Research Article

Study on Purple Nutsedge (*Cyperus rotundus*) Tuber Dormancy and its Control Through Combined Application of Growth Regulator and Herbicides

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Abstract

Laboratory experiments were conducted to study the purple nutsedge tuber dormancy and assessment of combined application of growth regulators along with herbicides for its early growth control. In experiment-1, tuber dormancy study was carried out in two methods *viz.*, selection of different size of the tubers by its weight (0.25g to >1g) and depth of burial in soil from 5cm to 30cm. In experiment-2, application of 0.01% cytokynin along with the effective herbicides *viz.*, Glyphosate, Metolachlor and Almix (Met Sulfuran Methyl + Chloromuran ethyl) in two ways by tank mix application and followed by application. The experiment findings indicated that thecombined application herbicides (Metolachlor 2.5 kg ha^{-1}) and growth regulator (0.01 % Cytokinin) as tank mix provided effective control of purple nutsedge. Application Glyphosate @ 3.0 kg ha^{-1} third day after sprouting induced by the cytokine (0.01 per cent) provided 92 per cent control.

Keywords: Purple nutsedge, Tuber dormancy, Cytokynin, Herbicides

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Introduction

Purple nutsedge is considered one of the worst weed of the world. Widely distributed throughout the tropics and subtropics in 52 different crops and in 92 countries [1]. Lowering in crop yields is one of the greatest impacts of this species. Purple nutsedge is so highly competitive and causes yield reductions of various crops ranging from 23-89 per cent [2]. Reducing the effect of perennial weeds in crop production systems begins with minimizing reproductive plant propagules (e.g., bud, suckers, seeds and tubers) that are produced and returned to the soil.

Cultural practices such as crop rotation and cultivation [3] and soil desiccation [4], do not provide sufficient control of this weed. Purple nutsedge has proved difficult to control with herbicides. Chemical control measures provide only poor or temporary control [5], because of limited uptake and translocation of herbicides, and to temporal inhibition of tuber sprouting [6]. All the commercial herbicides available in the market aimed to control or kill the growing above ground part of the weed plants. The development of dormant tubers enables nutsedge to adopt to various cultural and cropping methods, thus making eradication of this weed difficult. Black tubers exhibit the greatest of dormancy, while young, white tubers sprout easily. Dormant tubers have one to 13 buds. Only few buds will sprout under suitable conditions, the others remaining buds were in dormant condition. Apical buds inhibit sprouting of other buds on the same tuber [7]. Similarly experimental research result noted that, upon the death of the foliage of the growing plant, inhibition of tuber sprouting was relieved and sprouting of tuber buds occurred. Dissecting tubers also stimulated sprouting of dormant buds near the cut surface [8].

Lacking of scientific information regarding physiological and ecological aspects of tuber sprouting is creating difficulty in nutsedge control, which determines to a large extent the potential degree of infestation. The prediction of purple nutsedge tuber sprouting could provide an estimate of the tuber reservoir relative to emerged plants, upon which appropriate decisions for management strategies may be imposed. The understanding of tuber dormancy is important and a prelude to devising effective control method for this world worst weed. One approach for an effective control is to stimulate all buds in the tubers to sprout. The search for an effective method of nutsedge control continues from long back. The use of growth regulators has been suggested as a means to precondition of nutsedge tuber for its early control. It is only after the dormant buds have sprouted and formed shoots that an herbicide may be used effectively on the vegetative parts. After the tubers are exhausted of their viable buds, no rejuvenation of shoots is expected. Much work has been done to control the purple nutsedge through sprouted above ground plant parts. This

experiment aims to study the dormancy behavior of the tuber and its control by combined application of growth substances along with herbicides.

Materials and Methods

Tubers of purple nutsedge were collected in bulk from farmers filed (11°16'42" N 77°35'1" E), and used as the base material for the study.

Experiment-I: Influence of depth of burial on tuber dormancy

The tubers collected from field were treated with 0.01 per cent cytokinin and were buried into different depths ranged from 5 cm to 30cm at six levels (5 cm each) containing 20 tubers each in pots filled with field soil along with untreated tubers. Similarly different sizes of the tuber were selected based on the weight from less than 0.25g to more than1.0 g. The experiments were laid out in FRBD design in three replications. The pots were watered regularly and the tuber and seedling characters were recorded 30 days after sowing.

