

**THE EFFECT OF NITROGENOUS ADDITIVES TO
GLYPHOSATE FOR WATER HYACINTH *Eichhornia crassipes*
(Mart)Solms-Laub CONTROL**

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ABSTRACT

This research included three experiments, two experiments in a wire green house and one experiment in irrigation canals, to study the effect of glyphosate (herbicide) mixed with nitrogenous additives on controlling water hyacinth weed *Eichhornia crassipes* (Mart) Solms-Laub.

Firstly, in a wire green house, the experiments were conducted during summer 1999 season at the Agriculture Research Centre, Giza. Results in the 1st experiment revealed that glyphosate at 90 g a.i./ fed mixed with 2% ammonium sulfate gave the highest reduction percentage of dry weight of water hyacinth plants (from 86 -- 90.6% and 75% plant mortality). In the 2nd experiment, glyphosate at 180 g a.i./fed mixed with 2% ammonium sulfate and or 2% urea caused the highest reduction percentage of dry weight of water hyacinth plants (from 90.6 -- 94.4% and 87.5% plant mortality).

Secondly, in two irrigation canals chosen at Bahteem, Kalubia Governorate were conducted during 1999 and 2001 summer seasons. Results showed that glyphosate at 180 g a.i. / fed mixed with 2% ammonium sulfate gave the highest reduction percentage of dry weight of water hyacinth plants (from 93.86– 95.72% and 89.13 – 89.74 % plant mortality).

Key words: *glyphosate, nitrogenous additives (ammonium sulfate, ammonium nitrate and urea), water hyacinth.*

1. INTRODUCTION

Water hyacinth [*Eichhornia crassipes* (Mart)Solms-Laub] is a perennial free floating aquatic weed species that belongs to the family Pontederiaceae (Tackholm,1974).It is a serious pest in many tropical and subtropical countries of the world (Pieterse 1979, Labrada 1996)and in Egypt(Khattab and El-Gharably 1986 and Attalla 1998). The excessive growth of water hyacinth causes a serious problem as increasing loss of water, increasing siltation, changing in water chemistry, obstruction and reducing the fishing (Labrada 1996). The control of water hyacinth is a difficult task. In Egypt, water hyacinth was controlled in the past by using the chemical method (atrazine herbicides) as a main tool beside the mechanical method. However, the public opinion is strongly against the use of chemical control in Nile water which is used for irrigation and drinking. Recently, the strategy control mainly depending on mechanical control without solving water hyacinth problem. So, we need to use chemical control again for successful water hyacinth control. Glyphosate has been reported for controlling water hyacinth and it is applied at the rate 2-3lb/ acre (Ross and Lembi 1985, Ashton and Monaco 1991,Attalla and Salib 1999).It is the safest one for use in water and had moderate toxicity (LD₅₀ 4900 mg/kg) and is not mortal to fish (Muniyappa *et al.*, 1995, Kruger *et al.*, 1996 and Olaleye and Akinyemiju 1996).

Salisbury *et al.*, (1991) mentioned that glyphosate mixed with additives (urea, ammonium butyl phosphate and ammonium phosphate) to spray solution enhanced glyphosate activity on purple nutsedge. Also, they found that glyphosate at 0.42 kg/ha mixed with ammonium sulfate at 3.33 kg/ha was more effective for controlling johnsongrass (*sorghum halepense*) compared to glyphosate at 0.84 kg/ha. Donald (1988) reported that glyphosate at 0.56 kg/ha mixed with ammonium sulfate at 2.8 kg/ha killed foxtail barley (*Hordeum jubatum* L.). Nalewaja and Matysiak (1991) mentioned that glyphosate rates from 0.2 to 0.5 kg/ha mixed with ammonium sulfate from 1.5 to 10 kg/ha killed quack grass (*Agropyron repens* (L.) Beauv.).The additives such as ammonium sulfate and urea are used in

combination with glyphosate to maintain its optimum activity and reduced its rate (Suwunnamek and Parker (1975), Donald 1988, Nalewaja and Matysiak 1991, Reddy and Singh 1992, Coret and Chanel 1993 and El-Mahy 1999).

