International Journal of Farm Sciences **9(4):** 76-80, 2019; **doi: 10.5958/2250-0499.2019.00098.3**

Residual effect of pre-sowing weed management on the purple nutsedge (*Cyperus rotundus*) and succeeding maize germination and yield

K BRINDHA, C CHINNUSAMY and CR CHINNAMUTHU

Department of Agronomy, Tamil Nadu Agricultural University
Coimbatore 641003 Tamil Nadu, India
Email for correspondence: bindiya14@gmail.com

Received: 6.7.2018/Accepted: 11.7.2018

ABSTRACT

A study was carried out to evaluate different pre-sowing weed management methods on *Cyperus rotundus* and on succeeding maize germination and yield at Chinnankuppam village in Dharmapuri district, Tamil Nadu. Pre-emergence, early post-emergence and post-emergence herbicides viz metribuzin, halosulfuron methyl, glyphosate and 2,4-D were applied at different doses to select an optimum dose suitable for the management of purple nutsedge (*C rotundus*) as a pre-sowing weed management method. Pre-sowing weed management treatments did not influence the per cent germination of succeeding maize. Among the pre-sowing weed management treatments early post-emergence application of halosulfuron methyl at 50 g/ha followed by post-emergence application of glyphosate at 1.00 g/ha resulted in reduced density and dry weight (2.2 and 4.1/m^2, 0.37 and 0.70 g/m^2) followed by early post-emergence application of halosulfuron methyl at 75 g/ha (3.5 and 5.7/m^2, 0.60 and 0.97 g/m^2) at 15 and 30 DAS respectively. Simultaneously both the treatments increased the weed control efficiency of *C rotundus* (69.16 and 58.33%) and (50.00 and 42.26%) at 15 and 30 DAS respectively. Among the treatments pre-sowing application of early post-emergence halosulfuron methyl at 50 g/ha followed by post-emergence application of glyphosate at 1.00 kg/ha recorded the higher grain (9,387 kg/ha) and stover (9,500 kg/ha) yield of succeeding maize.

Keywords: Purple nutsedge; halosulfuron; glyphosate; weed management; maize

INTRODUCTION

Maize (*Zea mays* L) is the second most important cereal crop of the world in terms of total food production. It is grown for fodder as well as for grain. It is a very efficient utilizer of solar energy and has immense potential for higher productivity. Weeds are one of the most important production constraints in maize production. Weeds cause yield loss worldwide with an average of 12.8 per cent despite weed control applications and 29.2 per cent in the case of no weed control (Mahmoodi and Rahimi 2009). Therefore weed control is an important management practice for maize production that should be carried out to ensure optimum grain yield.

Weed interference is a severe problem in maize especially during early part of the maize growth stages due to slow early growth rate and wide row spacing. Weeds compete with maize for resources such as light, nutrients, space and moisture that influence the morphology and phenology of the crop and reduce the yield. Furthermore high weed infestation increases the cost of cultivation, lowers value of land and reduces the returns of corn producers.

Weed species infesting maize crop are functions of a complex interaction among soil characteristics, climate and cultural practices. These factors vary across regions and influence the composition and number of predominant weeds of economic importance to maize production. Among different weeds, purple nutsedge (*Cyperus rotundus*) germinates first and covers the ground immediately which affects the crop germination and early crop vigour by competing for the soil moisture and nutrients. Nutsedge is one of the most difficult perennial weeds of the world particularly in moisture-retentive soils of the tropics and sub-tropics.

Due to continuous use of atrazine and metribuzin in maize fields the population of grassy and broad-leaved weeds has been decreased whereas the population of *Cyperus* species has increased tremendously. For the control of weeds blind hoeing is recommended in the beginning but regrowth of nutsedge is very fast after hoeing as it spreads through rhizomes present in deeper layers of the soils. This weed possesses a predominant basal bulb just below ground level which produces a chain of tubers which penetrate as deep as 60 cm in soil. These tubers are prominent and grow rapidly and new shoots arise from these tubers. In the first month of purple nutsedge growth the mother tubers produce four daughter tubers and in three months the tuber population may reach almost hundred resulting in serious weed problem. In this study residual effect of pre-sowing weed management practices on *C rotundus* and on succeeding maize has been studied.

