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# EFFICACY OF SOME COMMON HERBICIDES AGAINST PARTHENIUM WEED

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## ABSTRACT

*Efficacy of five herbicides viz. Atrazil 38% SC, Ametryn+Atrazine 80WP, Bromoxynil+MCPA 40EC, Butachlor 60EC and Glyphosate 41SL was tested against Parthenium hysterophorus L. Recommended (X) as well as lower doses of 0.75X, 0.050X and 0.25X were sprayed on pot grown 5 and 8 week old Parthenium plants, corresponding to vegetative and flowering stages, respectively. Herbicidal efficacy was recorded in terms of number of days taken by the herbicide to completely kill the target weed. All the applied dosages of all the five test herbicides completely killed the target weed. However, variable herbicidal potential was observed with respect to both type and dose of herbicides. Bromoxynil+MCPA were found to be the most effective where all the employed doses of the herbicide completely killed the weed within 7 days at both the growth stages. Atrazil and Glyphosate killed 5 and 8 weeks old Parthenium plants in 5-10, and 12 days, respectively. Ametryn+Atrazine took 11 days to completely kill the weed at 5 week growth stage as compared to 14 days at 8 week growth stage. Butachlor was found to be the least effective herbicide.*

**Key words:** Allelopathy, Parthenium, Pakistan, Herbicides, Control.

## INTRODUCTION

*Parthenium* ( *Parthenium hysterophorus* L .), an aggressive weed of family Asteracea, is native to the subtropics of North and South America but now has invaded Asia, Australia (Evans, 1997) and Africa (Tamado and Milberg, 2000, 2004) during the last 50 years and is spreading at an alarming rate. The chemical analysis of *Parthenium* has indicated that all the plant parts including trichomes and pollens contain toxins called sesquiterpene lactones. The major components of toxin being 'Parthenin' and other phenolic acids such as caffeic acid, vanillic acid, anisic acid, chlorogenic acid and

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parahydroxy benzoic acid are lethal to human beings and animals (Oudhia, 1998; Belz *et al.*, 2007). In addition to health hazards a lot of available data also highlights its impact on agriculture as well as natural ecosystems (Chippendale and Panetta, 1994; Evans, 1997). There are reports of total habitat change in native Australian grasslands, open woodlands, river banks and floodplains due to *Parthenium* invasion (McFayden, 1992; Chippendale and Panetta, 1994). Similar invasions of national wildlife parks have also been reported in southern India (Evans, 1997). The weed has been rapidly spreading in Pakistan for the last 15-20 years. It has now become a major wasteland weed and is rapidly replacing the native flora in rainfed areas of the Punjab province and is also spreading in North Western Frontier Province and Kashmir. The weed grows luxuriously around the agricultural fields and is also found in some less competitive crops like watermelon and *Trifolium alexandrinum* L. (Javaid and Anjum, 2005; Javaid *et al.*, 2006a).

Fast growth rate, high reproductive potential, adaptive nature and interference by allelopathy (Kohli and Rani, 1994; Singh *et al.*, 2005) are the major contributing factors for rapid spread and successful establishment of this weed in any ecosystem. Above all, the lack of natural enemies of this weed in Pakistan and many parts of the world away from its natural home land is also contributing to a large extent in the rapid spread of this weed. Under such circumstances herbicidal approach seems a very viable option to control *Parthenium*. Earlier Kanchan and Jayachandra (1977) found that bromocil, diuron and terbacil @ 1.5 kg ha$^{-1}$ were very effective against *Parthenium*. Similarly Dhanraj and Mitra (1976) have reported that diquat @ 0.5 kg ha$^{-1}$ in 500 L spray can effectively control *Parthenium* at all growth stages. Mishra and Bhan (1994) have recommended the sulphonyl urea herbicides like chlorimuron ethyl and metsulfuron methyl to control *Parthenium* in non-cropped areas. Spraying of 2 kg, 2, 4-D sodium salt or 2L MCPA in 400 L of water controlled the growth of *Parthenium* seedlings. Likewise, MSMA @ 1L 100 ml$^{-1}$ of water successfully controlled fully grown *Parthenium* (Mahaderappa, 1996). In contrast to that several well known herbicides such as paraquat, trifluralin, diphenamid, napropamide, acetanilides, alachlor, metolachlor and propachlor have been shown to be ineffective against *Parthenium* weed (Labrada, 1990; Njoroge, 1991). Since use of chemical herbicides also poses health risks, the use of these chemicals should be reduced to minimum. The present research work was, therefore, carried out to evaluate the potential of different chemical herbicides against this weed so that a herbicide having highest weed control potential with minimum dosage may be recommended for control of *Parthenium* weed.

