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# TESTING OF HERBICIDES AT VARIOUS DOSES ON THE GROWTH STAGES OF WILD ONION GROWN IN POTS

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**ABSTRACT**

*To test the efficacy of herbicides on wild onion (A. tenuifolius) growth stages a pot experiment was conducted at the Department of Weed Science, Khyber Pakhtunkhwa Agricultural University Peshawar, Pakistan during 2005-06 and 2006-07 using Completely Randomized design with factorial arrangement and each treatment replicated twice. Four biotypes (Bannu, Karak, Bhakkar and Mianwali) of A. tenuifolius were subjected to two herbicides viz. isoproturon and fenoxaprop-p-ethyl each having four doses including an untreated check. The doses of fenoxaprop-p-ethyl were 0, 0.47 (½x), 0.94 (1X) and 1.30 (1.5X) kg a.i. ha$^{-1}$, while the doses of isoproturon were 0, 2.0 (½x), 4.0 (1X) and 6.0 (1.5X) kg a.i. ha$^{-1}$. Each biotype was subjected to 4 doses of each herbicide at 2 and 4 leaf and flowering stages. Each treatment was replicated twice. The data were recorded on fresh and dry weight of A. tenuifolius. The main effects of growth stages, biotypes and herbicides doses and the interaction of herbicides x doses and biotypes x growth stages significantly affected the fresh and dry weight. Among the growth stages, the highest value was observed for flowering stage (9.19 g), while lowest (0.95 g) fresh weed biomass was recorded at 2 leaf stage of A. tenuifolius. Among the herbicides doses the highest (4.83 g) fresh weight was recorded in untreated check while the lowest (3.66 g) fresh weight was observed at higher doses. Highest (4.76 g) fresh weight was observed for Mianwali biotype and the remaining biotypes showed similar response statistically. For dry weight, highest (1.97 g) value was recorded in untreated check, while the lowest (1.40 g) value was recorded in the higher doses. Among the biotypes, highest (2.16 g) dry weight was recorded for Mianwali biotype while the lowest (1.37 g) dry weight was recorded for Bannu biotype. It is thus recommended that wild onion may be treated at its 2 leaf stage with either fenoxaprop-p-ethyl or isoproturon for economy and environmental safety.*

*Key Words:* **A. *tenuifolius*, biotypes, doses, herbicides, growth stages, wild onion**

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## INTRODUCTION

Wild onion (*A. tenuifolius* Cav.) is the most aggressive weed of chickpea in the sandy zone of Pakistan. Herbicides comprise 20-30% of input costs in North American cropping systems (Derksen *et al*. 2002). Despite widespread farmer adoption of herbicides, there is ever-increasing interest in reducing herbicide doses and overall herbicide use. Growers cite low commodity prices, crop injury, and herbicide carryover concerns, the escalating problem of herbicide resistant weeds, and rising unease with the environmental and human health effects of pesticides as issues forcing them to reconsider how should they manage weeds (Beckie and Kirkland 2003). Without herbicides, successful long-term weed management will require a shift away from simply controlling weeds problem to systems that restrict weed reproduction, reduce weed emergence, and minimize weed competition with crops. Research has shown that competitive crop production practices can contribute to the development of more sustainable weed management systems (Mohler, 2002). Aamil *et al*. (2004) reported the effects of isoproturon, fluchloralin and 2, 4-D (0, 1000, 5000 and 10 000 μg ml$^{-1}$) on chickpea rhizobia, chickpea-Rhizobium symbiosis, yields, N content and photosynthetic pigments. Higher concentrations of these herbicides inhibited the growth of the root nodule bacterium (Mesorhizobium ciceri) in vitro. The herbicides applied at 2-fold the recommended doses (TF), adversely affected the health, photosynthetic pigments, and N content of chickpea. The normal and TF doses of the herbicides except fluchloralin TF increased the seed yield of chickpea.

