.67±5.30g) in 0.250kg a.i/ha of post emergence application of pursuit plus(purspost), 0.375kg a.i/ha of imazapre, 0.125kg a.i /ha purspost, and 0.375kg.a.i/ha imazapre respectively (Table 1).

In 2005 planting period, pod number per plant in Ife brown was significantly different in all herbicide treatments at (p=0.05). Highest pod number, pod weight, seed number and seed weight per plant in Ife brown were obtained in the weedy control of purspre (14.67±4.93, 20.17±12.47g, 122.00±88.78 and 15.33±9.29g), respectively. For TVX3-236 however, highest pod number, pod weight, seed number and seed weight per plant (21.33±6.11, 19.00± 1.73g, 137.33±48.20 and 14.00±1.00g) respectively were obtained in purspre at 0.375, 0.125, 0.375 and 0.125kg a.i /ha respectively (Table 2).

Effect of herbicides on reproductive performance of Ife brown and TVX 3236 (pod filling potential) in 2004 and 2005

In 2004, pod length, seed number per pod and filling potential in Ife brown were significantly different at p=0.05 in all the herbicide treatments and concentrations. Highest pod length, seed number/pod and pod filling potential (17.55±0.25cm, 15.00±1.00 and 1.02±0.04) were obtained

Table 2. Effect of herbicides on reproductive parameters of Ife brown and TVX3236 in 2005

	Pod No/plt		Pod Wt/plt		Seed No/plt		Seed wt/plt	
Herbcides (Kg.a.i/ha).	IFB	TVX3236	IFB	TVX3236	IFB	TVX3236	IFB	TVX3236
Imazapre								
Cont	8.33e-i	8.67e-i	13.00a-j	8.17g-j	65.00e-h	55.67f-h	8.33b-j	6.67e-j
0.125	5.00i	8.00e-i	6.67ij	8.67g-j	36.67h	63.67e-h	5.00i-j	6.67e-j
0.250	9.00d-i	8.00e-i	13.17a-j	8.00g-j	82.33a-h	51.00f-h	10.00a-j	5.67g-j
0.375	11.00c-i	10.33d-i	13.67b-j	9.00f-j	75.6c-h	58.00e-h	9.67a-j	6.67e-j
Imazapost								
Cont	11.67c-i	13.67b-f	13.33c-j	11.33b-j	75.67c-h	83.67a-h	10.00a-j	8.00b-j
0.125	7.67f-i	8.00e-i	9.83e-j	7.67g-j	54.00f-h	52.67f-h	7.67c-g	5.33h-j
0.250	7.33f-i	11.33c-i	11.67b-j	10.67c-j	61.33e-h	74.00d-h	8.00b-j	8.00b-j
0.375	10.33d-i	15.67a-d	15.67a-g	9.67e-j	93.67a-h	80.67b-h	11.67	8.33b-j
Pendipre								
Cont	8.67e-i	13.33c-g	10.67c-j	11.83b-j	66.67d-h	81.67a-h	8.00b-j	8.67b-j
0.125	11.33c-i	14.67b-e	14.67a-i	12.67b-j	72.67d-h	93.33a-h	10.00a-j	9.00b-j
0.250	12.67c-h	17.33a-c	18.33a-d	17.67a-e	113.33a-e	106.00a-f	13.00a-d	12.67a-e
0.375	12.00c-h	20.00ab	14.33a-j	17.00a-f	78.33c-h	131.00a-c	10.67a-j	13.33a-c
Pendipost								
Cont	10.67c-i	13.33c-g	14.00a-j	14.00a-j	76.33c-h	92.67a-h	10.00a-j	11.00a-i
0.125	6.33hi	6.67g-i	10.33d-j	6.17j	67.67d-h	39.67h	8.33b-j	4.67j
0.250	11.33c-i	8.00e-i	14.33a-j	7.33h-j	97.67a-g	48.33gh	10.00a-j	6.00f-j
0.375	10.67c-i	14.67b-e	18.33a-d	13.00a-j	82.00a-h	93.00a-h	12.00a-f	10.00a-j
Purspre								
Cont	14.67b-e	10.67c-i	20.17a	12.33a-j	122.00a-d	83.00a-h	15.33a	8.50b-j
0.125	13.00c-h	20.00ab	15.67a-j	19.00ab	89.67a-h	134.00ab	11.33a-h	14.00ab
0.250	10.67c-i	9.67d-i	12.33a-j	7.67g-j	84.33a-h	51.00f-h	8.33b-j	5.33j-h
0.375	11.67c-i	21.33a	15.00a-h	18.67a-c	81.00b-h	137.33a	11.33a-h	13.33a-c
Purspost								
Cont	10.67c-i	10.33d-i	10.33d-i	8.50g-j	67.00d-h	57.67e-h	9.67a-j	5.67g-j
0.125	10.33d-i	10.00d-i	14.33a-j	8.33g-j	74.00d-h	57.67e-h	10.00a-j	6.33e-j
0.250	8.00e-i	13.00c-h	12.83a-j	12.00b-j	64.33e-h	92.00a-h	8.67b-j	8.67b-j
0.375	10.33d-i	12.67c-h	15.00a-h	9.00f-j	77.33c-h	72.33d-h	8.67b-j	7.00d-j

