International Journal of Academic and Applied Research (IJAAR)
ISSN: 2643-9603
Vol.4 Issue 7, July – 2020, Pages: 168-177

Distribution and Control of Mesquite Tree *Prosopis Juliflora* (Swartz) DC Using Some Herbicide and Herbicide Mixtures in Gezira State, Sudan

Thoria Talab Abdeldaim Talab[1], Mohamed S. A. Zaroug[2]*, Dafalla A. Dawood[1]

1 Department of Weed Science Research, Crop Protection Center, Agricultural Research Corporation, Wad Medani, Sudan.
2 Department of Crop Protection, Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Sudan.
* Corresponding author tel.: +249122402202
E-mail address:mszarouk@gmail.com

Abstract: *Mesquite (Prosopis juliflora) is considered as one of the worst weeds that cause significant threat to agricultural production. It was introduced into Sudan to curb desertification, but in recent years became a serious weed. The present study was undertaken to investigate the distribution and the efficacy of some herbicides and their mixtures in controlling mesquite tree in Gezira State, Sudan. Ground surveys were used to determine the distribution and density, on-farm experiments were carried out to evaluate the efficacy of 2,4-D, glyphosate and their tank mixture as basal bark application, and 2,4-D as foliar application for controlling mesquite compared to recommended herbicide triclopyr. The herbicides were dissolved in diesel oil and applied using a knapsack sprayer. The presented results revealed that mesquite trees were distributed throughout the study area giving a relative mean field density in the four directions of 12.5%. High density was recorded in the northern and eastern directions amounted for 20.5 tree/100m^2 and 20 tree/100m^2, respectively. The basal bark application of tank mixture of 2, 4-D 5% + glyphosate 5% gave 100% control of mesquite trees within 90-120 days after treatment. The foliar application of 2, 4-D at 7% and 9% caused complete death of mesquite within 60-90 days after treatment. In conclusion, the current situation of mesquite spread reflected the increasing hazards to agricultural land due to mesquite invasion in Gezira State. It is therefore, necessary to adopt a management program using a tank mixture of 2, 4-D 5% + glyphosate 5% as basal bark application or 2,4-D at 9% as foliar application to control mesquite tree in sparse stands or in close canopy forests.*

Keywords: mesquite; basal bark; foliar; glyphosate, trylina

1. Introduction

Mesquite has been originally introduced to curb desertification, provide shade, fuel wood and fodder, but because of their invasive nature have become serious weeds (2). Also it's regarded as one of the worst weeds due to it is invasiveness, potential of spread, economic and environmental impacts (6). It has become a noxious woody weed in Sudan invading more than 700 thousand hectares of productive lands, in irrigated schemes (*New Halfa*, *Zeidab*, *Rahad* and *Gezira*), around riverbanks and deltas as in *Tokar* and *Gash*, eastern Sudan. Furthermore, the weed presents a serious threat to rangelands and pastures in Western and Eastern Sudan (2). Excessive removal of ground water by the tree lowers water tables and affects water quality (10). Furthermore, mesquite reduces efficiency of land preparation, increases machinery maintenance cost, retards water flow and interferes with silt removal when growing on canal banks (2). Mesquite has become a serious weed and invaded agricultural farmlands, pasturelands and waterways (14) also mesquite is allelopathic (15) and excretes allelopathic compounds (15) these allelopathic compounds lowers yield and quality of forage grasses and affect agriculture, threat forage grasses and animal production and these finally leads to lack of human nutrition (11).

In Sudan, several efforts have been made to control mesquite, but they are individualistic, isolated, sporadic and not sustainable, as long-term funding has never been guaranteed (3). The mechanical control practiced in *Gash Delta* and new *Halfa scheme* although effective they were labor intensive, expensive and difficult to apply, chemical control which is recently recommended by using Triclopyr (Trilina) may face problems of developing resistance in the future when used repeatedly, and biological control not practiced yet. Since mesquite is a noxious weed and difficult to control, it's continuous spread and invading of arable lands in Sudan should lead to reduced quality of land. Knowledge of extended distribution of this weed and its ecology will help in designing sustainable management program. Selection of control measures varies with the infestation characteristics, including mesquite tree size, density and habitat. A close follow up of mesquite in the cleaned areas is mandatory, since there is always the danger of re-invasion from nearby infested areas or re-establishment from the huge mesquite long-lived seed bank. It therefore this study was designed to know the extent of distribution and to find out

the best management practices to stop it's invasion in Gezira State.

