EFFECT OF VARIOUS WATER REGIMES AND HERBICIDES ON SPROUTING OF COMMON REED RHIZOME FRAGMENTS

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Abstract

Two separate experiments were conducted to examine the effect of various water regimes and herbicides on sprouting of common reed (*Phragmites australis* L.) rhizome fragments. Each experiment was laid-out in completely randomized design (CRD) having water levels and herbicides as treatments, replicated thrice. Five fragments of fresh rhizomes with active buds were placed in the soil in pots for investigating the effect of various water regimes on sprouting of common reed. Sproutings were examined up to two months. While in the 2nd experiment post emergence herbicides were applied to the re-sprouts to check the efficacy of various herbicides against common reed management. Various water regimes affected the re-sprouting of common reed rhizomes. The lowest sprouting (6.66%) were noted in control treatment where no water was applied except at the time of placing the rhizomes in the pots, while maximum (96.66%) sprouting observed within (T3) water was applied from 5th to 7th weeks (5 times). While in the 2nd experiment herbicides significantly affected the re-sprouting ability, growth and biomass production of common reed and minimum re-sprouting and shoot biomass (3.33% and 6.00 g), respectively, were noted for fenoxaprop-p-ethyl as compared to control treatment (90.00% and 38.67 g) where no herbicide had been applied. Therefore it is concluded from the results that on either side from water regime (T5) the re-sprouting ability decreases and buds mortality increases.

Keywords: *Phragmites australis* L., common reed, water regimes, rhizomes fragments, herbicides, sprouting.

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Introduction

Phragmites australis L. commonly known as common reed belongs to family Poaceae. Common reed has distributed globally except the frozen lands of arctic and antarctic, but its core distribution area is Europe, the Middle East and America (Haslam, 2010; Eller et al., 2017). It is adapted to wide range of wetland sites water courses, stream banks and marshy areas etc. it is most frequent in areas with water level from near the soil surface to few feet above ground (Ostendorp 1993). Common reed thrives mostly in freshwater bodies but can also tolerate saline water containing up to 16% salt (Köbbing, et al. 2013).Common reed can grow from seeds, but most often it is propagated from rhizomes (Huhta, 2009). It has excellent capability to grow from rhizomes fragments during mechanical weed control when rhizomes are being cut and carried away by water movements or any other agency can initiate new Common reed stands if deposited in the moist soil near water bodies or wetland. It is one of the pioneer weeds and often grows in mono-culture (Ostendorp, 1993). Allirand and Gosse (1995) calculated the global area infested by common reed as 10 million hectares. By now if half of that area is found, it would be more than 4 million hectare and by harvesting half of it, that yields 5 ton ha^{-1} on the average the quantity of biomass obtained from that area would be more than10 million tons per annum, from nutrient-poor soils, and not from eutrophic water or under dystrophic conditions (Haslam, 2010).Common reed that grows on non-submerged saline soils occasionally has a dwarf habit (Thevs et al., 2007).

Nowadays *P. australis* is exhibiting one of the most rapid expansions in wetland vegetative history throughout the world. Its survival and growth on the terrestrial land in Pakistan is one of the invasive ability of *P. australis* and it exhibits semiaquatic phenomena for their distribution and existence to a wide range of ecosystem. It is propagated through rhizomes like *Sorghum halepense* and is less dependent on germination from seeds (Kashif et al. 2015). It is a big threat to the fresh water bodies of Khyber Pukhtunkhwa if left unchecked (Fawad et al., 2013). Climatic change has one of the most negative impacts on plant population disturbance in the 21st century. Abrupt change in weather climatic condition i.e. increase in temperature, less rain fall and long drought caused several aggressive aquatic species adaptable to semi aquatic habitat; whereas some plant species invaded native plant populations and becoming a threat to the native plant and ecosystem. Investigating the effect of various water regimes on the sprouting ability and growth of common reed may help in managing the menace of common reed by non-chemical way. According to Hellings and Gallagher (1992) common reed sprouting were badly affected by flooding to the soil surface and using this method it might be controlled in combination with other weed control strategies like the use of herbicides. Therefore the current research work was designed to evaluate the sprouting ability and growth of Common reed under various water regimes and to find out the efficacy of various herbicides for controllingcommon reed.

Materials and Methods

Experimental site description

Two different experiments were conducted in the Department of Weed Science, The University of Agriculture, Peshawar to find out "The effect of various water regimes on the re-sprouting ability of common reed" and "to check the performance of different herbicides for controlling common reed infestation.''