Experiemnt-II: Influence of combined application of growth regulator and herbicides on purple nutsedge tuber sprouting

One set of tubers were treated with 0.01 per cent cytokynin and herbicides with various rates viz., Glyphosate (2.5kgha^{-1} and 3.0 kgha^{-1}), Metolachlor (1.5kgha^{-1} and 2.0 kgha^{-1}) and Almix (4 gha^{-1} and 6 gha^{-1}) similarly another set of tubers were treated with 0.01 per cent cytokynin alone and allowed to sprout and spray the same set of herbicides. The experiments were laid out in FCRD design in three replications

Tuber viability was calculated by the tubers collected from each treatment and replication after the sprouting / germination period were given with a longitudinal cut and soaked in 1.0 per cent tetrazolium chloride solution and kept at 40 ^{0} C for 6 h. The tubers were then rinsed thoroughly with water and were examined by staining. The stained and unstained tubers were counted and the mean expressed in percentage to the total tubers placed for germination. The germination percentage and other growth parameters was calculated

Results and Discussion

Influence of depth of burial and size of the tuber on tuber germination and growth

The tubers buried at different depths of soil significantly influenced the tuber sprouting and growth characters of purple nutsedge. Highly significant differences were obtained among the different depth of burial of tubers and tuber treatments (tubers treated with 0.01 % cytokinin and control) for the tuber characters *viz.*, germination, dormancy and vigour index. However, the interaction effects between the treatments and different depth of burial were non significant.

As evident from the **Table 1**, the germination percentage was decreased with increasing the depth of burial of tubers. Among the depth of burial, 5 cm was recorded the maximum germination of 77 per cent, followed by 10, 15, 20 and 25 cm *viz.*, 72, 69, 64 and 56 per cent respectively. The minimum sprouting was recorded in 30 cm depth (51 per cent). Between the treatments, tubers treated with 0.01 per cent cytokinin recorded the maximum germination percentage (76 per cent), while untreated tubers recorded the minimum germination percentage (53 per cent).The interaction effects between the depth of burial of tubers and dormancy breaking treatments were non significant.

The maximum value of vigour index (2688) was obtained with the depth of burial of tubers at 5 cm, and was followed by 10, 15, 2 and 25 cm depths attained the values *viz.*, 2522, 1890, 1401 and 1058 respectively. The minimum vigour index value was recorded with 30 cm depth (867). Dormancy breaking cytokinin treatment imposed tubers recorded the highest value of vigour index (2099), while untreated tubers recorded the lowest value (1376). Interaction effect due to depth of burial and cytokinin treatments were non significant (Table 1). The similar results were found with earlier research experiments [9].

Influence of size of tuber on its germination and growth

Significant difference in germination percentage was noticed between different size of tubers and cytokinin treatments (**Table 2**). Among the different size of tubers, 0.5-75 g was recorded the maximum germination percentage (78 per cent), followed by 0.25-0.50, more than 1 and 0.75-1 g recorded 75, 74 and 72 per cent respectively. Minimum

sprouting was recorded with less than 0.25 g sized tubers (71 per cent). Between the treatments, tubers treated with 0.01 per cent cytokinin recorded the maximum sprouting (87 per cent), while untreated tubers recorded the minimum sprouting (61 per cent). The interaction effect between the different size of the tubers was non significant.

Table 1 Influence of depth of burial on tuber germination and vigour index of purple nutsedge

Depth of burial (D) (cm)	Treatment (T)					
	Germination (%)			Vigour index		
	Untreated	Treated 0.01 % cytokinin	Mean	Untreated	Treated 0.01 % cytokinin	Mean
5	64 (53.55)	89 (70.80)	77 (62.17)	2154	3222	2688
10	60 (50.81)	83 (65.96)	72 (58.39)	2013	3031	2522
15	56 (48.07)	81 (63.92)	69 (56.00)	1491	2290	1890
20	53 (46.92)	75 (59.81)	64 (53.35)	1094	1709	1401
25	46 (42.51)	66 (54.14)	56 (48.32)	822	1295	1058
30	39 (38.84)	62 (51.95)	51 (45.40)	684	1050	867
Mean	53 (46.79)	76 (61.10)	-	1376	2099	-
	D	**T**	**D X T**	**D**	**T**	**D X T**
SEd	1.35	0.78	1.91	107	62	152
CD(P =5 %)	2.80	1.62	NS	223	129	316

Table 2 Influence of size of tuber on germination and vigour index of purple nutsedge

Tuber Size (S) (g)	Treatments (T)					
	Germination (%)			Vigour index		
	Untreated	Treated 0.01 % cytokinin	Mean	Untreated	Treated 0.01 % cytokinin	Mean
< 0.25	55 (47.68)	86 (70.62)	71 (66.26)	1227	2272	1750
0.25 – 0.50	61 (51.16)	90 (71.81)	75 (69.89)	1656	2677	2166
0.50 – 0.75	65 (53.54)	91 (73.21)	78 (72.15)	1916	3145	2531
0.75 – 1.00	60 (50.77)	83 (65.60)	72 (66.17)	1980	2886	2433
> 1.00	64 (52.94)	84 (66.48)	74 (68.28)	2255	2934	2595
Mean	61 (51.22)	87 (69.54)	-	1807	2783	-
	S	**T**	**S X T**	**S**	**T**	**S X T**
SEd	2.887	1.826	4.083	233	147	328
CD (P =5 %)	NS	3.837	NS	489	309	NS

The maximum value of vigour index (2595) was recorded with the tuber weighing more than 1 g and was followed by 0.5-75, 0.75-1, 0.25-0.5 g *viz.*, 2531, 2433 and 2166 respectively (Table 2). The lowest vigour index value of 1750 was recorded less than 0.25 g weighing tubers. Among the treatments, 0.01 per cent cytokinin treated tubers recorded the maximum value of vigour index (2783), compared to untreated tubers (1807). Similar result was recorded in yellow nutsedge tuber [10].

