Original Research Article

EFFECTIVENESS OF ALTERNATIVE CONTROL METHODS FOR TITHONIA DIVERSIFOLIA ON WATER YAM (*Dioscorea alata*) PLOT

ABSTRACT

Tithonia diversifolia has become a significant agronomic problem to optimum arable crop production in Nigeria which has necessitated effective and timely control if good yield is expected on infested soil. This study compared the performance of water yam under different weed control methods on *Tithonia* infested plot at Ogunba village near Baaya-Oje in Surulere Local Government area of Ogbomoso, Oyo State during the 2015 growing season. Eight (8) control treatments were evaluated namely: Weed control with Atrazine, Diuron, 2 hoe weeding, 3 hoe weeding, Black plastic mulch, grass mulch, Diuron + Atrazine + Plastic mulch (IWM) and unweeded plot. The three (3) hoe weeding and the unweedeed plot served as the control treatments. The experiment was laid out in a Randomized complete block with three replicates. Yam setts were planted at a spacing of 1m x 1m to give a population of 10000 plants/ha. Atrazine and Diuron were applied at the rate of 2.5kg a.i/ha, 2 hoe weeding was done at 3 and 6 week after planting (WAP), 3 hoe weeding was done at 3,6 and 9 WAP, while grass mulch was applied at the rate of 5 tons/ha. In IWM, Atrazine and Diuron were applied each at half recommended rate (1.25kg/ha) before applying plastic mulch. The treatments were applied pre-emergently on a rain wetted soil after planting. Data were collected on growth and yield parameters of yam as well as on *Tithonia* weed population and dry matter yield.

Results showed that weed control methods significantly ($P \leq 0.05$) influenced water yam yield. The highest tuber yield (21 tons/ha) in plastic mulch was comparable to IWM (20

tons/ha), 3 hoe weeding (19 tons/ha) and 2 hoe weeding (18 tons/ha). Grass mulch (16 tons/ha), Diuron (15 tons/ha), Atrazine (14 tons/ha) were also not significantly ($P \leq 0.05$) different. Thus, it may be concluded that plastic much is the most efficient of the methods for weed control in yam. The implication of this finding is discussed.

Keywords: *Water Yam; Alternative Control Methods; Tithonia diversifolia.*

1. INTRODUCTION

Water yam a native to warmer region of north and south hemispheres belongs to the plant family Dioscoreacae and genus alata [1]. It is the world's most popular yam after the *Dioscorea rotundata*/*cayenensis* complex in terms of consumption [2]. Water yam is most popular and prevalent in Abakaliki farming Community of Ebonyi State as well as Ijebu in the South West in Nigeria [3]. Water yam is a major staple in West and central Africa and an important supplementary food in East Africa. It is also an important source of income in rural and marginal areas [4].

The major uses of water yam are for human consumption, income generation and socio-cultural or religious events. In Ogun State it is processed into *Ikokore* (local dish), while *Ojojo* (yam cake) is made from water yam in Oyo and Osun states of Nigeria. Dried slices are generally milled into flour, which is used to produce, a thick brown paste (*amala*) served with soup. It has also found use as laxative and for the treatment of fever, gonorrhea, leprosy, tumors and hemorrhoids [5].

Weed infestation is a major factor in the cultivation of root and tubers in Nigeria. [6]. This is due to the fact that yams and a host of other root crops have slow rate of growth which makes them poor weed competitors at their early stages of growth. For a profitable yam production, the bulk of labour requirement goes into weed control. The frequency of weeding and debilitating effect of weeds on crops is a function of weed type, control method and crop

type [7]. Higher frequency of weeding is required for aggressive weeds such as *Tithonia diversifolia* [8].

Tithonia diversifolia (Mexican Sunflower) is a shrub that belongs to the plant family Asteracae [9]. It is a fast growing annual weed with broad leaves which form canopy cover rapidly thereby easily out-competing accompanying plants. The weed has continued to replace common weeds on the road sides as well as farmlands in the humid savanna and open space in the forest region [7]. Due to the aggressive growth and high biomass accumulation of *Tithonia*, its effective and timely control is a necessity for good yield [10].