MATERIAL and METHODS

The field experiment was conducted in the northwestern agro-climatic zone of Tamil Nadu (Chinnakuppam village, Dharmapuri district) with geographical region of 12.04^{o}N latitude and 78.48^{o}E longitude at an altitude of 392 m amsl. For the pre-sowing management of *C rotundus* in a non-crop ecosystem a field infested with mature stage of *C rotundus* was selected. The experiment was laid out in randomized block design with nine treatments and three replications. Different herbicides and herbicide combinations were used in this experiment. The treatments used were T_1 [Pre-emergence (PE) metribuzin 1.25 kg/ha)], T_2 [Early post-emergence (EPOE) halosulfuron methyl 75 g/ha)], T_3 [Post-emergence (POE) glyphosate 1.25 kg/ha)], T_4 (POE 2,4-D 1.25 kg/ha), T_5 (PE metribuzin 1.00 kg/ha followed by POE glyphosate 1.00 kg/ha), T_6 (EPOE halosulfuron methyl at 50 g/ha followed by POE glyphosate 1.00 kg/ha), T_7 (PE metribuzin at 1.00 kg/ ha followed by POE 2,4-D 1.00 kg/ha), T_8 (PE metribuzin 1.00 kg/ha + 2,4-D 1.00 kg/ha followed by POE glyphosate 1.00 kg/ha) and T_9 (Control, unsprayed). After two months of the above pre-sowing weed management treatments to study the residual effect of herbicides on succeeding maize trial was laid out without disturbing the layout of the experimental field. Observations on *C rotundus* and maize were recorded 15 and 30 days after sowing (DAS) and at harvest.

RESULTS and DISCUSSION

Effect of pre-sowing weed management on density, dry weight and control efficiency of *C rotundus*: Pre-sowing weed management practices had significant influence on the density, dry weight and control efficiency of *C rotundus* at all stages of succeeding maize (Table 1). Pre-sowing weed management with treatment T_6 (Early post-emergence application of halosulfuron methyl at 50 g/ha followed by post-emergence application of glyphosate at 1.00 kg/ha) at 15 DAS registered lesser density of *C rotundus* in succeeding maize which was followed by T_2 (Early post-emergence application of halosulfuron methyl at 75 g/ha) whereas application of new molecule of halosulfuron methyl at 50 and 75 g/ha was significantly superior and comparable with each other with respect to density of *C rotundus* but T_8 (Pre-emergence application of metribuzin at 1.00 kg/ha + 2,4-D at 1.00 kg/ha followed by post-emergence application of glyphosate at 1.00 kg/ha) was on par with T_2 at 30 DAS. Invariably unsprayed control recorded higher density of *C rotundus* at all the stages of observation. According to the Gannon et al (2012) soil plus foliar applications of halosulfuron provided the higher level of growth suppression against *Cyperus* spp. Ghosh et al (2017) reported that the sedge weed control by halosulfuron methyl 75 WG at four different doses (60.0, 67.5, 90.0 and 135 g/ha) showed better results at 30, 45 and 60 days after application on both density and biomass than all the other herbicidal treatments.

Cyperus dry weight was lower in T_6 followed by post-emergence application of glyphosate at 1.00 kg/ha followed by T_2. Both the treatments recorded 0.37 and 0.60 g/m^2 of *Cyperus* dry weight respectively. T_4 (Post-emergence application of 2,4-D at 1.25 kg/ ha) recorded higher *Cyperus* dry weight (1.03 g/m^2) than other treatments but lesser than T_9 (Control, unsprayed) (1.20 g/m^2). At 30 DAS T_6 registered conspicuously lower *Cyperus* dry weight and it was closely followed by T_2. The above treatments recorded 0.70 and 0.97 (g/m^2) of *Cyperus* dry weight respectively. Chand et al (2014) reported that the dry weed biomass of *C rotundus* was significantly lower with application of halosulfuron at higher doses.