2. Materials and methods:

This study was designed with the objectives to determine distribution, and control of mesquite tree. For these purpose field surveys were conducted during 2016/2017- 2017/2018 in Gezira State, Sudan to determine mesquite distribution and the efficacy of some herbicides were tested in the field.

2.1 Study Area

Gezira state is located in central Sudan (Fig 1). The state lies between the Blue Nile and the White Nile in the east-central region of the country 14^0 24''N- 33^0 31"E. It has an area of 27,549 km (https://www.wikiwand.com/en/Gezira_ (state). The climate of the region is semi-desert with a mean annual precipitation of 100-250 mm/year, with the rainy season extended from June to October and the dry season from March to June. The mean annual evapotranspiration is 2400 mm/year. The mean annual minimum and maximum temperatures are 12 °C in January and 42°C in May, respectively. The soil of the area is characterized by heavy clay soil (clay 60%), with pH 8-8.5, low organic matter and nitrogen, adequate potassium and low available phosphorous (5).

2.2 Ground surveys to estimate density of mesquite

Field trips were conducted during seasons 2016/2017-2017/2018 to determine distribution and density of mesquite tree in Gezira State, ground surveys were done around Blue Nile and *Elmanagle* area samples were taken using of Global positioning System unit (GPS). Surveys were conducted at four locations in 10 kilometer width along the East and West Blue Nile banks, in addition to *El Managle* area in the Gezira State. The number of mesquite trees were counted; mean field density for each unit was estimated. Six sites were selected in each location and three samples were taken in each one. The sample size was 10×10 m quadrat, numbers of mesquite trees per quadrat were counted, then samples mean of each site and location were estimated.

Mean field density for mesquite for all area (MFD) =

$$\frac{\text{Mean field density}}{\text{Sum mean field density}} \times 100$$

2.3 Chemical control:

On farm experiments were conducted to test the efficacy of 2, 4-D, Glyphosate and their mixtures in controlling mesquite. In addition to Triclopyr as standard herbicide treatment, trees treated with diesel oil and untreated trees included for comparison. Sole herbicide and herbicide mixtures were tested in either basal bark or foliar application. In naturally growing mesquite; shrubs of approximately equal age and size (120-150 cm height) were selected for the experiments. Every shrub was treated as an observation, they were tagged and labeled. Treatments were arranged in a Completely Randomized Block Design (CRBD) with four replicates. Means were statistically separated using Duncan`s Multiple Range test at $p \geq 0.05$ for significance.

2.3.1 Basal bark application of herbicide and herbicide mixtures in controlling mesquite (2015-2016)

Basal bark application experiments were conducted during 2015-2016 to evaluate the efficacy of 2, 4-D, Glyphosate and their mixtures with or without addition of 10 g salicylic acids dissolved in diesel oil in control of mesquite tree. The herbicides and their mixtures and the rates of application making a total of treatments as shown in table 2. The herbicides 2, 4-D and glyphosate at rate of 3, 5% (v/v) each were applied as single dosage with or without addition of 10 gram/L of salicylic acid in tank mixtures dissolved in diesel oil. The experiment comprised tank mixtures of 2, 4-D and Glyphoste dissolved in diesel oil all mixtures used with and without addition of 10 gram salicylic acid/L applied (v/v). Triclopyr at rate1.66% (v/v), trees treated only by diesel oil alone and untreated trees were included as controls for comparison. The treatments were applied by a knapsack sprayer direct spray to the stem 10-15 cm above ground in diesel oil.

2.3.2 Basal bark application of 2, 4-Dand Glyphosate mixtures to control mesquite tree (2016-2017)

On farm experiments were conducted in 2016-2017 to evaluate the efficacy of 2, 4-D and glyphosate mixtures in control of mesquite tree based on the results obtained in the first season. The tested rates include: 2, 4-D 5 % + glyphosate 5%, 2, 4-D 5% + glyphosate 3%, 2, 4-D 3% + glyphosate 5% and 2, 4-D 3% + glyphosate 3% all herbicide mixtures were dissolved in diesel oil and applied using knapsack sprayer. In addition to Triclopyr at1.66% (v/v) dissolved in diesel oil as standard treatment. Diesel oil-treated and untreated mesquite trees were added as control for comparison. All treatments applied as direct spray to the trunk of the selected trees 10-15 cm above ground.