Suwanketnikom (1997) mentioned that C^{14} -glyphosate at 1.5 kg/ha mixed with 1% ammonium sulfate increased its phytotoxicity and its penetration into nutsedge leaves more than the addition either one alone in the green house. The increasing penetration of C^{14} - glyphosate into the leaves may change glyphosate molecule to a more readily absorbed form NH_4^+ or from SO_4^- complexed directly with glyphosate molecule through the phosphonate and carboxylate groups and resulted in a more readily absorbed form. Thelen *et al.*, (1995) mentioned that the additives might alter the physical properties of the spray solution or leaf cuticle to the point where C^{14} glyphosate could directly penetrate the leaf.

This investigation aimed to study the effect of glyphosate mixed with nitrogenous additives on controlling water hyacinth.

2. MATERIALS AND METHODS

Three experiments were conducted, in a wire green house (two experiments) and in irrigation canals (one experiment), to study the effect of glyphosate (herbicide) mixed with nitrogenous additives on controlling water hyacinth during 1999 and 2001 summer seasons.

2.1. Wire green house experiments

Water hyacinth plants were collected from a dense stand which existed in El-Zommer irrigation canal at Giza Governorate. They were conducted from 1-6-1999 to 8-7-1999 and repeated from 15-7-1999 to 19-8-1999.

2.1.1. Eight treatments were used in the 1st experiment as follows

- 1-untreated check (control).
- 2-Glyphosate (Round up 48% SL= 36% glyphosate) at 90g *a.i.* /fed.
- 3-Glyphosate at 90g *a.i.*/fed. + 1% $(NH_4)_2 SO_4$.
- 4-Glyphosate at 90g *a.i.*/fed. + 2% $(NH_4)_2 SO_4$.
- 5-Glyphosate at 90g *a.i.*/fed. + 1% Urea.
- 6-Glyphosate at 90g *a.i.*/fed. + 2% Urea.

- 7-Glyphosate at 90g *a.i.*/fed. + 1% NH₄ NO₃.
- 8-Glyphosate at 90g *a.i.* /fed. + 2% NH₄ NO₃.

2.1.2.Eight treatments were used in the 2nd experiment as follows

- 1-untreated check (control).
- 2- Glyphosate at 180 g *a.i.* /fed.
- 3- Glyphosate at 180 g *a.i.* /fed. + 1% (NH₄)₂ SO₄ .
- 4-Glyphosate at 180 g *a.i.* /fed. + 2% (NH₄)₂ SO₄.
- 5-Glyphosate at 180 g *a.i.* /fed. + 1% Urea.
- 6-Glyphosate at 180 g *a.i.* /fed. + 2% Urea.
- 7-Glyphosate at 180 g *a.i.* /fed. + 1% NH₄ NO₃.
- 8-Glyphosate at 180 g *a.i.* /fed. + 2% NH₄ NO₃.

The plants were sprayed after one week from canal collecting by glyphosate with or without three nitrogenous fertilizers. Plastic pots of (4 L) capacity (20cm in diameter and 15cm height) were used. Each pot contained 2 plants. The plants had the same number of leaves(5-6 leaves) and fresh weight(25-50 g). The treatments were arranged in a complete randomized block design with 4 replicates. The plants were watered daily in order to maintain water level.

Data recorded were as follows:

- 1- Survival plants number/pot.
- 2-Leaf number of survival plants/pot.
- 3-Dry weight of survival plants (g)/pot.