## MATERIALS AND METHODS

*Parthenium* plants were grown in pots of 24×30 cm diameter each containing 5 kg of sandy loam soil having organic matter 0.9%, pH 8.2, nitrogen 0.05%, available phosphorus 14 mg kg$^{-1}$ and available potassium 210 mg kg$^{-1}$. Pots

were arranged in a completely randomized manner under natural conditions. There was one plant of *Parthenium* in each pot.

Suspensions of recommended (X) and lower doses of 0.75R, 0.050R and 0.25R five chemical herbicides namely Atrazil 38% SC, Ametryn+Atrazine 80WP, Bromoxynil+MCPA 40EC, Butachlor 60EC and Glyphosate 41SL were prepared in water (Table-1). Different doses of test herbicides were sprayed with a hand atomizer on 5 and 8 weeks old pot grown *Parthenium* plants, corresponding to vegetative and flowering stages, respectively. The control treatment was sprayed with tap water. Effect of herbicides was monitored till all the plants in herbicidal treatments became dead. Data regarding the herbicidal efficacy of various employed chemicals were collected in terms of number of days taken by each herbicide to completely kill the target weed. Plants were further monitored for one month after death to examine regeneration of *Parthenium* in test herbicidal treatments. The data were subjected to analysis of variance (ANOVA) followed by Duncan's Multiple Range Test to delineate mean differences (Steel and Torrie, 1980).

## RESULTS AND DISCUSSION

All the five test herbicides were found effective against the *Parthenium* weed. Similar herbicidal effects of Buctril Super and Chwastox have recently been reported by Javaid *et al.* (2006b) against *Parthenium*. However, in the present study the applied herbicides exhibited a variable potential against the target weed species at the two growth stages.

Among the five test herbicides, Bromoxynil+MCPA was found to be the most effective. All the applied concentrations of this herbicide were found to be equally effective resulting in complete mortality of the target weed in 7 days at both the growth stages (Table-2). Bromoxynil is a nitrile herbicide that acts by inhibiting photosynthesis in target species of plant. This herbicide works by disrupting the plants ability to produce energy or cell-related activities (Anonymous, 1998). MCPA works by concentrating in the meristematic tissues where it interferes with protein synthesis, cell division and ultimately the growth of the plant. (EXTOXNET, 1996). Bromoxynil+MCPA has also been proved very effective in the management of weeds of wheat (Hussain *et al.*, 203).

Atrazil and Glyphosate were almost equally effective against *Parthenium* and were second to Bromoxynil+MCPA in their *Parthenium* mortality potential. Younger plants of *Parthenium* of 5 week old were more sensitive to these herbicides as compared to mature plants of 8 week old. Application of recommended dose of Atrazine and Glyphosate completely killed the 5 week plants in 7 and 8 days while rest of the doses killed them in 9 and 10 days, respectively. However, both the herbicides took 12 days for

complete killing of 8 week old plants (Table-2). Glyphosate is one of the most toxic herbicides, with many species of wild plants being damaged or killed by applications of less than 10 micrograms per plant. Glyphosate can be more damaging to wild flora than many other herbicides. Glyphosate kills plants by inhibiting the enzyme 5-enolpyruvoyl-shikimate-3-phosphate synthase, which forms the aromatic amino acids: phenylalanine, tyrosine and tryptophan. Atrazine is used to kill both broadleaf and grassy weeds. It is the second most widely used herbicide in the United States, after glyphosate. However, it is highly persistent in soil and has been classified as a Restricted Use Pesticide (RUP) due to its potential for groundwater contamination (Ware, 1986).