Table 1. Basal bark applied 2, 4-D, Glyphosate and their mixtures used in controlling mesquite tree (2015 – 2016)

Year	Common Name	Doses Rate \L
	Glyphosate	3%
	Glyphosate	5 %
	Glyphosate +SA	3% + 10 SA
	Glyphosate +SA	5% + 10 SA
	2,4-D	3%
	2,4-D	3% + 10 SA
	2,4-D +SA	5%

Basal bark application 2015-2016	2,4-D + SA	5% + 10 SA
	2,4- D + Glyphosate Glyp	3% +3%
	2,4-D + Glyphosate +SA	3% +3% + 10 SA
	2,4-D + Glyphosate	5% +5%
	Triclopyr	1.66%
	untreated trees\ trees treated by diesel alone	

2.3.3 Foliar application of 2, 4-D in diesel oil as single and split doses to control mesquite trees

The objective of this experiment was to compare the application of 2, 4-D in a single and split dose as foliar spray in controlling of mesquite. The herbicide was dissolved in diesel oil and applied in a single dose at 5%, 7% and 9% and then the same doses were splited into three doses: 3+1+1, 5+1+1 and 5+2+2 in 15 days interval to get 5%, 7% and 9%, respectively. In addition to Triclopyr at 2% dissolved in diesel oil as standard treatment. Diesel oil-treated and untreated mesquite trees were added as control for comparison. All treatments applied as foliar spray to the selected trees.

Table 2. Foliar applied 2, 4-D in diesel oil as single and split doses used to control mesquite trees

Treatments	Doses rate	15 day	30 day
2,4-D 5%	5%	-	-
2,4-D * 5% split	3%	1%	1%
2,4-D 7%	7%	-	-
2,4-D 7%*split	5%	1%	1%
2,4-D 9%	9%	-	-
2,4-D 9% *split	5%	2	2
Triclopyr	2%	-	-
Diesel alone	-	-	-
Untreated	-	-	-

2.4 Statistical analysis

Treatments were arranged in a Completely Randomized Block Design (CRBD) with four replicates. Means were separated for using Duncan`s Multiple Range. Test at $p \geq 0.05$ for significance.

3. Results

3.1 Distribution and density

General map of the surveyed areas showed the distribution of mesquite tree in four locations three of them in 10 kilometer width along the East and West Blue Nile banks, and one location in *El Managle* area (Fig 1). High colonization of mesquite population was obtained in the North and East, while it was sparse in the south and west of Blue Nile.

The results presented revealed that mesquite trees were distributed throughout the study area giving a relative mean field density in the four locations of 12.5%. High density was recorded in the northern and eastern locations amounted for 20.5/100m^2 and 20/100m^2, respectively.

Surveys demonstrated that mean field density of mesquite trees varied with locations, highest densities observed in North and East regions and lower densities were obtained at Southern followed by Western location. The results presented in table 3 showed relatively dense population of mesquite trees in the sampling sites of the northern and eastern locations (20-20.5/100 m^2), and sparse unevenly distributed mesquite trees were observed in the sampling sites of the southern and western locations (3-5/100 m^2).

Table 3. Distribution, density and mean field density of mesquite trees in Gezira State, Sudan

Location	Sampling site	density	MFD*
Eastern 3.11.2016	*Hantoub*	34	20.5
	Ganomap	8	
	Abuharaz	8	
	Elsharafa	18	
	Dalawat	32	
	Rofaha	20	
Northern 28.11.2016	*Wad-Balal*	27	20
	Wad-Elmagdoub	20	
	Abufroa	30	
	Alkamleen	8	
	Altekaina	25	
	Elgdeed althora	13	
Southern 18.1.2017	*Canal 77*	14	5
	Elhajabdela	7	
	Faris	0	
	Hemira	0	
	Makawi	2	
	Alhadad	7	
Western (Almanagel) 21.12.2016	*Almanagel*	8	3
	Dar-Elmagam	8	
	El-ManagelElsenaat	4	
	WadMahmoud	0	
	Wadrabiea	0	
	Eboued	0	
Relative mean field density			12.5%

MFD* = mean field density

International Journal of Academic and Applied Research (IJAAR)
ISSN: 2643-9603
Vol.4 Issue 7, July – 2020, Pages: 168-177