Experiment-II: Pre-emergence control of purple nutsedge using growth promoting substance and herbicides
Sprouting control and viability reduction (tank mix application)

The data associated with the effect of combined application of 0.01 per cent cytokinin and herbicides with different concentration levels as tank mix under different germination media on nutsedge tuber sprouting control and viability reduction is presented in the **Table 3**.

It was observed that the tank mix application of 0.01 per cent cytokinin with different herbicides significantly reduced the viability and sprouting of purple nutsedge. Higher sprouting control of 100 per cent was recorded with metolachlor @ 2.0 kg ha^{-1} and metolachlor @ 1.5 kg ha^{-1}. The minimum control of 93 per cent was recorded with almix @ 4 g $ha^{-1}$and almix @ 6 g ha^{-1}. In the case of viability reduction metolachlor @ 2.0 kg ha^{-1} recorded the maximum percentage of 95. The minimum viability reduction (71 per cent) recorded with almix @ 4 g ha^{-1}. Application of 0.01 per cent cytokinin and metolachlor @ 2.0 kg ha^{-1} in the paper media recorded one hundred per cent reduction in the viability of purple nutsedge followed by 96 percent with 0.01 per cent cytokinin + metolachlor

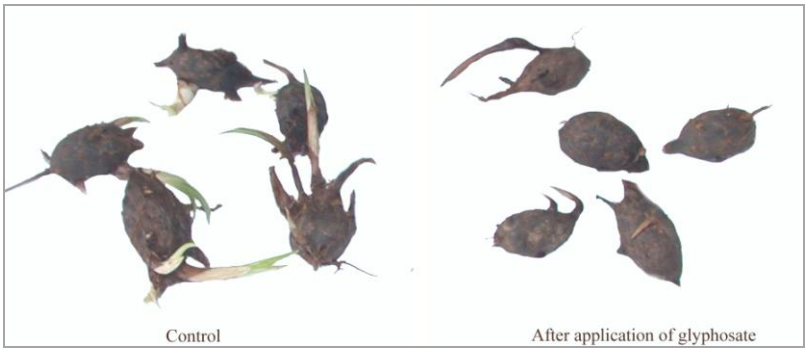
@ 1.5 kg ha^{-1}. In earlier studies also shows that that 99 % of the tubers had viability up to 42 months and also the higher amount of stored energy is responsible for vigours growth and fast reproduction of the plant after emergence [11].

Table 3 Effect of combined application of growth regulator and herbicides on tuber viability

Treatments	Tank mix application		Followed by application	
	Sprouting control (%)	Viability reduction (%)	Foliage control (%)	Viability reduction (%)
T_1 – Glyphosate @ 2.5 kg ha^{-1}	92	75	100	78
T_2 – Glyphosate @ 3.0 kg ha^{-1}	94	78	100	84
T_3 - Metolachlor @ 1.5 kg ha^{-1}	100	86	92	76
T_4 – Metolachlor @ 2 kg ha^{-1}	100	90	100	30
T_5 – Almix @ 4 g ha^{-1}	86	68	70	64
T_6 – Almix @ 6 g ha^{-1}	86	72	74	73
Mean	93	78	89	76

Foliage control and viability reduction (followed by application)

Maximum foliage control of 100 per cent was recorded with glyphosate @ 2.5 kg ha^{-1}, glyphosate @ 3 kg ha^{-1} and metolachlor @ 2.0 kg ha^{-1}. The minimum foliage control (77 per cent) was recorded with almix @ 4 g ha^{-1}. In the case of viability reduction maximum percentage of 88 per cent was recorded with glyphosate @ 3.0 ka ha^{-1}.Application of 0.01 per cent cytokinin and glyphosate @ 3.0 kg ha^{-1} in the paper media recorded 92 per cent reduction in the viability of purple nutsedge followed by 87 per cent with 0.01 per cent cytokinin followed by application of glyphosate @ 2.5 kg ha^{-1}. This may be attributed that glyphosate, a post-emergence non selective systemic herbicide, might have influenced one hundred per cent on the growing sprouts and reduced the viability of tubers.



Conclusion

Tuber germination did not influenced significantly by the tuber weight. Combined application herbicides (Metolachlor 2.5 kg ha^{-1}) and growth regulator (0.01 per cent cytokinin) as tank mix provided effective control of purple nutsedge. Application glyphosate @ 3.0 kg ha^{-1} third after sprouting induced by the cytokine (0.01 per cent) provided 92 per cent control.

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