Table 1. Effect of pre-sowing weed management treatments on *C rotundus* density, dry weight and control efficiency in maize

Treatment	Density (number/m^2)		Dry weight (g/m^2)		Control efficiency (%)	
	15 DAS	30 DAS	15 DAS	30 DAS	15 DAS	30 DAS
T_1	2.83 (6.0)	3.32 (9.0)	1.75 (1.06)	1.86 (1.46)	14.16	13.09
T_2	2.35 (3.5)	2.77 (5.7)	1.61 (0.60)	1.72 (0.97)	50.00	42.26
T_3	2.66 (5.1)	3.08 (7.5)	1.71 (0.92)	1.83 (1.35)	23.33	19.64
T_4	2.72 (5.4)	3.15 (7.9)	1.74 (1.03)	1.88 (1.54)	11.66	8.33
T_5	2.70 (5.3)	3.02 (7.1)	1.69 (0.87)	1.81 (1.28)	27.50	23.80
T_6	2.05 (2.2)	2.47 (4.1)	1.54 (0.37)	1.64 (0.70)	69.16	58.33
T_7	2.86 (6.2)	3.24 (8.5)	1.71 (0.91)	1.79 (1.22)	24.16	27.38
T_8	2.61 (4.8)	2.95 (6.7)	1.68 (0.82)	1.77 (1.15)	31.66	31.54
T_9	3.00 (7.0)	3.44 (9.8)	1.79 (1.20)	1.92 (1.68)	-	-
SEd	0.09	0.04	0.04	0.04	-	-
$CD_{0.05}$	0.21	0.10	0.08	0.10	-	-

DAS: Days after sowing

T_1 [Pre-emergence (PE) metribuzin 1.25 kg/ha)], T_2 [Early post-emergence (EPOE) halosulfuron methyl 75 g/ha)], T_3 [Post-emergence (POE) glyphosate 1.25 kg/ha)], T_4 (POE 2,4-D 1.25 kg/ha), T_5 (PE metribuzin 1.00 kg/ha followed by POE glyphosate 1.00 kg/ha), T_6 (EPOE halosulfuron methyl at 50 g/ha followed by POE glyphosate 1.00 kg/ha), T_7 (PE metribuzin at 1.00 kg/ha followed by POE 2,4-D 1.00 kg/ha), T_8 (PE metribuzin 1.00 kg/ha + 2,4-D 1.00 kg/ha followed by POE glyphosate 1.00 kg/ha), T_9 (Control, unsprayed)

Cyperus control efficiency was higher with T_6 followed by T_2 at 15 DAS. This was followed by T_8. At 30 DAS generally *Cyperus* control efficiency of all treatments was lower than 15 DAS. *Cyperus* control efficiency values were higher under T_6 and T_2 than rest of treatments. Halosulfuron, an ALS-inhibiting herbicide effectively reduced purple nutsedge regrowth to less than 5 per cent of the non-treated following soil and/or foliar applications (Vencill et al 1995). In corn a foliar application of halosulfuron at 72 g/ha controlled purple nutsedge more than 90 per cent 58 days after planting (Webster and Coble 1997) but new shoots had emerged by 120 days after planting.