Values in the same group and column carrying the same letter/s are not significantly different at (p=0.05)
Imazapre=pre-emergence application of Imazaquin; Imazapost=post-emergence application of Imazaquin
Pendipre=pre-emergence application of Pendimethalin; Pendipost=post-emergence application of Pendimethalin; Purspre=pre-emergence application of Pursuit plus; Purspost = post-emergence application of Pursuit plus; Cont = weedy Control

at 0.250kg a.i /ha of pendipre and 0.375kg a.i/ha of pendipost respectively (Table 3). In TVX3236 however, pod length, seed number per pod and pod filling potential were found to be significantly different in all the herbicide treatments. Highest pod length, seed number per pod and pod filling potential (16.75±0.25cm, 14.50±1.50 and 1.08±0.12) were obtained in the weedy control of imazapre and at 0.125kg a.i /ha of imazapre (Table3). In 2005 planting season, pod length, seed number per pod and filling potential in Ife brown and TVX3236 were significantly different at p=0.05 in all the herbicide treatments with the exception of pendipost, pendipre and purspre where seed number per pod in Ife brown and filling potential in TVX3236 were not significantly different respectively (Table 4). Highest pod length, seed number and filling potential per pod in Ife brown (16.67±0.58cm, 13.67±1.15 and 0.87±0.25) were obtained at 0.125 and 0.250 kg.a.i/ha of pendipre and pendipost respectively (Table 4). On the other hand, TVX3236 had the highest (14.67±1.53cm, 13.33±3.79 and 0.92±0.25) pod length, seed number and filling potential per pod at 0.250kg a.i/ha of imazapre, imazapost and pendipre for pod length and 0.250kg.a.i/ha in imazapost and 0.250kg a.i/ha of purspost respectively.

Discussion

Pod length in both 2004 and 2005 trials, were not physically affected by weed control treatments in both Ife brown and TVX3236. Though analysis of variance

indicates some significance at (p=0.05). Adenubi and Adejonwo (2006) reported longer pods, heavier seeds and higher grain yield in cowpea at lower planting density. However, reduction in pod length due to increase in weed density was reported by Obadoni and Ikem (2006)

Seed number per pod was not always a function of pod length and weed control treatment, however, reduction in seed number per pod was noticed in Ife brown at higher concentration of 0.375kg.a.i/ha of pendipre, purspre and purspost in 2004 trial and in imazapost in 2005. Seed number per pod of Ife brown in 2005 trial was relatively higher in herbicide treatments than the weedy controls except in purspre plot where weedy control produced higher seed number. The same trend was noticed in TVX3236 in which weedy plots produced less seed number than the herbicide treated plots. This observation corroborates the observations of Adenubi and Adejonwo (2006) as well as Obadoni and Ikem (2006) who separately reported reduction in seed number per pod due to weed competition as well as plant population respectively.

Conclusion

Results from this study revealed that both imidazolinone and dinitroaniline herbicides used were adequate both as pre and early post emergence applications for weed control in cowpea without any serious set back on the reproductive parameters such as Pod number per plant, pod weight per plant, seed number per plant, pod length, seed number per pod and pod filling potential.

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