Ametryn+Atrazine was found slightly less effective than Atrazil and Glyphosate. All the applied concentrations of this herbicide were found equally effective. However, the herbicidal efficacy was reduced with the age of the target weed. It took 11 days to completely kill the weed at 5 week growth stage as compared to 14 days at 8 week growth stage (Table-2). Ametryn, a member of the Triazine chemical family, is an unrestricted or General Use Pesticide (GUP), which inhibits photosynthesis and other enzymatic processes of the target plants (Anonymous, 1989).

Butachlor was found to be the least effective herbicide. It took 13–16 days for complete death of the weed at 5 week growth stage and 18–20 days 8 week growth stage depending upon the employed concentration of the herbicide (Table-2). The least efficacy of this herbicide against the *Parthenium* may be attributed to the fact that this herbicide is generally used as a pre-emergence weedicide both for grasses and broad-leaf weeds in rice (Salcedo and Reges, 1972). However, the present study reveals that it also has a post-emergence herbicidal effect against *Parthenium* weed.

Generally *Parthenium* plants regenerate after few days once its top is killed by the herbicide application (Mahaderappa, 1999). However, in contrast to that there was no regeneration of the plants in any of the test herbicidal treatment.

In the present study since the test herbicides were found effective even at a lower dosages of one forth of the recommended dose, there are comparatively less environmental risks in their usage. Furthermore, since plant did not regenerate after death of the top that also increases the importance of these herbicides for their selection against *Parthenium*. Thus in light of the results of the present study it is recommended that *Parthenium* should be managed by using lowest doses of these herbicides especially those which take comparatively less time to kill this alien weed species.

**Table-1. Details of herbicides used to control Parthenium weed.**

| S. No. | Trade name | Common name | Recommended Rate (X) kg/L $ha^{-1}$ |
|---|---|---|---|
| 1 | Atrazil 38% SC | Atrazine | 1.0 L |
| 2 | Ametryn+Atrazine 80WP | ametryn+atrazine | 2.5 kg |
| 3 | Bromoxynil+MCPA 40EC | bromoxynil+MCPA | 1.0 L |
| 4 | Butachlor 60EC | Butachlor | 2.0 L |
| 5 | Glyphosate 41SL | Glyphosate | 4.0 L |

**Table-2. No. of days required for complete killing of *Parthenium* by the application of different herbicides and percentage mortality.**

| Herbicide | Dose | Days taken for complete death of *Parthenium* 5 weeks old plants | 8 weeks old plants | Mortality (%) |
|---|---|---|---|---|
| Atrazil 38% SC | 1 X | 7h | 12d | 100a |
| | 0.75X | 9f | 12d | 100a |
| | 0.50X | 9f | 12d | 100a |
| | 0.25X | 9f | 12d | 100a |
| Ametryn+Atrazine 80WP | 1 X | 11d | 14c | 100a |
| | 0.75X | 11d | 14c | 100a |
| | 0.50X | 11d | 14c | 100a |
| | 0.25X | 11d | 14c | 100a |
| Bromoxynil+MCPA 40EC | 1 X | 7h | 7e | 100a |
| | 0.75X | 7h | 7e | 100a |
| | 0.50X | 7h | 7e | 100a |
| | 0.25X | 7h | 7e | 100a |
| Butachlor 60EC | 1 X | 13c | 18b | 100a |
| | 0.75X | 14b | 20a | 100a |
| | 0.50X | 14b | 20a | 100a |
| | 0.25X | 16a | 20a | 100a |
| Glyphosate 41SL | 1 X | 8g | 12d | 100a |
| | 0.75X | 10e | 12d | 100a |
| | 0.50X | 10e | 12d | 100a |
| | 0.25X | 10e | 12d | 100a |

In a category, values with different letters show significant difference ($P \leq 0.05$) as determined by Duncan's Multiple Range Test.
X = Recommended dose

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