2. 2. Canal experiments

Two irrigation canals at Bahteem, Kalubia Governorate infested by water hyacinth plants were chosen. Each canal was 300m long and 2 m wide. In each canal only 280 m were sprayed by glyphosate at 180 g *a.i.*/fed. mixed with 2% ammonium sulfate in 1st canal and glyphosate at 180 g *a.i.*/fed. with 2% urea in 2nd canal. The remained (20 m) of each canal was used as untreated check (control) in 1999 season. In the second canal 220m were sprayed by glyphosate at 180 g *a.i.* /fed. mixed with 2% ammonium sulfate in 1st canal and glyphosate at 180g *a.i.*/fed. with 2% urea in 2nd canal. Meanwhile,60m were sprayed by glyphosate at 180 g *a.i.*/fed. alone and 20m were used as control for each canal in 2001 season. The application was done in 28-8-1999 and 22-8-2001. In 16-9-1999 and 12- 9 - 2001, the treated and untreated water hyacinth plants /m² for 4 replicates were

collected to estimate the following characters:

- 1-Survival plant number.
- 2-Healthy leaf number.
- 3-Dry weight of survival plants (g).

Data were statistically analyzed according to Snedecor and Cochran (1982) and L.S.D. at the level 5% for comparisons between the treatment means.

3. RESULTS AND DISCUSSION

3. 1. Wire green house Experiment

3.1.1.Under glyphosate at 90 g a.i./fed.

Results in Table(1) show that plant number, leaf number and dry weight of water hyacinth were decreased significantly when treated with glyphosate at 90 g a.i./fed. alone and or mixed with ammonium sulfate, ammonium nitrate and urea as compared with the control in the two periods of experiment.

Glyphosate at 90 g a.i./fed. mixed with 2% ammonium sulfate gave the highest mortality percentage of plant number/pot by 50 % in both periods as compared with control. Meanwhile, the mortality percentage of plant number/pot by glyphosate at 90 g a.i./fed. alone was 37.5 in both periods as compared with the control.

The highest reduction percentage of leaf number/pot was obtained from glyphosate at 90 g a.i./fed. mixed with 2% ammonium sulfate by 90 % in 1st period and 83.3 % in 2nd one as compared with the control. Meanwhile, Glyphosate at 90 g a.i./fed. alone reduced leaf number/pot by 47.5% in 1st period and 50% in 2nd one as compared with the control.

The highest reduction percentage of water hyacinth dry weight/pot was obtained from glyphosate at 90 g a.i./fed. mixed with 2% ammonium sulfate by 90.6 % in 1st period and 86 % in 2nd one as compared with the control. Meanwhile, Glyphosate at 90 g a.i./fed. alone reduced dry weight/pot by 48.9 % and 54.1 % in the 1st and 2nd periods, respectively.

3.1.2.Under glyphosate at 180 g a.i./fed.

Results in Table(2) show that plant number, leaf number and dry weight of plants/pot were decreased significantly with glyphosate at 180 g a.i./ fed. alone and or mixed with ammonium sulfate,

nitrate and urea as compared with the control in the two periods of the experiment.

Table (1): Effect of spraying glyphosate at 90 g a.i./fed. alone and mixed with urea, ammonium sulfate and ammonium nitrate on water hyacinth plant number, leaf number and dry weight (g)/pot.

Treatments	Rate/fed.	1 st period (1/6 – 8/7/1999)			2 nd period (15/7- 19/8/1999)		
		Plant No./Pot	Leaf No./pot	Dry weight (g)/pot	Plant No./pot	Leaf No./ Pot	Dry weight (g)/pot
Control		2.00	10.0	7.20	2.00	10.5	7.48
Glyphosate	90g	1.25	5.25	3.68	1.25	5.25	3.43
Glyphosate +(NH ₄) ₂ SO ₄	90g +1%	0.75	2.25	1.56	0.75	3.00	2.15
Glyphosate +(NH ₄) ₂ SO ₄	90g +2%	0.50	1.00	0.68	0.50	1.75	1.05
Glyphosate +Urea	90g +1%	1.00	4.00	2.45	1.00	4.25	3.01
Glyphosate +Urea	90g +2%	0.75	2.00	1.35	0.75	2.00	1.42
Glyphosate + NH ₄ NO ₃	90g +1%	1.25	5.25	3.90	1.25	5.50	3.85
Glyphosate + NH ₄ NO ₃	90g +2%	1.00	3.75	2.05	1.00	4.00	2.94
LSD 5%		0.63	1.05	1.22	0.63	1.21	0.42

The highest mortality percentage of water hyacinth plants number/pot was obtained from glyphosate at 180 g a.i./fed. mixed with 2% ammonium sulfate or mixed with 2 % urea by 87.5 % in two treatments in both periods as compared with the control. Meanwhile, glyphosate at 180 g a.i./fed. alone reduced plant number by 62.5% in both periods as compared to the control.

