

七种除草剂防除凤眼莲试验研究^{*}

Control Effect of Seven Kinds Herbicides on *Eichhornia crassipes*

石亮成¹, 董志德², 谢桃结¹, 周玲³ 石钢⁴

SHI Liang-cheng¹, DONG Zhi-de², XIE Tao-jie¹, ZHOU Ling³, SHI Gang⁴

(1. 广西柳州市园林科研所, 广西柳州 545005; 2. 广西柳州市植保植检站, 广西柳州 545001; 3. 广西柳州市农产品检测中心, 广西柳州 545001; 4. 广西柳州市城市广场管理处, 广西柳州 545001)

(1. The Garden Research Institute of Liuzhou City, Liuzhou, Guangxi, 545005, China; 2. Liuzhou Plant Protection Station, Liuzhou, Guangxi, 545001, China; 3. Liuzhou Agricultural Testing Center, Liuzhou, Guangxi, 545001, China; 4. The Square Management Office of Liuzhou City, Liuzhou, Guangxi, 545001, China)

摘要: 选用 78% 溴腈·莠灭净 WP, 95% 草甘膦原药+草甘膦伴侣 WP, 20% 噻吩磺隆 WP, 95% 草甘膦铵盐 SG, 20% 氯氟吡氧乙酸 EC, 20% 百草枯 AS, 25% 百草枯 AS 共 7 种除草剂, 于 2010 年在柳州市柳南区太阳村镇董家屯的农民鱼塘进行防除凤眼莲 [*Eichhornia crassipes* (Mart.) Soims] 的小区药效试验。试验结果表明, 78% 溴腈·莠灭净 WP, 20% 百草枯 AS 和 25% 百草枯 AS 的防效均为 100%; 95% 草甘膦原药+草甘膦伴侣 WP 的防效为 93.2%~93.6%; 95% 草甘膦铵盐 SG 的防效为 90.8%~91.4%。在 900~4500g(ml)/hm² 剂量范围内 7 种除草剂对水生生物安全, 对周边环境无不良影响和危害。

关键词: 凤眼莲 防除 除草剂

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Abstract: The effects of 7 herbicides on controlling *Eichhornia crassipes* were observed in fish ponds. The results showed that the control effect of 78% Bromo nitrile·Ametryn WP and 20% Paraquat AS was 100%; the control effect of 95% mixture WP by the Glyphosate and the Glyphosate companion was 93.2% to 93.6%; the control effect of 95% Glyphosate ammonium SG was 90.8% to 91.4%. All 7 herbicides were safe to the aquatic in the fish ponds and the environment when they were in the dose range from 900ml to 4500ml per hm².

Key words: *Eichhornia crassipes*, control, herbicides

凤眼莲 [*Eichhornia crassipes* (Mart.) Soims], 异名凤眼蓝, 布袋草, 水葫芦等, 属雨久花科凤眼莲属常年水生草本植物^[1], 分布于世界四大洲, 尤以亚热带地区分布为甚。该植物生命力强, 繁殖快, 在气温 13℃ 开始生长繁殖, 在高温 39℃ 时仍能繁殖^[2]。只要气候条件适宜, 凤眼莲每 5d 就能繁殖 1 株新植株^[3], 而且呈几何级数繁殖生长, 8 个月内就能繁衍

成 60 万株的群体^[4]。广西属亚热带海洋性季风气候区, 阳光充足, 雨量充沛, 最宜凤眼莲生长。近年来, 凤眼莲在广西柳州市的一些河道, 鱼塘, 沟渠逸生繁殖十分严重, 严重地影响了水面生态环境和渔业发展^[5]。据报道, 我国每年人工打捞凤眼莲耗费至少在 1 亿元以上^[6]。为了防除柳州市柳江河内的凤眼莲, 保护柳江河水面生态环境和渔业发展, 我们选用 7 种除草剂, 于 2010 年在鱼塘进行了小区药效试验。

