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Assessment of seed rain of matured *Parthenium hysterophorus* L. with glyphosate application

K. KALAICHELVI

Department of Agronomy, Agricultural College and Research Institute
Madurai-625104, Tamil Nadu

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ABSTRACT

Parthenium hysterophorus L., an obnoxious invasive weed is posing a severe threat to biodiversity and also reduces yield in different field crops and is a prolific seed producer. A field experiment was conducted to study is glyphosate and combined application of glyphosate with chlorimuron ethyl 9 g ha^{-1} have any control on Parthenium seeds if it is applied at maturity stage. Complete drying was observed on 10 DAHS with glyphosate spraying at 10 ml/litre whereas, complete drying was observed only at 15 – 20 DAHS with glyphosate + chlorimuron ethyl 9g ha^{-1}. P. hysterophorus plants were germinated at higher rate and earlier in glyphosate applied plot; when compared to hand weeded plot and unweeded plots. This might be due to the fastened maturity of seeds or early senescence of Parthenium. Weed seed bank assessment at 0-15 cm depth revealed that glyphosate application has recorded more number of Parthenium emergence under pot culture and field condition when compared to its combination with chlorimuron ethyl at 9g ha^{-1}. Uprooting is found to be successful technology if the Parthenium is at maturity phase as it resulted in Zero (0) seedling emergence under field condition. To confirm weed seeds are not killed due to glyphosate application, weed seeds were collected form the glyphosate applied treatments and raised under microplot condition. Seeds expressed 95 per cent germination which showed that glyphosate application has no check on weed seeds and its viability.

Keywords: Glyphosate, parthenium and seed

Parthenium hysterophorus L., an obnoxious invasive weed commonly known as carrot weed or congress weed belongs to the family *Asteraceae* is posing a severe threat to biodiversity and multiplication of our natural vegetation in recent years. *Parthenium* is native of south America and its first appearance in India was reported in Pune during 1955. This invasive weed reported to have major impact on human and animal health besides a major threat to bio diversity. This weed has been reported to be the source of dermatitis, nasal and naso - brancheal diseases in human and animal. Feeding of *Parthenium* to cattle would cause salivation, onset of diarrhoea, dermatitis and gastro intestinal irritation. Invasion of *Parthenium* reported in forest observed at alarming rate with little or no growth of other species. Growth inhibitors released in to the soil through leaching and decaying of *Parthenium* cause reduction in yield of cultivable crops to the tune of 40 per cent in field crops and 90 per cent in grazing fields of Maharashtra and reported to have affected the pollination of the crops cultivated nearby. The main toxin responsible for such effect of the weed is *Parthenin*.

During 1980, *Parthenium* spread was restricted mostly in cultivable lands but now it has been turned out to a major threat invading cropping and as well as hilly areas. Many pastures and non - cropped areas have been ruined and lost its economical value because of severe infestation of *P. hysterophorus* in recent years. Higher seed production ability and adaption to wider range of climatic conditions favours the multiplication and spreading of these weeds on large areas. Its capacity to germinate even with slightest moisture and dormancy, immense seed production ability and light weight of seeds favours its rapid infestation in crop, plantations and forest ecosystem. *P. hysterophorus* is an invasive plant with wide amplitude of ecological adaptability being both photo and thermo insensitive. It produces freely from numerous seeds (5000-10,000) per plant, besides its crown buds which put forth new shoots as and when mother shoot is cut. Plant flowers and sets seeds throughout this cropping period.

To deplete the weed seed bank, all the management options should be followed before flowering. Since sometimes we missed the stage of herbicide application, it is programmed to study is glyphosate and combined application of glyphosate with chlorimuron ethyl 9 g ha^{-1} have any control on Parthenium seeds if it is applied at maturity stage. Walia *et al*. (2002) reported that other herbicides with the exception of glyphosate applied to well establish parthenium weed plants did not provide satisfactory control.

To assess the influence of glyphosate application and its combination with chlorimuron ethyl and manual uprooting on seeds of *P. hysterophorus,* one acre field was identified at nearby farmers' field of Tapioca and Castor Research Station, Yethapur during 2016 which

Short communication

Email: kalaiagronomy@gmail.com

was completely infested with *P. hysterophorus* and at full maturation phase with an average height of 1-1.5 m height.

Glyphosate was applied at 10ml l^{-1} alone and it was also combined with chlorimuron ethyl at 9 g ha^{-1} and was applied through knapsack sprayer. The weed control efficiency was expressed on visual scoring by randomly identified 10 plants.

Besides this, the same strips of treatments were not disturbed and allowed for seed germination to assess the influence of herbicides and manual control on weed seeds (carryover effect). Soil samples were also collected at 0-10 cm depth in all the treatments including manual uprooting and un uprooted plots as control and studied for the weed seed bank. The processed soil was watered for 90 days in pots and expressed as number of parthenium kg^{-1} of soil. Further, to precisely confirm the influence of herbicides on weed seeds, seeds are collected from glyphosate applied parthenium plant and observed for germination in microplots.