The highest reduction percentage of leaf number/pot was obtained from glyphosate at 180 g a.i./fed mixed with 2 % ammonium sulfate or mixed with 2 % urea by 95 % in each treatment in the 1st period and 89.1 and 91.3 %, respectively in the 2nd one as compared with the control. Meanwhile, the reduction percentage of leaf number by glyphosate at 180 g a.i./fed alone was 80 % in the 1st period and 73.9 % in the 2nd one.

The highest reduction percentage of dry weight/pot was obtained from glyphosate at 180 g a.i./fed mixed with 2% ammonium sulfate or mixed with 2 % urea by 90.7 and 91.4%, respectively in the 1st period and 94.2 and 94.6 %, respectively in the 2nd one as compared with the control. The reduction percentage of water hyacinth dry weight by glyphosate at 180 g a.i./ fed.alone was 74.9%

in the 1st period and 79.4 % in the 2nd one.

Table (2): Effect of spraying glyphosate at 180 g a.i./fed alone and mixed with urea, ammonium sulfate and ammonium nitrate on water hyacinth plant number, leaf number and dry weight(g)/pot.

Treatments	Rate/ fed.	1 st period (1/6- 8/7/1999)			2 nd period (15/7-19/8/1999)		
		Plant No./pot	Leaf No./pot	Dry weight (g)/pot	Plant No./pot	Leaf No./pot	Dry weight (g)/pot
Control		2.00	10.0	7.52	2.00	11.5	7.38
Glyphosate	180 g	0.75	2.00	1.88	0.75	3.00	1.48
Glyphosate +(NH ₄) ₂ SO ₄	180g +1%	0.50	0.75	1.05	0.50	2.00	0.58
Glyphosate +(NH ₄) ₂ SO ₄	180g+2%	0.25	0.50	0.70	0.25	1.25	0.43
Glyphosate +Urea	180g+1%	0.50	1.25	1.13	0.50	1.50	0.95
Glyphosate +Urea	180g+2%	0.25	0.50	0.65	0.25	1.00	0.40
Glyphosate + NH ₄ NO ₃	180g+1%	0.75	2.50	1.81	0.75	2.75	2.00
Glyphosate + NH ₄ NO ₃	180g+2%	0.50	2.25	1.42	0.50	2.25	1.83
LSD 5%		0.64	1.23	0.83	0.64	1.29	0.8

3.1.3. Irrigation Canal Experiment

Results in Table(3) show that survival plant number, healthy leaf number and dry weight of plants/m² were decreased significantly with glyphosate at 180 g a.i./fed. alone or mixed with 2% ammonium sulfate or mixed with 2% urea in irrigation canals as compared with the control in the two seasons. Glyphosate at 180 g a.i./fed mixed with 2% ammonium sulfate decreased plant number, leaf number and dry weight of plants/m² by 89.13, 91.24 and 93.86 %, respectively in the 1st season and 89.74,92.49 and 95.72, respectively in the 2nd one as compared with the control. Meanwhile, glyphosate at 180 g a.i./fed mixed with 2% urea decreased the same characters by 86.96, 90.1 and 93.72 %, respectively in the 1st season and 88.46, 91.47 and 95.22 %, respectively in the 2nd one as compared with the control. The reduction percentage of plant number, leaf number and dry weight by glyphosate at 180 g a.i./fed. alone was 58.97, 75.05 and 77.34 %, respectively in the 2nd season. No regrowth was recorded after the application. These results may be due to that NH₄⁺ increased the penetration and translocation of glyphosate, thereby increasing its toxicity. These results are in agreement with those obtained by Shilling *et al.*, (1990), and Salisbury *et al.*,(1991).