Halosulfuron methyl (3-chloro-5-(4,6-dimethoxypirimidin 2-ylcarbamoylsulfamoyll-l-metbyl-pyrasole-4-carboxylate) is a selective herbicide for post-emergence control of sedges and other weeds. Halosulfuron-methyl interferes with ALS enzyme resulting in a rapid cessation of cell division and plant growth in both roots and shoots. The sulfonylurea herbicides are rapidly absorbed by the foliage as well as by the roots of plants (http://passel.unl.edu/communities/index.php?idinformationmodule=980466115&idcollectionmodule=1130274198&topicorder=3&maxto=4&minto=1. Halosulfuron methyl is readily translocated throughout the plant and inhibits cell division. Decomposition of the sulfonylureas in the soil takes place by both hydrolytic and microbial processes. The rate of degradation is enhanced by increased temperatures, soil moisture content and low soil pH. Its adsorption to clay or soil colloids is relatively low. Gannon et al (2012) reported that soil and soil plus foliar applications of halosulfuron provided the highest level of growth suppression indicating that herbicide-soil contact is required for optimum sedge control with this herbicide.

Effect of pre-sowing weed management practices on maize germination: Germination percentage in different pre-sowing weed management practices did not differ significantly indicating that halosulfuron methyl did not have any adverse effect on germination of maize. Post-emergence application of halosulfuron methyl at 52.5, 60.0, 67.5, 75.0 and 150.0 g/ha in sugarcane did not affect the germination (Chand et al 2014).

Effect of pre-sowing weed management practices on maize yield attributes: Data pertaining to various yield attributes viz number of cobs/plant, number of rows/cob, Number of grains/row, grain and stover yield and test weight as influenced by different pre-sowing weed management treatments are presented in Table 2

The cob bearing per plant was not influenced significantly by different pre-sowing weed management treatments. Among the pre-sowing weed management with T_6 registered higher values of all yield attributes viz number of cobs/plant, number of rows/cob, number of grains/row and test weight followed by T_2. Lower values of all yield attributes were registered in T_4 but more than unsprayed control. This could be because of elimination of crop weed competition during early growth as well as later of the crop growth and development in this treatment and consequently greater dry matter accumulation by plants causing improvement in yield attributes. Mathukia et al (2014) noted significantly highest cob length, cob girth, number of cobs/plant, number of kernels/cob and cob yield.

Effect of pre-sowing weed management practices on maize yield: Significantly higher grain yield was registered in pre-sowing weed management with T_6 (9,387 kg/ha) which was followed by T_2 (7,773 kg/ha). However T_8 (5,911 kg/ha) was on par with T_5 (Pre-emergence application of metribuzin at 1.00 kg/ha followed by post-emergence application of glyphosate at 1.00 kg/ha) (5,675 kg/ha). Lower grain yield of 3,280 kg/ha was attained in T_4 but it was more than control (2,112 kg/ha) (Table 2).

The stover yield of maize was significantly influenced by pre-sowing weed management practices. Among the treatments T_6 produced higher stover yield of 9,500 kg/ha which was on par with T_8 (9,500 kg/ha) and T_2 (9,400 kg/ha). Lower stover yield of 7,500 kg/ha was attained in T_4 followed by control (7,000 kg/ha). The increase in grain and straw yield could be due to better leaf area and dry matter accumulation by plant which was mainly because of availability of plant growth resources to the plant on account of reduced weed competition. Raut et al (2017) observed that metsulfuron methyl (20% WG 4 g/ha) 15 DAS recorded higher grain and straw yield as compared to all other herbicidal treatments.

CONCLUSION

Among the pre-sowing weed management practices early post-emergence application of halosulfuron methyl at 50 kg/ha followed by post-emergence application of glyphosate at 1.00 kg/ha followed by early post-emergence application of halosulfuron methyl at 75 kg/ha effectively reduced the density of *C rotundus* and it was found safe to succeeding maize and also improved the grain yield of maize. Thus pre-sowing weed management practices of early post-emergence application of halosulfuron methyl at 50 kg/ha followed by post-emergence application of glyphosate at 1.00 kg/ha was realized to be the best treatment for effective control of *C rotundus* and yield of succeeding maize.