Complete drying was observed on 10 DAHS with glyphosate spraying at 10 ml l^{-1} whereas, complete drying was observed only at 15 – 20 DAHS with tank mix combination of glyphosate + chlorimuron ethyl 9g

Table 1: Control of *P. hysterophorus* with different herbicide combinations

	T_1 - Glyphosate at 10 ml l^{-1}				T_2 - Glyphosate at 10 ml l^{-1}+ chlorimuron ethyl at 9 g ha^{-1}			
Random plant	**10 DAHS**	**15 DAHS**	**20 DAHS**	**Observation**	**10 DAHS**	**15 DAHS**	**20 DAHS**	**Observation**
1.	10	10	10	Complete drying was observed on 10 DAHS (Days after Herbicide Spraying) and has recorded 100% control over other treatments.	7 (Leaf alone dried)	10	10	Complete drying was observed only in 60 % of randomly identified plants and remaining 40% of the plants did not show complete
2.	10	10	10		7 (Leaf alone dried)	10	10	control on 10 DAHS and complete drying was observed only on
3.	10	10	10		10	10	10	15 DAHS.
4.	10	10	10		7 (stem greenish)	8	10	
5.	10	10	10		10	10	10	
6.	10	10	10		8	10	10	
7.	10	10	10		10	10	10	
8.	10	10	10		10	10	10	
9.	10	10	10		10	10	10	
10.	10	10	10		10	10	10	

ha^{-1}.Gaikwad *et al*. (2008) reported that total eradication of parthenium was achieved with the application of glyphosate (0.50 and 0.75%), atrazine (0.2 and 0.3%), 2,4-D (0.2 and 0.3%) and metribuzin (0.25 and 0.50%) at 30 days after spraying.

New *P. hysterophorus* plants were germinated at higher rate and earlier in glyphosate applied plot when compared to hand weeded plot and unweeded plots. This might be due to the fastened maturity of seeds or early senescence of *Parthenium* and shattering of viable seeds quickly when compared to either uprooted plots or unweeded plots. Hence, application of herbicide should be more effective and economical only before pre - maturation phase of *P. hysterophorus* to avoid the increased frequency of application of herbicides and increased seed rain. Kaur *et al*., 2014 reported that the most effective treatments for parthenium weed control were glyphosate and metribuzin, having higher mortality at 4 weeks after treatment (WAT) at both rosette and bolted stages than 2, 4-D, triasulfuron + terbutryn, bromoxynil + MCPA and atrazine + s-metolachlor, atrazine, s-metolachlor. Pendimethalin was the least effective treatment for both growth stages. Overall, the efficacy of herbicides was promising on rosette parthenium plants than bolted plants. Khan *et al*., 2012 reported that at bolting stage 91 and 75 per cent mortality was observed in case of glyphosate and metribuzin, respectively after four weeks of application.

Weed seed bank assessment at 0-15 cm depth (Table 2) revealed that glyphosate application has recorded more number of *Parthenium* emergence under pot culture and field condition when compared to its combination with chlorimuron ethyl at 9 g ha^{-1} which is

Table 2: Assessment of seed rain under different *Parthenium* management practices under pot culture and field condition

Treatments	*P. hysterophorus* population under field condition per m^2	Parthenium under pot culture condition (No. kg^{-1} of soil)
Glyphosate at 10 ml l^{-1}	233	49
Glyphosate at 10 ml l^{-1} + chlorimuron ethyl at 9 g ha^{-1}	13	7
Uprooted plot	0	1
Un uprooted plot	250	30

ALS inhibiting sulfonyl urea group herbicide. The science on restricted number of parthenium seedling emergence with these combinations needs further study. However, Singh *et al*., 2004 reported that parthenium weed is highly sensitive to amino acid synthesis and photosynthesis inhibitors compared to herbicides with other modes of action. This combination was tried for enhancing efficiency of control as already reported that chlorimuron plus glyphosate improved entire leaf, small flower, and tall morning glory control over glyphosate alone (Jason *et al*., 2004). Uprooting found to be successful technology if the Parthenium is at maturity phase as it resulted in zero seedling emergences under field condition. Weed seed bank was completely reduced by uprooting.

The experimental results revealed that glyphosate at 10 ml litre^{-1} has no effect on weed seeds. To confirm this weed seeds were collected form the glyphosate applied treatments and raised under pot culture condition. Seeds expressed 95 per cent germination which showed that glyphosate application has no check on weed seed viability. This was against the results of Mondal *et al*., 2017 that the physiological responses of glyphosate treatment with pea seeds showed significantly reduced seed germination, shoot and root length in peas. The percentage of germination in glyphosate treated seeds was decreased up to 17.0 per cent as against 98.0 per cent in control. A gradual inhibition of hypocotyl and radicle elongation in *Hibiscus* was observed by application of glyphosate (Kamble, 2006).

To break the natural development of resistance to a particular weed to a particular herbicides; combinations are being tried worldwide especially for the glyphosate resistant crops. Here the glyphosate application and its tank mix combination with chlorimuron ethyl 9 g ha^{-1} was evaluated for its efficiency and control on seeds. To conclude, complete drying was observed on 10 DAHS with glyphosate spraying at 10 ml litre^{-1} whereas, it was obtained only at 15-20 DAHS with glyphosate + chlorimuron ethyl 9g ha^{-1}. *P. hysterophorus* plants were germinated at higher rate and earlier in glyphosate applied plot when compared to hand weeded plot and unweeded plots. This might be due to the fastened maturity of seeds or early senescence of *Parthenium*. Weed seed bank assessment at 0-15 cm depth revealed that glyphosate application has recorded more number of *Parthenium* emergence under pot culture and field condition when compared to its combination with chlorimuron ethyl at 9 g ha^{-1}. Uprooting found to be successful technology if the *Parthenium* is at maturity phase as it resulted in zero (0) seedling emergence under field condition. Seeds expressed 95 per cent germination which showed that glyphosate application has no check on weed seeds and its viability. Hence, application of herbicide should be more effective and economical only before pre - maturation phase of *P. hysterophorus* to avoid the increased frequency of application of herbicides and increased seed rain.

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