Experiment # 1

The aim of this experiment was to examine the effect of water levels on the re-sprouting ability of common reed rhizome fragments. This experiment was laid out in completely randomized design (CRD) having eight treatments whose detail is given below and replicated three times. Each pot having diameters of 20 inches with a depth of 12 inches had soil up to 8 inches. The *P. australis* rhizomes were collected from Peshawar (Bakshu Pull) and brought fresh to the laboratory of Weed Science Department. The rhizomes were cut into sizeable fragments each having up to 5 active buds. The number of buds in each treatment was kept uniform. Five rhizomes fragments were buried into the moist soil in each pot. Different water levels were then applied on weekly basis according to their respective treatments. The duration of the experiment was two months. After putting the rhizome fragment in the pots having soil, water was added to experimental units uniformly on the 1st day and later on according to the experimental plan. There was no temperature adjustment and all the treatment received the same environmental temperature.

The treatments used in experiment are given below:

T1= Water was applied all the seven weeks (i.e. 7 times)

T2= Water was applied between2nd to 7th weeks (6 times)

T3= Water was applied between 3rd to 7th weeks (5 times)

T4= Water was applied between 4th to 7th weeks (4 times)

T5= Water was applied between 5th to 7th weeks (3 times)

T6= Water was applied between 6th to 7th weeks (2 times)

T7= Water was applied between 7thto 8thweeks (1 time)

T8=No water was applied during the entire period of experiment.

Data were recorded on the following parameters:

1. **Sprouting %:**

The data on sprouting were recorded on basis of sprouting percentage after treatments application at the end of the experiment according to the following formula:

Sprouting (%) = 100 x (total buds – un-sprouted buds)/ total buds

Experiment # 2

The purpose of this second separate experiment was to find out the effect of herbicides application on the re-sprouting ability of common reed rhizome fragments. The experiment was arranged in completely randomized design (CRD), with 7 herbicidal treatments and a weedy check replicated three times. Five fresh rhizomes fragments, with 5 active buds of common reed were sown in each pot with suitable water regime (i.e. from 3rd week onwards after planting) for sprouting. The duration of this experiment was two month. After one month when the plants reached a height of 10-12 cm, different herbicidal treatments were applied to the pot and foliage of the common reed by using their common doses mentioned on the herbicide label.

The detail of the herbicides is given below.

Treatments	Dose (kg a.i. ha^{-1})	**Treatments**	Dose (kg a.i. ha^{-1})
T1= Alachlor	2.4	**T5**= Mesotrione+atrazine	0.21 + 1.2
T2= fenoxaprop-p-ethyl	0.937	**T6**= Metolachlor	2.10
T3= Isoproturon	1.00	**T7**= Sulponyl urea	0.015
T4= Clodinafop	0.096	**T8**= Control	-----

Mortality (%):

The herbicide application killed most of the sprouts in each treatment. But some of the sprout survived and tolerated the herbicide dose and some of the sprouts emerged later than the herbicide application. The data on mortality (%) were recorded on basis of mortality percentage after treatments application at the end of the experiment according to the following formula:

Plant mortality (%) = 100 x (total sprouts – survived sprouts)/ total sprouts

Shoot biomass (g):

Shoot weight (g) of each unit was calculated at the end of the experiment through destructive sampling i.e. cut them for samples and weigh them by using a digital balance and then converted into average.

Statistical Analysis:

Data on the studied parameters of both the experiments were analyzed statistically by using analysis of variance techniques in Microsoft excel 2007, suitable for CRD and the results were confirmed by analyzing through Statistix8.1 software. Means were compared through LSD test at 5% probability level (Steel and Torrie, 1980)

Results and Discussion

Sprouting %

Data on sprouting (%) was recorded after eight weeks of different water levels application. Water levels were applied per week to their respective treatments. Data was recorded when the *phragmites* reached with an average height of 10-12 cm. The statistical analysis of data revealed that different water levels had significant ($P \leq 0.05$) effect on the sprouting (%) of common reed (Table 1). Sprouting % of common reed was more in (T3) water was applied from 3rd to 7th weeks (5 times from 3 to 7 weeks) followed by (T4) water was applied from 4th to 7th weeks (4 times from 4 to 7 weeks) levels, respectively. The common reed sprouting % from treatment 5 to 8 shows drying during the 5th week. While in the (T1) water was applied all the seven weeks (water applied from 1 to 7 weeks) *phragmites* sprouts showed retarded growth after four water levels, due to stagnant water condition, which is followed by (T2) water was applied 2nd to 7th weeks (6 times from 2 to 7weeks) showed good growth. Results showed that increase water level condition on *phragmites* sprouts tolerated up to four weeks after that the rhizomes cause decaying or the shoot growth retarded. While in water scarcity for initial growth of *phragmites* was also tolerated from three to four weeks. In no water applied of control treatment, the initial sproutings dead. Our results are in line with that of Vretare *et al*, (2001) stated that, when common reed grows in deep water compared to shallower sites, the weed invests proportionally less energy on the rhizome formation and similarly fewer but taller stems are produced. Moreover the rhizomes grow more superficially in the substrate. Similarly Rushworth, (2014) also worked on the influence of variations in reed swamp structure and extent and concluded that water levels had a significant effect on the population structure of common reed. In pot experiment it shows significant results to the water levels. In case of field experiments/trail there will be more clear observations on the water level. These results are in line with the work of Hellings and Gallagher (1992) who also reported that common reed sprouting were badly affected by flooding to the soil surface. They attributed this effect to the lack of oxygen to the roots in the flooded condition.