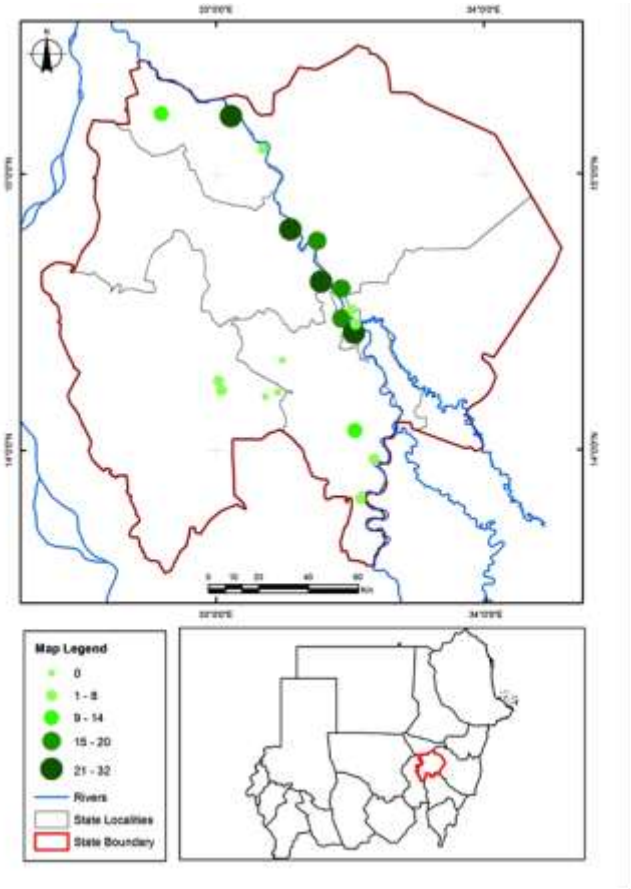

Fig. 1 Distribution and density of mesquite trees in survey points in Gezira State, Sudan

3.2 The efficacy of glyphosate and 2, 4-D and their tank mixtures in controlling mesquite:

3.2.1 Effects of basal bark spray of glyphosate and 2, 4-D and their mixtures on mesquite control

Glyphosate alone in diesel oil at 3% and 5%, showed 10% of tissue mortality15 days after treatments and increased to 30 and 49% at 90 days after application, respectively, after 120 days tissues mortality dropped to 19.33 and 37%, respectively. Adding10g of salicylic acid to the above concentration of Glyphosate improved the herbicide efficacy and tissue mortality by 60 & 39% after 15day and 90 days, respectively. The efficacy of Glyphosate at both concentrations with salicylic acid also reduced after 120 days to 36.7 and 62.3%, respectively (Table, 4).

Application of 2, 4-D alone at concentrations of 3% and 5% displayed 10% of tissue mortality at 15 days and increased to 55 and 68.3% at 90 days after treatment, respectively then dropped to 41.7% at 120 days after treatment tissue with the lower concentration of 3% and to 72.3% at concentration of 5%. Adding 10g salicylic acid to 2, 4-D at 3% and 5% gave 10% and 28.3% tissue mortality 15 days after treatment, respectively and the herbicide performance increased to 77.7% and 78.3% in 90 days after treatment, respectively and dropped to72.3%, 76.3% after 120 days respectively (Table 4).

Mixed spraying of 2, 4-D 3% + Glyphosate 3% displayed 13% of tissue mortality 15 days after treatment and increased to 49% at 90 days, then dropped to 41.7% after 120 days and trees started resprouting. Adding of 10g salicylic acid to 2, 4-D 3% + Glyphosate 3% increased tissue mortality to 25% at 15 days after treatment then tissue death was increased to 70% and 71.7% after 90 and 120 days, respectively.

Basal bark application of 2, 4-D 5% + Glyphosate 5% gave 30.7% tissue mortality 15 days after treatments and increased to 88% and 100% at 90, 120 days after treatment, respectively. Whereas, adding of 10 g salicylic acid to the same mixtures improved tissues mortality and herbicide mixture performance and showed 49.0% tissue mortality 15 days after treatments which increased to 100% tissue mortality in 90 and 120 days after treatment, respectively. These were comparable to the standard treatment of Triclopyr 1.66% v/v which resulted in 25% of tissue mortality 15 days after treatment and complete death after 90-120 days. Diesel oil alone had slight effect at 15 days, untreated plant weren't affected (Table 4).