The study of the response of the crop at various growth stages is also important because fenoxaprop, like other graminicide, is only effective in post emergence application to weeds and effectively control some weeds even in advanced stages of growth (Beringer *et al*. 1982). Many other workers have reported the enhanced tolerance with advanced stage (Kells *et al*. 1984 and Derr *et al*. 1985). On the other hand, some findings show susceptibility at certain later stages of growth particularly in cereal (Olson *et al*. 1951). Timing of chemical weed control has an important impact on the efficacy of herbicides. For good economic returns, herbicides need to be applied at the most tolerant stage of the crop coupled with the most vulnerable stage of weeds. An increased tolerance to herbicides due to age has been reported in several weeds and crop species (Street and Richard, 1983; Kells *et al*. 1984). Increased tolerance to fenoxasprop in rice with more advanced growth stage has been reported by Snipes and Street. (1987).

The efficiency of herbicides on weeds is influenced by dose. Generally, high herbicide doses are recommended but these doses may be an overestimation of the amount required to obtain adequate control. Promising ways to minimize herbicide consumption include the use of low doses (Zoschke, 1994). However, as the surviving weeds will be able to set seed and, when incorporated to the seed bank, weed populations may increase in the following years, the effective herbicide dose must be precisely known. Weed species vary in their susceptibility to herbicides and there is growing concern due to the increase of species difficult to control with herbicides. Furthermore, as weeds increase in size, they become less susceptible to herbicides (Devlin *et al*. 1991; Klingaman *et al*. 1991; Blackshaw and Harker, 1997). Wille *et al*. (1998) concluded that herbicides were more efficacious at low wild oat densities than at high wild oat densities. Dieleman *et al.* (1999) also reported that herbicide efficacy on velvetleaf and common sunflower (Helianthus annuus L.) was greater at low than at high weed densities. Thus, any crop production practice that reduces weed populations over time is important to the successful use of reduced herbicide doses.

Some crops are likely to be more amenable than others to the use of reduced herbicide doses. Kirkland *et al*. (2000) reported that good crop yields and the highest net returns could be attained with a 50% herbicide dose in barley but that a 100% herbicide dose was required to attain the highest yields and net returns in lentil (Lens culinaris L.).

The present studies are an attempt to investigate efficacy of ½x, 1X and 1.5X doses of herbicides against A. *tenuifolius* with the following objectives:

i. To identify the most susceptible growth stage of A. *tenuifolius* to herbicides.
ii. To figure out the more economical herbicide for the control of A. *tenuifolius.*
iii. To quantify herbicides doses for the better management of A. *tenuifolius.*

## MATERIALS AND METHODS

### *Location of Experiment*

The experiment designed to evaluate the effect of different herbicide doses at various growth stages of A. *tenuifolius* grown in pots was conducted at the Department of Weed Science, Khyber Pakhtunkhwa Agricultural University Peshawar, Pakistan during mid-October, 2005-06 and 2006-07.

### *Seed Collection and Herbicides Application*

Four biotypes of A. *tenuifolius,* collected from districts Bannu, Karak (Khyber Pakhtunkhwa Province - Pakistan) and Bhakkar and Mianwali (Punjab - Pakistan) were seeded in pots of 10 cm filled with a sandy loam soil, in three phases. Ten seeds per pot were seeded. The seeds of wild onion were planted in three phases at one month interval to obtain the plant simultaneously at all growth stages (2 leaf, 4 leaf and flowering). Two herbicides (isoproturon and fenoxaprop-p-ethyl) were tried each having four doses including an untreated check. The doses of fenoxaprop-p-ethyl were 0, 0.47 (½x), 0.94 (1X) and 1.30 (1.5X) kg a.i. $ha^{-1}$, whereas the doses used for isoproturon were 0, 2.0 (½x), 4.0 (1X) and 6.0 (1.5X) kg a.i. $ha^{-1}$.

### *Procedure for Herbicides Applications*

Each biotype was subjected to 4 doses of each herbicide at 2 leaf, 4 leaf and flowering stage of A. *tenuifolius.* All the three stages of plants were sprayed at the same time when the last phase reached two leaf, second was with four leaf and the last phase at flowering stage at the time of herbicides application. For herbicides spray, knapsack sprayer was used fitted with T-jet nozzle. Each treatment was replicated twice. Pots were watered weekly.