1 材料与方法

1.1 供试药剂

7 种除草剂为: (1) 78% 溴腈·莠灭净 WP (中等

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作者简介: 石亮成(1952-), 男, 高级工程师, 主要从事园林植物引种栽培研究工作。

^{*} 广西柳州市科学研究与技术开发计划攻关项目(2008030906)资助。

毒,江苏辉丰农化有限公司生产);(2)95%草甘膦原药+草甘膦伴侣 WP(微毒,山东京博农化有限公司生产);(3)20%噻吩磺隆 WP(低毒,北京中农科美化工有限公司生产);(4)95%草甘膦铵盐 SG(低毒,上海悦联化工有限公司生产);(5)20%氯氟吡氧乙酸 EC(低毒,美国陶氏益农公司生产);(6)20%百草枯 AS(中等毒,先正达南通作物保护有限公司生产);(7)25%百草枯 AS(中等毒,先正达南通作物保护有限公司生产)。

1.2 试验地概况

本试验在距离广西柳州市 28km 的柳州市柳南区太阳村镇董家屯的农民鱼塘进行。鱼塘水面面积约 0.13hm²,水深 0.8~1.5m,塘内饲养有唐角鱼和七星鱼,水源处于静止状态,水色为灰色,pH 值为 7。塘面凤眼莲长势十分旺盛,植株高 50~60cm,整个鱼塘犹如一片绿茵草坪,看不见水面。四周为大片稻田包围。

1.3 试验设计

试验药量按照各除草剂每公顷的使用量配置:(1)78%溴腈·莠灭净 WP3750g;(2)95%草甘膦原药+草甘膦伴侣 WP900g;(3)20%噻吩磺隆 WP900g;(4)95%草甘膦铵盐 SG2400g;(5)20%氯氟吡氧乙酸 EC 900ml;(6)20%百草枯 AS 4500ml;(7)25%百草枯 AS 3000ml。每种除草剂为 1 个试验处理。试验共设 7 个处理,1 个空白对照区(CK),每个处理小区面积为 12m²(2m×6m),4 次重复,共计试验小区面积为 348m²。小区随机区组排列。各处理小区于 2010 年 6 月 30 日下午一次性施药,每个药剂每小区均兑水 30kg 拌匀,用手动式射水筒均匀喷洒在凤眼莲叶面上,仅施 1 次药。施药期间的 15d 内无雨,天气晴朗,阳光强烈,气温 33~35℃,最高达 37℃。

1.4 试验调查方法

药效调查是每小区调查 4 点,每点 0.25m² 共计 1m²,于施药后每隔 5d 进行 1 次观察,并记录药后凤眼莲个体及群体的生物性状表现。试验的第 5 天、第 15 天、第 30 天作重点调查,计算株防效,并用 Duncan 新复极差法进行方差分析。同时,第 30 天加测鲜重防效,第 45d 最后一次观察防除效果及水生生物危害情况。

株防数(%)=(对照区株数-防治区株数)÷对照区株数×100

鲜重防数(%)=(对照区鲜重-防治区鲜重)÷对照区鲜重×100

安全性调查是施药后 5d、10d、15d、20d、25d、30d 定期观察鱼塘内有无塘角鱼、七星鱼等浮头或死亡的现象。经济投入调查是将每公顷施用除草剂防除与人工打捞防除凤眼莲的费用核算成本并进行比较。

2 结果与分析

2.1 防除效果

表 1 结果显示,施药后 5d 凤眼莲叶片开始变黄干枯,10d 叶柄开始干枯,植株的株芽变色,15~20d 植株枯萎倒伏呈枯黑色,株芽变黑死亡,30d 植株的蔓枝和根须腐烂,原植株形成的紧密群体此时易分离,散碎漂浮。45d 仅剩下 20%噻吩磺隆和 20%氯氟吡氧乙酸处理小区的凤眼莲群体叶尖枯黄,叶片微卷,但是仍青绿,株芽仍生长,其它处理小区的凤眼莲群体完全倒伏呈枯黑状。