3.2.2 Efficacy of basal bark application of tank mixtures of 2, 4-D and Glyphosate on control of mesquite, season (2016-2017)

The basal bark application of the tank mixtures of 2, 4-D 3% + glyphosate 3% displayed 13.3% tissue mortality at 15 days after treatment, and increased to 42.2-38.7% in 90-120 days after treatments. Applying of 2, 4-D at rate 3% tank mixture with glyphosate at rate of 5% scored 15.3% of tissue mortality at 15 days after treatment then increased to 41.7% tissue mortality at 90-120 days after application. Mixed up of 2, 4-D at 5% + glyphosate at 3% scored 16.3% tissue mortality at 15 days after treatment, then tissues mortality was increased to 48.3 and 48.3%, 90 - 120 days after treatments. Basal application of tank mixture of 2, 4-D 5% + glyphosate 5% displayed excellent performance in mesquite tissue mortality which started with 22% in 15 days after treatment and increased to 100% at 120 days after application without resprouting. These results compared with standard herbicide Triclopyr at rate 1.66% (v/v) which revealed 20.3% at 15days after application and increased to 100% tissue mortality at 120 days after application. Diesel oil alone showed 10% tissue mortality at 15 days after application and the effect disappeared shortly after application (Table 5).

3.2.3 Effect of foliar application of 2, 4-D in diesel oil to control mesquite trees

Single dose of 2, 4-D at 5% displayed 25% tissue mortality after 15 days which increased to 98% at 90 days after application, and then tissue mortality dropped to 65% in 120

days after treated. Increasing the single dose to 7% & 9% caused 68 and 75% in 15 days after application, respectively and caused complete death in 90 -120 days after treatment, whereas application of 5, 7 and 9% as split doses caused 45, 65 and 60% of tissue mortality 15 days after application and the death percentage increased during 60 days then significantly dropped after 90 days (Table 6). Triclopyr resulted in 98-100% tissue mortality when applied at 2 % (v/v) in diesel oil as foliar spray at 30-120 days after treatments. Trees treated with diesel alone showed 0-15% tissue mortality within one month and the trees started recovered (Table 6).

Table 4. Efficacy of basal bark application of 2, 4-D, glyphosate and their tank mixture and with or without salicylic acid additive on control of mesquite tree (2015\2016)

Treatments	15Day	30day	60day	90day	120day
Glyphosate 3 %	10.00e	13.7gh	23.7f	30.3e	19.3f
Glyphosate 3% +SA	10.0e	18.7fg	38.3ef	56.0cd	36.7e
Glyphosate 5%	10.0e	18fg	36.7f	49de	37.3f
Glyphosate 5% +SA	16.7d	21.3efg	46.7cde	68.3.bcd	62.3cd
2,4-D 3%	10.00e	31.3cde	40.0def	55.0 cd	41.33bc
2,4-D 3% + SA	10.00e	41.00bc	61.67abcd	77.67abc	72.33bc
2,4-D 5%	10.00e	42.0 bc	56.00de	68.3bcd	72.3bc
2,4-D 5% +SA	28.33bc	51.00ab	61.67abcd	78.33abc	76.33bc
2,4- D 3% + Glyp3%	13.00de	28.33def	41.67cdef	49.00de	41.67e
2,4-D3%+ Glyp 3%+SA	25.00c	35.33cd	50.00bcde	70.00bcd	71.67bc
2,4-D 5%+ GlyP 5%	30.67b	40.67bc	63.33abc	88.00ab	100.0a
2,4-D5%+ GlyP 5%+SA	49.00a	61.67a	81.67a	100.00a	100.0a
Triclopyr 1.66%	25.00c	49.33b	80.33a	100.00a	100.00a
Diesel	10.00e	9.00gh	0.00g	0.00f	0.00g
Untreated	0.00f	0.00h	0.00g	0.00f	0.00g
SE ±	1.783	3.804	6.819	7.573	3.801
CV%	17.98%	21.15%	26.39%	21.77%	11.21%

***Means followed by different letter(s) in same columns are significantly different according to (DMRT) at 0.05 levels**