REFERENCES

Chand M, Singh S, Bir D, Singh N and Kumar V 2014. Halosulfuron methyl: a new post-emergence herbicide in India for effective control of *Cyperus rotundus* in sugarcane and its residual effects on the succeeding crops. Sugar Technology **16(1):** 67-74.

Gannon TW, Yelverton FH, and Tredway LP 2012. Selective exposure of yellow nutsedge (*Cyperus esculentus*),

Table 2. Effect of pre-sowing weed management on yield attributes and yield of succeeding maize

Treatment	Number of cobs/plant	Number of rows/cob	Number of grains/row	Test weight (g)	Grain yield (kg/ha)	Stover yield (kg/ha)
T_1	1	13	16	43	3,975	8,700
T_2	1	15	22	53	7,773	9,400
T_3	1	13	17	44	4,322	8,950
T_4	1	12	15	41	3,280	7,500
T_5	1	14	19	48	5,675	9,250
T_6	1	16	24	55	9,387	9,500
T_7	1	14	18	47	5,264	9,000
T_8	1	14	19	50	5,911	9,500
T_9	1	11	12	36	2,112	7,000
SEd	0.01	0.31	0.35	1.34	117	203.40
$CD_{0.05}$	NS	0.66	0.75	2.85	248.53	431.19

NS: Non-significant

T_1 [Pre-emergence (PE) metribuzin 1.25 kg/ha)], T_2 [Early post-emergence (EPOE) halosulfuron methyl 75 g/ha)], T_3 [Post-emergence (POE) glyphosate 1.25 kg/ha)], T_4 (POE 2,4-D 1.25 kg/ha), T_5 (PE metribuzin 1.00 kg/ha followed by POE glyphosate 1.00 kg/ha), T_6 (EPOE halosulfuron methyl at 50 g/ha followed by POE glyphosate 1.00 kg/ha), T_7 (PE metribuzin at 1.00 kg/ha followed by POE 2,4-D 1.00 kg/ha), T_8 (PE metribuzin 1.00 kg/ha + 2,4-D 1.00 kg/ha followed by POE glyphosate 1.00 kg/ha), T_9 (Control, unsprayed)

purple nutsedge (*Cyperus rotundus*) and false green kyllinga (*Kyllinga gracillima*) to post-emergence herbicides. Weed Technology **26(2):** 294-99.

Ghosh A, Mondal D, Bera S, Poddar, Kumar A, Bandopadhayay P and Ghosh RK 2017. Halosulfuron methyl: for effective control of *Cyperus* spp in sugarcane (*Saccharum officinarum* L) and its residual effect on succeeding green gram (*Vigna radiata* L). Journal of Crop and Weed **13(2):** 167-174.

http://passel.unl.edu/communities/index.php?idinformationmodule=980466115&idcollectionmodule=1130274198&topicorder=3&maxto=4&minto=1

Mahmoodi S and Rahimi A 2009. Estimation of critical period for weed control in corn in Iran. International Journal of Agricultural and Biosystems Engineering **3(1):** 27-32.

Mathukia RK, Dobariya VK, Goshi BS and Chhodavadia SK 2014. Integrated weed management in rabi sweet corn (*Zea mays* L var *saccharata*). Advances in Crop Science and Technology **2(4):** doi: 10.4172/2329-8863.1000139.

Raut VG, Khawale VS, Yadav AM, Meshram D and Izalkar A 2017. Influence of different herbicides on growth, yield and economics of maize. Journal of Soils and Crops **27(2):** 77-81.

Vencill WK, Richburg JS, Wilcut JW and Hawf LR 1995. Effect of MON-12037 on purple (*Cyperus rotundus*) and yellow (*Cyperus esculentus*) nutsedge. Weed Technology **9(1):** 148-152.

Webster TM and Coble HD 1997. Purple nutsedge (*Cyperus rotundus*) management in corn (*Zea mays*) and cotton (*Gossypium hirstutum*) rotations. Weed Technology **11(3):** 543-548.