表 2 结果显示,凤眼莲受药后随着时间的推移,枯萎程度日趋加重,死亡率增高,30d 即达到 90%以上的死亡,其中:78%溴腈·莠灭净 WP,20%百草枯 AS 和 25%百草枯 AS 各处理小区,凤眼莲的株防效和鲜重防效均为 100%,防除效果极显著;95%草甘膦原药+草甘膦伴侣 WP 和 95%草甘膦铵盐 SG 各处理小区,株防效和鲜重防效分别为 93.2%~93.6%和 90.86%~91.4%,防除效果显著;而 20%噻吩磺隆 WP 和 20%氯氟吡氧乙酸 EC 各处理小区,株防效和鲜重防效分别为 12.6%~13.2%和 2.2%~3.0%,防除效果不明显。

2.2 安全性评价

药后 5d、10d、15d、20d、25d、30d 分别在鱼塘多个方位及塘缘打捞凤眼莲,对水面进行观察,没有发现塘角鱼、七星鱼、福寿螺、田螺及水蛭、青蛙等浮头或死亡现象;对旁边未用药的凤眼莲也未出现任何药害症状,对周边环境也无不良影响或造成危害。

2.3 经济投入比较

表 3 结果显示,除草剂防除投入每公顷的费用最大为 630 元,最小为 262.50 元,其经济顺序从少到多依次为:20%百草枯 AS<25%百草枯 AS<95%草甘膦原药+草甘膦伴侣 WP<78%溴腈·莠灭净 WP<95%草甘膦铵盐 SG,而人工打捞投入的费用为 5250 元,大于药物防除费用的 8~20 倍,化学防除是经济得多的。

表 1 凤眼莲药后植株个体及群体的生物性状

Table 1 Plant individual and population biological characters of the *E. crassipes* after the treatment