Table 5. Effect basal bark application of 2, 4-D and Glyphosate mixtures on mesquite tissue mortality 2016-2017

Treatments	15 days	30days	60days	90days	120days
2,4-D 3% + Glyp3%	13.33b	30.33bc	43.33c	42.21c	38.67c
2,4-D 3% + Glyp5%	15.33ab	32.33abc	43.33c	41.67b	41.67b
2,4-D 5% + Glyp3%	16.33ab	40.67ab	61.67b	48.00b	48.33b
2,4-D 5% + Glyp5%	22.00a	42.67a	75.00a	91.67a	100.0a
Triclopyr 1.66%/L	20.33a	24.00c	76.00a	89.33a	100.00a
Diesel	10.00b	6.667d	0.00d	0.00d	0.00d
Untreated	0.00c	0.000d	0.00d	0.00d	0.00d
SE ±	6.473	13.065	12.801	8.854	6.074
CV%	26.17%	29.10%	16.33%	12.27%	8.17%

***Means followed by the same letter (s) are not significantly different, according to Duncan's Multiple Range Test at *P= 0.05*.**

Table 6. the efficacy of foliar application of a single and split dosage of 2, 4-D in control of mesquite tree:

Treatments	15 day	30 day	60 day	90 day	120 days
2,4-D 5%	25.00cd	28.00c	65.00bc	98.00a	65.00bc
2,4-D5%split*	45.00bc	58.00b	50.00c	10.00c	10.00d
2,4-D 7%	68.00ab	100.00a	100.00a	100.00a	95.00a
2,4-D 7%**split	65.00ab	90.00a	78.00b	70.00b	60.00c
2,4-D 9%	75.00a	100.00a	100.00a	100.00a	100.00a
2,4-D 9%***split	60.00a	85.00a	80.00b	67.00b	72.00b
Triclopyr 2%	80.00a	98.00a	100.00a	100.00a	100.00a
Diesel alone	15.00d	10.00cd	0.00d	0.00c	0.00e
Untreated	0.00d	0.00d	0.00d	0.00c	0.00e
SE ±	27.071	24.604	17.302	14.021	8.849
CV%	38.67%	24.68%	17.14%	13.82%	8.85%

Means followed by different letter (s) in same columns are not significantly different, according to the Duncan's Multiple Range Test at *P= 0.05

***Foliar application used 3% in diesel, second application after 15 day used 1% and third dose 1% after one month.**

**** Foliar application used 5% in diesel, second application after 15 day used 1% and third dose 1% after one month.**

***** Foliar application used 5% in diesel, second application after 15 day used 2% and third dose 2% after one month.**

4. Discussion:

4.1 Distribution of mesquite

The presented results revealed that mesquite trees were distributed throughout the study area giving a relative mean field density in the four locations of 12.5%. This situation reflected the increasing hazards to agricultural land due to mesquite invasion in Gezira State. These indicated that the widespread of mesquite in Gezira State which may lead to loss of crop land and lower water table. Also widespread of mesquite in Gezira State could possibly be attributed to the suitable environment where vast clay plains and water are available this agreed with Luukkanen, O *et al.* (12) who reported that mesquite tends to establish, successfully, on clay or alluvial soils which have good water retention. Babiker, (2006) reported that the major factor contributing to the spreading of mesquite tree is animals, he reported that during the dry season animal eat mesquite pods transport the seeds to other places as in Gash river, river bank, ponds and other sources of water and therefore during the rainy season water comes and flush the seeds or remainder of the animal dung and moves to the other places these similar to the finding that describe the possibility of mesquite seeds to dispersal through animal movement and water recourses, also in agreement with the report of Babiker *et al.* (2) that suggested the bulk of mesquite infestation (>90%) is in eastern Sudan, where livestock keeping income, that help in transfer and distribution of mesquite seeds through animals movements, addition to Fisher *et al.* (7) who indicated that the pods are transported by flood waters and run-off.