Table 1. Effect of different water levels on sprouting (%) of common reed

Treatments/ various water regimes	**Sprouting (%)**
T1= water level 7	33.33 cd
T2= water level 6	46.66 cd
T3= water level 5	96.66 a
T4= water level 4	73.33 b
T5= water level 3	53.33 bc
T6= water level 2	33.33 cd
T7= water level 1 (s	26.66 de
T8= control	6.66 e
LSD value at 0.05 α level	21.780

Mortality (%):

Statistical analysisof data showed that different herbicides had a significant effect on the common reed mortality % (Table 2). Maximum mortality (86.67%) was recorded in the fenoxaprop followed by (86.33%) in the clodinafop. Similarly, minimum common reed mortality was recorded in the metolachlor, alachlor and sulfonyl urea with (13.33%) mortality. While, 0.00% mortality was recorded in the control pots. Comparative analysis of data revealed that fenoxaprop is best for the control of common reed. Similarly Gul et al (2018) also reported that the application of herbicides disturbed regeneration of rhizomes and therefore ensuredthe successful weed control where translocate herbicides were used. Similarly and according to Mauchamp, et al., (2001) about 18.7% plants died in the permanent submergence treatment for six weeks old seedlings. Whereas submerged leaves senesced, except the terminal (youngest) leaves in all treatments of permanently submerged plants.

Shoot biomass (g)

The statistical analysis of the data regarding shoot biomass (g) of common reed as affected by different herbicides revealed that various herbicidal treatments had a significant effect ($P \leq 0.05$)on the shoot biomass/ shoot weight of (Table 2). Result indicted that minimum shoot biomass (6.00 g) was recorded in the fenoxaprop followed by clodinafop (13.00 g). Though, maximum shoot biomass was recorded in the control (38.67g) which is followed by metolachlor (29.00 g) and alachlor (25.00 g), respectively. These results are in conformity with the findings Lopez (1993) who applied glyphosate and found that it is best for the management cattails to zero biomass as compared to other herbicides as well as other management strategies; he stated that glyphosate being systematic herbicide if used @ 05 L ha^{-1} can cut cattail biomass by 95 %.

From the experimental results it is concluded that the application of too much water as well as too less water effect the sprouting ability of water is suitable for the growth of common reed to grow or survive for four week in pot or control condition. Maximum water level decay buds and in case of sprouting the shoot growth stagnant water condition. While the water stress causes ability of the shoots after sprouting. Fenoxaprop and clodinafop proved best for the complete control of common reed as compared other herbicide used in the experiment. Similarly according to Mauchamp, et al., (2001) submergence differentially affected plant shoot biomass and shoot length, depending upon herbicide rate and age of the seedling. Therefore, major variations were noted among the partial and the totally submerged treatments. The partial submerged plants (50 & 80%) significantly enhanced biomass accumulation and growth, whereas the totally submerged treatments produced lower biomass with little growth in shoot length, whereas there was less or no effect on the number of shoots produced. The overall results of the experiments clearly indicates that common reed needs slightly moist soil to start the re-sprouting and do not need standing water during that period, while after re-sprouting it do need water i.e. from 3rd weed onwards and dry conditions afterwards (T6-T8) cannot be tolerated. Therefore flooding common reed after cutting for three weeks of draining and keeping them dry for 8 weeks can be used as cultural control method for common reed management, while in case of herbicides fenoxaprop-p-ethyl gives desirable results to control the common reed and to stop further infestation.

Table 2. Effect of different herbicides application on plant height (cm), shoot biomass (g) and plant mortality (%) of common reed

Treatments	**Mortality (%)**	**Shoot Biomass (g)**
Alachlor	13.33 b	25.00 c
Fenoxaprop-p-ethyl	86.66 a	6.00 e
Isoproturon	13.33 b	28.00 bc
Clodinafop	83.33 a	13.00 d
Mesotrione + atrazine	16.66 b	26.67 bc
Metolachlor	13.33 b	29.00 bc
Sulponyl urea	13.33 b	31.67 b
Control	0.00 c	38.67 a
LSD value at 0.05 α level	09.3479	5.9960

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