除草剂 Herbicides	药后性状 Traits after drug treatment				
	5d (2010-07-05)	10d (2010-07-10)	15d (2010-07-15)	20d (2010-07-20)	45d (2010-08-15)
78% 溴腈·莠灭净 WP 78% Bromo nitrile·Ametryn WP	叶片变黄, 叶柄 2/3 仍青绿 Leaves became yellow and two thirds of the petioles were still green	叶片、叶柄干枯, 株芽变黑, 倒伏不明显 Leaves and petioles became dry and withered, while the plant bud was black, and lodging was not obvious	全株呈枯黄色, 倒伏明显, 株芽死亡 Whole plant was dry and yellow, lodging obviously, and the bud was dead	群体枯黑色, 完全倒伏 Group was dry and black, lodging completely	完全倒伏呈一平面, 群体呈枯黑色 Group turned dry and black, lodging completely as a plane
95% 草甘膦原药+草甘膦伴侣 WP 95% Glyphosate and the Glyphosate companion WP	70% 叶片干枯, 30% 叶片转黄, 株芽仍存活 70% leaves became dry and withered, 30% leaves turned yellow, and the bud was still survival	叶片、叶柄干枯, 株芽变黑, 倒伏不明显 Both leaves and petioles became dry and withered, the bud turned black, lodging was not obvious	全株呈枯黄色, 倒伏明显, 株芽死亡 Whole plant was dry and yellow, lodging obviously, and the bud was dead	群体枯黑色, 完全倒伏 Group was dry and black, lodging completely	完全倒伏呈一平面, 群体呈枯黑色 Group turned dry and black, lodging completely as a plane
20% 噻吩磺隆 WP 20% Thifensulfuron-methyl WP	叶片青绿油亮, 无药害感 Leaves were green and bright with on sense of phytotoxicity injury	50% 叶尖变黄, 叶片微卷, 但仍青绿, 株芽仍存活 Half of the leaf apices became yellow, leaves rolled slightly but still green, the bud was still survival	70% 叶尖变黄, 叶片微卷, 但仍青绿, 株芽仍存活 70% leaf apices became yellow, leaves rolled slightly but still green, the bud was still survival	群体叶尖枯黄, 叶片微卷, 但仍青绿, 株芽仍生长 Leaf apices of group became dry and yellow, leaves rolled slightly but still green, and the bud was still in growth	群体叶尖枯黄, 叶片微卷, 但仍青绿, 株芽仍生长 Leaf apices of group turned dry and yellow, leaves rolled slightly but still green, and the bud was still in growth
95% 草甘膦铵盐 SG 95% Glyphosate ammonium SG	50% 叶片干枯, 50% 枯黄, 叶柄弯曲变黄, 株芽仍存活 Half of the leaves were dry and withered, the other half were dry and yellow with the bud survival	叶片、叶柄干枯, 少部分株芽存活, 群体呈倒伏状 Both the leaves and petioles were dry and withered, a few bud were still survival with the group lodging	全株呈枯黄色, 倒伏明显, 株芽死亡 Whole plant was dry and yellow, lodging obviously, and the bud was dead	群体枯黑色, 完全倒伏 Group was dry and black, lodging completely	完全倒伏呈一平面, 群体呈枯黑色 Group turned dry and black, lodging completely as a plane
20% 氯氟吡氧乙酸 EC 20% Fluroxypyr EC	叶片青绿, 无枯黄表现, 无药害感, 株芽仍生长 Leaves were green, bud was still in growth, without the dry-yellow performance and the sense of phytotoxicity injury	叶片微萎蔫, 叶柄弯曲, 有药害感, 群体青绿, 株芽仍生长 Leaves were wilting a little with the petioles bent and the sense of phytotoxicity injury, group was green, and the bud was still in growth	叶片、叶柄表现轻微药害感, 株芽仍生长 Both the leaves and petioles showed a little sense of phytotoxicity injury, bud was still in growth	少部分叶尖枯黄, 群体仍青绿, 药害不明显, 株芽仍生长 A few leaf apices were dry and yellow, and the group was still green, without obvious phytotoxicity injury	50% 叶尖枯黄, 群体仍青绿, 株芽仍生长, 有药害但不明显 50% leaf apices were dry and yellow, and the group was still green, with the sense of phytotoxicity injury but not obviously
20% 百草枯 AS 20% Paraquat AS	叶片干枯, 叶柄枯黄, 株芽仍存活 Leaves were dry and withered, the petioles were dry and yellow, and the bud was still survival	叶片及叶柄干枯, 株芽变黑色, 群体倒伏 Both leaves and petioles were dry and withered, and the bud turned black, group lodging	全株呈枯黄色, 群体倒伏明显, 株芽死亡 Whole plant was dry and yellow, with the group lodging obviously	全株呈枯黑色, 群体完全倒伏 Whole plant was dry and black with the group lodging completely	完全倒伏呈一平面, 群体呈枯黑色 Group turned dry and black, lodging completely as a plane
25% 百草枯 AS 25% Paraquat AS	叶片及叶柄干枯, 株芽仍存活 Both leaves and petioles were dry and withered, and the bud was still survival	全株干枯, 株芽变黑色, 群体倒伏 Whole plant was dry and withered, and the bud became black, with the group lodging	全株呈枯黄色, 群体倒伏, 株芽死亡 Whole plant was dry and yellow, with the group lodging and the bud dead	群体枯黑色, 完全倒伏 Group was dry and black, lodging completely	完全倒伏呈一平面, 群体呈枯黑色 Group turned dry and black, lodging completely as a plane
空白对照 Blank	叶片青绿发亮, 群体青绿, 生长旺盛 Leaves were green and bright, and the group was green and grew well	全株干枯, 株芽变黑色, 群体倒伏 Whole plant was dry and withered with the bud being black and the group lodging	全株呈枯黄色, 群体倒伏, 株芽死亡 Whole plant was dry and yellow with the group lodging and the bud dead	群体枯黑色, 完全倒伏 Group was dry and black, lodging completely	生长旺盛, 群体青绿色 Plant grew well and the group was green