4.2 The efficacy of glyphosate and 2,4-D and their tank mixture in controlling mesquite:

Basal bark application of the herbicides at the lower 10-15 cm of the stem of mesquite tree proved to be effective method of application to control individual mesquite trees, these finding agreed with Mitchell *et al.* (13) who reported the effectiveness of basal bark application of solutions applied to the entire circumference of the lower 15 cm of each stem. The use of 2, 4-D and glyphosate sole application of each herbicide, irrespective of concentration rate showed lower efficacy in control of mesquite trees. Sole application of glyphosate showed poor performance compared to the sole application of 2, 4-D. While tank-mixed application of them depicted effective control, these results agreed with Shanwad *et al.* (17) who reported that the combination of 2, 4-D and glyphosate gave better results than each herbicide alone. Combination of 2, 4-D 5% + Glyphosate 5% in diesel oil as basal bark spray gave excellent performance on control of mesquite tree and caused complete tissue mortality within 90-120 days comparable to Triclopyr at 1.66% which recommended by Agricultural Research Corporation (ARC) on control of mesquite tree, these findings in agreement with those of Shanwad *et al.* (17) who reported that combination of herbicides (Glyphosate and 2, 4- D) resulted excellent control of *Prosopis juliflora.* Use of the herbicide mixture of 2, 4-D and glyphosate is cheap and available compared to others, moreover 2, 4-D and glyphosate are relatively non-toxic chemicals and they do not persist in the environment. Furthermore, the continuous use of one molecule (Triclopyr) on control of mesquite tree may develop resistance and hazard to the environment. Mesquite was spread and covers wide area and need more work for management and abundance of tools such as herbicides may help in sustainable management program, care must be taken during application to minimize effects to surrounding desirable vegetation. Adding10 g salicylic acid (SA) to 2, 4-D and glyphosate increased tissue mortality and herbicides performance irrespective of doses, these result agree with a number of studies showed that exogenous application of salicylic acid (SA) influenced the antioxidant capacity of plant, at the same time, since adaptation to oxidative stress includes not only the regulation of the synthesis and repair of proteins but also increased an dioxidant activity (1). A greater understanding about contents of chlorophyll pigments would be expected to yield improved methods of evaluating plant responses to the environmental stresses (4), (8). Sabater *et al*, (1978) found that the decrease in the total chlorophyll content associated with the application of salicylic acid (SA) mixed with glyphosate in maize plant compared to the control. Decrease in the total chlorophyll led to plant dried, mesquite tree leaves and stems covered by waxes, sticky and gum the use of salicylic acid (SA) act as a peeling agent increases herbicide penetration and movement these will gradually result in dried plant. However, the management method was influenced by good coverage, these similar to the findings of Sabater, B. and Rodriguez, M. I. (16) who reported that the decrease of chlorophyll may be due to the formation of proteolytic enzymes such as chlorophyllase, which is responsible for the chlorophyll degradation.

Application of 2, 4-D as foliar spray in diesel oil increased tissue mortality with highest doses 7% and 9% resulted in excellent performance of 100% within 30-60 days after treatment. Application of split-doses irrespective of rates of concentration decreased herbicide efficacy, because the foliage of mesquite trees dried after first application, the leaves and branches remained yellow (acute toxicity), these findings were also comparable with those of Jacoby P. and Ansley (9) who reported that although 2, 4-D provided excellent suppression of top growth, and also similar with Waisel (18) and Weinert, E and Sakri, FA (19) who reported that the early stage plants internal systems were collapsed (xylem and phloem cells of stem were died) due to the effect of these systemic herbicides.

Basal bark application of tank-mixed 2, 4-D 5% + glyphosate5% gave excellent performance in control of mesquite tree in addition to the low cost than foliar spray which consume large amount of herbicide and diesel oil.

However, in close canopy forest the use of foliar treatment is more applicable than basal bark application where basal bark application is very difficult. It could be concluded that mesquite trees present a potential hazards on agricultural production in Gezira State, Sudan. Use of the herbicides 2,4-D and glyphosate could be used as an integral components for containment of mesquite spread and control. However, care must be taken during application of herbicides to minimize hazards to surrounding desirable vegetation. These could be possible by the choice of herbicides, the correct application method, dosage, time of application and follow-up actions are very important.

5. **Reference:**

(1). Ananieva E. A., Christov K. N., Popova L. P. (2004) Exogenous treatment with salicylic acid leads to increased antioxidant capacity in leaves of barley plants exposed to paraquat. J Plant Physiol 161: 319-328.

(2). **Babiker, A. G. T., El fatih, A. A., Hassan, A. M. (2004)** Prospects of chemical control of mesquite (*Prosopis juliflora*). *Workshop on Control and Eradication of Mesquite and other Noxious Weeds*. Wad Medani, Hospitality Palace 14 February 2004. (Unpublished).