However, since manual weeding is usually laborious, time consuming, expensive and is bedeviled by non-availability of/or inadequate labour, there is the need for alternative control method. The objective of this study therefore was to evaluate the effectiveness of alternative control methods for weed control in water yam planted on *Tithonia diversifolia* infested soils.

2. MATERIALS AND METHODS

The field experiment was conducted at Ogunba village near Baaya-Oje in Surulere Local Government Area, Ogbomoso, Oyo State in the Southern guinea savanna zone with bimodal rainfall pattern which extends for eight to nine months of the year [11] on a *Tithonia diversifolia* infested plot. The soil type was sandy loam (85.4%, Sand, 11.4%, Silt and 3.2%, clay). The soil has the following essential nutrients concentrations; N, 0.27, P, 5.57 and K, 0.44. The organic carbon content was 1.83. The temperature ranges from 25^{o}C – 33^{o}C with humidity above 76% all the year round except in January when the dry wind blow from the North [12].

Ridges were made manually after marking out on 4m x 3m plots. There were four ridges per plot replicated three times with 2m space separating the replicates. Each replicate measured 31 x 4m. The experiment was laid out in a Randomized Complete Block Design

with eight weed control treatments namely: Atrazine, at 2.5kg a.i/ha, Diuron at 2.5kg a.i/ha, 2 hoe weeding at 3 and 6 week after planting (WAP), 3 hoe weeding at 3, 6 and 9 WAP**,** Black plastic mulch, Grass mulch at 5 tons per hectare, Atrazine + Diuron (each at 50% of dosage) + Plastic mulch (IWM) and weedy plot. The herbicides were applied to rain wetted soil pre-emergently. Yam sets of 250g each treated with wood ash to prevent fungal attack was planted at a spacing of 1m x 1m and a depth of 15cm. After the emergence of yam, stakes were provided for the vines. Harvesting of tuber was done at eight months after planting. Data were collected on the growth and yield parameters of water yam as follows: vine length was measured using meter rule, while vine diameter was measured using venier calipers, number of leaves per plant by direct counting of fully expanded leaves and survival percentage (%) at 8 WAP by direct counting and later conversion to percentage. The number of tubers per plant was taken by counting, weight of tuber per plant by using Weighing Balance while the tuber weight per plot was determined and converted to tuber yield per hectare. Weed density was estimated from 3 randomly placed quadrat of 0.25m x 0.25m at a spacing of 30cm interval, while the dry weight of the weed was measured using weighing balance after having oven dried to a constant weight. Data collected were subjected to analysis of variance (ANOVA) and the means were compared using Duncan Multiple Range Test (DMRT) at 5% probability level [13].

3. RESULTS

Sprouting of Yam Sett and Yam Vine Survival Water yam sprouting was significantly affected by weed control method ($P \leq 0.05$) at 4 weeks after planting (WAP) (Table 1). The highest sprouting (90%) was produced under grass mulch and diuron which were not significantly ($P \leq 0.05$) different from those of 2 hoeing (75%), 3 hoeing (86%), atrazine (80%) and weedy plot (88%). Plastic mulch and IWM had the lowest sprouting (54%, 57% respectively). At 8 WAP, there was no significant difference in the survival percentage of water yam seedlings across the treatments ($P \leq 0.05$). The highest survival was however

recorded under Diuron and weedy plot 100% while the lowest (88%) was observed under plastic mulch.

Number of Leaves on Water Yam Vine

Number of leaves per plant was significantly ($P \leq 0.05$) affected by the weed control treatments (Table 2). The number of water yam leaves per plant varied significantly with the weed control methods. At 6 WAP, Atrazine treatment produced the highest number of leaves per plant (20.33) which was not significantly different ($P \leq 0.05$) from those of grass mulch (19.33), 3 hoe weeding (18.33) and 2 hoe weeding (18.67). The weedy plot had the least number of leaves (13.67). At 8 WAP however, 3 hoeing had the highest number of leaves (41.00) while weedy plot had the least (26.33). There were no significant difference ($P \leq 0.05$) in the number of leaves per plant on plots treated with 2 hoe weeding (39.33), 3 hoe weeding (41.00), atrazine (40.33) and IWM (38.00) (Table 2).