In general, glyphosate alone at 90 & 180 g a.i./fed showed a minimal reduction of water hyacinth plant number, leaf number and dry weight in both periods as compared with the control. The highest

reduction percentage of plant number, leaf number and dry weight was obtained by glyphosate at 90 g a.i./fed. mixed with 2% ammonium sulfate followed by 2% urea and 1% ammonium sulfate in both periods as compared with the control in the greenhouse experiment. Plant number, leaf number and dry weight of plants were decreased significantly by glyphosate at 180 g a.i./fed mixed with 2% ammonium sulfate and 2% urea in both periods in the greenhouse and irrigation canal experiments. It can be concluded that using glyphosate at 180 g a.i./fed mixed with 2% ammonium sulfate or 2% urea is recommended for controlling water hyacinth in the canals without regrowth.

Table(3): Effect of glyphosate at 180 g a.i./fed. alone and mixed with 2 % urea or 2 % ammonium sulfate on water hyacinth plant number, leaf number and dry weight (g)/m² in the irrigation canals during 1999 and 2001 seasons.

Treatments	Rate/fed.	1999 season			2001 season		
		Plant No. / m ²	Leaf No. / m ²	Dry weight (g)/m ²	Plant No. / m ²	Leaf No. / m ²	Dry weight (g)/m ²
Control		92.0	685.0	4479.7	78.0	586.0	3712.7
Glyphosate	180g	-----	-----	-----	32.0	146.0	841.3
Glyphosate+(NH ₄) ₂ SO ₄	180g +2%	10.0	60.0	275.6	8.0	44.0	158.9
Glyphosate + Urea	180g +2%	12.0	68.0	281.4	9.0	50.0	177.5
LSD 5%		3.40	98.3	72.7	13.62	80.88	282.80

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تأثير إضافة المواد النيتروجينية على تحسين كفاءة مبيد الجليفوسيت لمقاومة نبات ورد النيل

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المعمل المركزى لبحوث مقاومة الحشائش - مركز البحوث الزراعية-الجيزة

ملخص

يحتوى هذا البحث على ثلاث تجارب أجريت اثنتان فى الصوبة السلكية وتجربة فى المجرى المائى لدراسة تأثير اضافة مركبات نيتروجينية مع مبيد الجليفوسيت لمقاومة نبات ورد النيل.

أولاً: تجربتا الصوبة السلكية

اجريت خلال صيف ١٩٩٩ فى مركز البحوث الزراعية بالجيزة. اوضحت النتائج فى التجربة الاولى ان اضافة كبريتات الامونيوم ٢ % الى مبيد الجليفوسيت بمعدل ٩٠ جم/فدان ادى الى موت النباتات بمقدار ٧٥ % ونقص للمادة الجافة بمقدار ٨٦-٩٠,٦ % . اما فى التجربة الثانية فقد ادى اضافة كبريتات الامونيوم ٢ % او يوريا ٢% الى مبيد الجليفوسيت بمعدل ١٨٠ جم/فدان الى موت نباتات ورد النيل بمقدار ٨٧,٥ % لكلا المعاملتين وقد ادى الى نقص المادة الجافة بمقدار يتراوح ٩٠,٦-٩٤,٤ % لكلا المعاملتين.

ثانياً : تجربة المجرى المائى

تم اختيار قناتى رى فى منطقة بهتيم بمحافظة القليوبية و اوضحت النتائج ان اضافة كبريتات الامونيوم ٢% الى الجليفوسيت بمعدل ١٨٠ جم/فدان ادى الى موت نباتات ورد النيل بمقدار ٨٩,١٣ % ونقص المادة الجافة بمقدار ٩٣,٨٦ % فى الموسم الاول. وايضا موت النباتات بمقدار ٨٩,٧٤ % ونقص المادة الجافة بمقدار ٩٥,٧٢ % فى الموسم الثانى.