(3). **Babiker, A. G. T. (2006).** Mesquite (*Prosopis* spp.) in Sudan: history, distribution and control. In: Problems *posed by the introduction of prosopis spp. in selected countries*. (Labrada, R. ed). Pp 11-20. Plant Production and Protection division. FAO. Rome.

(4). **Blackburn G. A. (1998)** Quantifying Chlorophylls and Caroteniods at Leaf and Canopy Scales: An Evaluation of Some Hyperspectral Approaches. Remote Sensing of Environment 66: 273-285.

(5). **Elbasher, O. A. (2016).** Vermination of climate changes using rainfall and temperature as indicators and its impacts on agricultural production in the arid zone of Sudan (1981-210). Ph.D. Thesis, University of Gezira, Sudan

(6). **Felker, P., and Guevara, J. C. (2003)** Potential of commercial hardwood forestry plantation in arid-lands. An economic analyses of *Prosopis* lumber production in Argentina and the United States. *Forest Ecology and management*. 186: 271-286.

(7). **Fisher, C. E., Meadors, C. H., Behrens, R., Robinson, E. D., Morton, H. L. (1959).** Control of mesquiteon grazing lands.Texas agricultural experimental station Bulletin. No.935:1-23.

(8). **Golkar P., Arzani A., Rezaei A. M., Yarali Z., Yousefi M. (2009)** Genetic variation of leaf antioxidants and chlorophyll content in safflower. African Journal of Agricultural Research 4: 1475-1482.

(9). **Jacoby P. and Ansley R. J. (1991),** Mesquite: classification, distribution and control. In :James LF, Evans JO, Ralphs MH, child RD, eds. Noxious. Range weeds, Boulder, Colorado, USA. Westriew press.

(10). **Khanzada, A. N., Morris, J. D., Ansari, R., Slavich, P. G. and Collopy, J. J. (1998).** Ground water uptake and sustainability of *Acacia* and *Prosopis* plantation in southern Pakistan.Agricultural water Management. 36: 121-139.

(11). **Lui, L. C. (1990).** Chemical control of Albizz and mesquite in two selected pastures in southwestern Puerto Rico. Journal of Agriculture University Of Puerto Rico. 74: 433 – 439.

(12). **Luukkanen, O., Turakka, A. and Holmberg, G. (1983).**Forest nursery and afforestation experiments in the White Nile and north Kordofan provinces in Sudan. *Sudan-Finland Consulting Programme in Forestry Technical Report* 7.Pp25.

(13). **Mitchell, R., Sosebee, R. and Britton, C. (1998).** Mesquite management option in Texas.Areport.Department of Range, Wildlife and Fisheries Management. Texas Tech. Unviersity. Lubbock, Texas. Pp5.

(14). **Ngujiri, F. D. and Choge, S. K. (2004)**.Status and impact of *Prosopis* spp. in Kenya. In: *Proceeding of the Workshop on Integrated Management of Prosopis Species in Kenya* (Choge, S. K. and Chikamai, B. N. eds). pp 17-30. Soi Safari Club, Lake Baringo, Kenya.

(15). **Nimbal, C. l., Panchal, Y. C. and Patil V. S. (1981**).Studies on chemical control of honey mesquite. In " Proceedings 8th Asian – Pacific Weed Sci. Soc. Conf". Pp243 – 247.

(16). **Sabater, B., Rodriguez, M. I. (1978).**Control of chlorophyll degradation in detached leaves of barley and oat through effect of kinetin on chlorophylla selevels. Physiology Plant 43: 274-276.06

(17). **Shanwad, U. K.,Chittapar, B.M., Honnali., Shankergoud, S. N. (2015).** Management of Prosopis juliflora through Chemicals: A Case Study in India. Journal of biology, agriculture and health care IssN 2225-093X Vol.5, No.23, 2015- 30/3/2017.

(18). **Waisel, Y (1972)** Biology of halophytes. Academic press New York .

(19). **Weinert, E and Sakri, FA (1974)** sulfate content in plants tissues of some Iraqi desert plants.flora (jena).166:65-73. Elfadl, M.A. and Luukkanen, O. (2003) Effects of pruning on Prosopis juliflora: Considerations for tropical dry land agroforesty. Journal of Arid Environments, 53:441-445.