The Length of Water Yam Vine

The vine length of water yam was significantly influenced ($P \leq 0.05$) by the treatments (Table 3). At 6 WAP, 2 hoe weeding produced the longest vine (43.50 cm) while the shortest vine was observed under grass mulch (34.00 cm). At 8 WAP, 2 hoe weeding gave the longest vine (99.47cm) which is similar to those of 3 hoe weeding, atrazine and IWM (95.47cm, 97.60cm and 92.80cm respectively). Plastic mulch, grass mulch and Diuron were however comparable to atrazine, 3 hoe weeding and IWM ($P \leq 0.05$).

Vine Stem Diameter of Water Yam

The effect of the control methods on the vine diameter of water yam is presented in Table 4. Grass mulch consistently had the thickest vines across the periods of measurement ($P \leq 0.05$) while weedy plot had the thinnest. The thickest vine (0.57 cm) was produced under grass mulch at 8 WAP while the thinnest (0.42 cm) was produced under weedy plot.

Population and dry matter yield of *Tithonia diversifolia* under various control methods

The population of *Tithonia diversifolia* varied significantly ($P \leq 0.05$) with the weed control methods. The highest weed population (96.00) occurred in the unweeded plot, while the plastic mulch and IWM treated plots had the least (30.68). Weed control with 3 hoe weeding (70.68) was comparable to attrazine (66.68), Diuron (62.68) and 2 hoe weeding (70.68) ($P \leq 0.05$).

The dry matter weight, (Table 5), of the weed also varied significantly with the weed control methods ($P \leq 0.05$). The highest dry matter yield was obtained from the weedy plot (3.32 kg/m^2) while the least was obtained from plastic mulch treatment (0.33 kg/m), which was similar to IWM. Values for other treatments were statistically similar ($P \leq 0.05$).

Water yam tuber yield as affected by weed control methods

Table 6 shows the effects of weed control methods on the water yam tuber yield. The number of water yam tuber per plant at harvesting did not vary significantly with the weed control methods ($P \leq 0.05$). Average number of tubers per plot at harvesting was 3.67 tubers, highest number of tubers was obtained from Diuron treated plot (4.00) while the least number was obtained from weedy plot (3.00). The weight of tuber per plant varied significantly with the weed control methods ($P \leq 0.05$). Plastic mulch (2.10 kg) and IWM (2.07 kg) had tuber yields which were significantly better than other treatments. The tuber yield of water yam plant with 3 hoe weeding (1.90 kg) was also comparable to those obtained from plastic mulch and IWM. The tuber yields from other treatments are in the order 2 hoe weeding (1.77 kg) > Grass mulch (1.60 kg) > Diuron (1.53 kg) > atrazine (1.40 kg).

The estimated tuber yield of water yam per hectare as affected by the weed control method is presented in Table 6. The yield estimates followed the same trend as in tuber yield per plant with the plastic mulch producing the highest yield (21.0 t/ha) which was followed by IWM (20.0 t/ha). The weedy plot had the least yield per plot (3.0 t/ha).

4. DISCUSSION

Tithonia diversifolia, an aggressive weed with rapid canopy formation has a significant effect on both growth and yield parameters of water yam. This is largely due to the fact that water yam has slow initial growth which made it to be quickly out-competed by fast growing and aggressive weeds like *Tithonia*. The close canopy formation by *Tithonia diversifolia* tend to shut out insolation from plants growing underneath [8].

Plastic mulch gave a very good weed control due to its solarisation effects as well as acting as a physical barrier to weed emergence [10]. The higher yield obtained from plastic mulch and IWM may be due to timeliness in weed control and reduced soil compaction [14]. As expected, the least yield (3 tons) was obtained from the weedy plot due to unhindered to weed competition. Hoe weeding produced yield lower than those of plastic mulch and IWM possibly due to the competition before weeding. [7] Had reported commencement of weed-Crop competition before weeds are considered necessary for removal by hoe weeding. Lower yield under the herbicides than plastic mulch, IWM grass mulch and hoe weeding may be due to initial observed phytotoxic effects of the herbicides on the yam growth before being overcome. Grass mulch lower than the herbicides and hoe weeding may be due to interference by weed regrowth before decomposing mulch replacement.