3 结束语

经 7 种除草剂对凤眼莲的防除试验结果表明, 78% 溴腈·莠灭净 WP, 20% 百草枯 AS, 25% 百草枯

AS, 对凤眼莲的防除效果优良; 95% 草甘膦原药+草甘膦伴侣 WP 和 95% 草甘膦铵盐 SG 防除效果次之; 而 20% 噻吩磺隆 WP 和 20% 氯氟吡氧乙酸 EC 防除效果不明显。为尽量保证水体环境不发生污染, 在药

表 2 7 种除草剂对凤眼莲的防除效果

Table 2 Control effect of seven kinds of herbicides on *E. crassipes*

除草剂 Herbicide	剂量 Dosage (667m ²) *	均株数 Average (strain)	药后植株的防治效果 Strain control effect(%)			平均总鲜重 Average whole green weight (kg)	药后的鲜重 防效 Control effect on green weight after 30d treatment (%)
			5d	15d	30d		
78%溴腈·莠灭净 WP 78% Bromo nitrile · Ametryn WP	250g	65.3	10.5	43.5	100 ^a	无 Without	100 ^a
95%草甘膦原药+草甘膦伴侣 WP 95% Glyphosate and the Glypho- sate companion WP	60g	64.9	0.6	13.4	93.2 ^b	2.3	93.6 ^b
20%噻吩磺隆 WP 20% Thifensulfuron methyl WP	60g	66.0	0	0	12.6	31.4	13.2
95%草甘膦铵盐 SG 95% Glyphosate ammonium SG	160g	65.1	13.2	50.5	90.86	2.9	91.4 ^b
20%氯氟吡氧乙酸 EC 20% Fluroxypyr EC	60ai	63.7	0.4	0.7	2.2	35.1	3.0
20%百草枯 AS 20% Paraquat AS	300ml	64.2	28.6	77.2	100 ^a	无 Without	100 ^a
25%百草枯 AS 25% Paraquat AS	200ml	65.4	31.5	82.8	100 ^a	无	100 ^a
空白对照 Blank		65.2				36.2	

*: 每个药剂均兑水 30kg 喷洒。Each herbicide is dissolved in 30kg water then asperse.

表 3 除草剂防除与人工打捞凤眼莲的投入比较

Table 3 Investment comparison between herbicide control and artificial salvage for *E. crassipes*

药剂名称及用量 Herbicide and its dosage	除草剂防除投入 Investment of herbicide(yuan/hm ²)			人工打捞 Artificial salvage(yuan/hm ²)		节约 Save (yuan/hm ²) *
	药剂费 Herbicide expense *	人工费 Artificial expense	合计 Total	运输费 Transport expense	合计 Total	
78%溴腈·莠灭净 WP 78% Bromo nitrile · A metryn WP(3750g)	375	150	525			4575
95%草甘膦原药+草甘膦伴侣 WP 95% Glyphosate and the Glyphosate com- panion WP (900g)	180	150	330			4386
95%草甘膦铵盐 SG 95% Glyphosate ammonium SG (2400g)	480	150	630	—		4680
20%百草枯 AS 20% Paraquat AS (4500ml)	112.5	150	262.5			4312.5
25%百草枯 AS 25% Paraquat AS (3000ml)	150	150	300			4350
人工打捞 Artificial salvage				300	2250	5250

*: 药剂费是市场价格,人工打捞费是当地的价格,节约费用是相对于人工打捞费用的相对数额。The herbicide expense is based on market price, the artificial salvage expense is based on the locality, the save is corresponding to the artificial salvage expense.

物的使用过程中,应尽量使药物雾化落于叶面而少落入水中,一次用药即可达到防除效果。当然一次性用药对水体的污染程度如何,还有待进一步的试验研究。在资金投入方面,使用除草剂比人工打捞节约 8~20 倍。95%草甘膦原药+草甘膦伴侣 WP 和 95%草甘膦铵盐 SG 两种除草剂,在药剂毒性含量上均属低毒,在防除凤眼莲的使用上具有良好的推广应用前景。

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