From the above it could be concluded that plastic mulch, arising from an effective weed control, is the best option for optimum water yam yield.

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Table 1: Effect of weed control methods on sprouting of water yam sett and plant survival

Treatment	% Sprouting at 4 WAP	% Survival at 8 WAP
Plastic mulch	54b	88a
Grass mulch	90a	98a
2 hoe weeding	75a	96a
3 hoe weeding	86a	96a
Atrazine	80a	96a
Diuron	90a	100a
IWM	57b	96a
Weedy	88a	100a

Means with the same letter along the column are not significantly different by DMRT (P = 0.05).

Table 2: Effect of weed control methods on the average number of leaves of water yam

Treatment	6 WAP	8 WAP
Plastic mulch	18.00bc	36.67bc
Grass mulch	19.33ab	36.00c
2 hoe weeding	18.67ab	39.33abc
3 hoe weeding	18.33ab	41.00a
Atrazine	20.33a	40.33ab
Diuron	16.00c	36.00c
IWM	17.33bc	38.00abc
Weedy	13.67d	26.33d

Means with the same letter(s) along the column are not significantly different by DMRT (P = 0.05).

Table 3: Effect of weed control methods on the vine length of water yam

	Vine length (cm)	
Treatment	6 WAP	8 WAP
Plastic mulch	41.90a	90.47b
Grass mulch	34.00b	89.97b
2 hoe weeding	43.50a	99.47a
3 hoe weeding	40.83a	95.47ab
Atrazine	39.57ab	97.60ab
Diuron	41.40a	89.43b
IWM	42.57a	92.80ab
Weedy	41.43a	69.67c

Means with the same letter in each column are not significantly different at P = 0.05 (DMRT).

Table 4: Effect of weed control methods on the vine stem diameter of water yam

	Vine diameter (cm)	
Treatment	6 WAP	8 WAP
Plastic mulch	0.47b	0.50b
Grass mulch	0.52a	0.57a
2 hoe weeding	0.42cd	0.49b
3 hoe weeding	0.42cd	0.48b
Atrazine	0.43bc	0.50b
Diuron	0.44bc	0.50b
IWM	0.43bc	0.47b
Weedy	0.39d	0.42c

Means with the same letter in each column are not significantly different at P = 0.05 (DMRT).

Table 5: Effect of weed control methods on the weed population and weed biomass on water yam plots at 12 WAP.

Treatment	Weed Population (unit/m^2)	Weed Biomass (kg/m^2)
Plastic mulch	30.68d	0.33d
Grass mulch	54.68c	1.50bc
2 hoe weeding	70.68b	1.67b
3 hoe weeding	57.32bc	1.04c
Atrazine	66.68bc	1.37bc
Diuron	62.68bc	1.01c
IWM	30.68d	0.53d
Weedy	96.00a	3.32a

Means with the same letter in each column are not significantly different at p = 0.05(DMRT).

Table 6: Effects of weed control methods on the yield and yield parameters of water yam

	Average number of tuber per plant	Average weight of tuber per plant (kg)	Average yield per plot (kg)	Estimated yield per hectare (Tones)
Plastic mulch	3.67a	2.10a	24.50a	21 a
Grass mulch	3.67a	1.60cd	18.60d	16 cd
2 hoe weeding	3.67a	1.77bc	21.53c	18 bc
3 hoe weeding	3.67a	1.90ab	22.8bc	19 ab
Atrazine	3.67a	1.40d	17.87d	14 d
Diuron	4.00a	1.53cd	18.90d	15 cd
IWM	3.67a	2.07a	23.30ab	20 a
Weedy	3.00a	0.33e	5.27e	3 e

Means with the same letter in each column are not significantly different at p = 0.05 (DMRT).