### *Data Recording*

The data were recorded on fresh and dry weight of A. *tenuifolius* one month after application at each growth stage. The plants were harvested manually with the help of a scissor at the time when the plants were free of dew. After harvesting, plants were put in paper bags. The Paper bags were labeled with a permanent marker. Fresh weight was recorded right after harvesting the sample. While dry weight was recorded after drying the plants at $65^0$C in oven for 48 hours when the plants were completely dried and free of moisture. Both fresh and dry weight was taken on an electronic balance (Veg tag International) in grams (g).

### *Statistical Analysis*

The data recorded on each trait were individually subjected to ANOVA using MSTATC computer software and the means were separated by using Fisher's protected LSD test (Steel and Torrie, 1980).

## RESULTS AND DISCUSSION

### *Fresh Biomass 2005-06*

Analysis of variance of the data showed that herbicides, biotypes, and their interactions differentially affected the fresh biomass of A. *tenuifolius* during 2005-06 (Fig.1. a). The main effects of biotypes showed that the lowest (4.16 g) fresh biomass was observed for Bannu biotype and highest (4.70 g) weight was recorded in Mianwali biotype while the remaining biotypes produced almost the same fresh weight. In the interaction of herbicides and biotypes, fenoxaprop-p-ethyl produced the highest (4.90 g) fresh weight in Mianwali biotype while lowest (3.97 g) fresh weight was recorded for Karak biotype for the same herbicide. Almost similar responses have been recorded for isoproturon in all the tested biotypes. Growth stages, herbicides doses and their interactions differentially affected the fresh biomass of A. *tenuifolius* during 2005-06 (Fig. 1 b). The data indicated that the main effect of growth stages produced the lowest (0.95 g) biomass at two leaf stage while highest (9.19 g) fresh weight was recorded at flowering stage. Among the herbicide doses minimum (3.66 g) fresh weight was recorded at the highest herbicide (1.5X) dose while maximum (4.83 g and 4.73 g) fresh weight was observed in untreated and low (½x) doses, respectively. In the interaction of growth stages and herbicides doses the minimum (0.95 g) fresh weed biomass was recorded at 2 leaf stage for all the tested herbicides doses while maximum (9.44 g) fresh weight was recorded at flowering stage for all the doses. The variability in fresh and dry weight of biotypes showed that agro-ecological factors play an important role in the tolerance of wild onion to herbicides. All the herbicide doses responded to the growth stages of wild onion. Lower (½x) and recommended (1X) doses provided satisfactory results at two and four leaf stages, which mean that reducing the herbicides doses will work adequately and reduce the environmental risk. All the four biotypes produced very low dry biomass at two leaf stage ((Devlin *et al.* 1991).

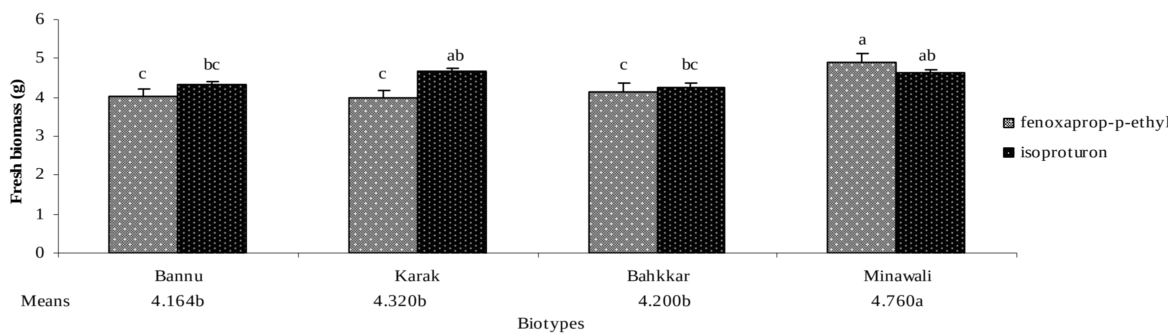


**Fig.1-a. Fresh biomass of different biotypes of A. *tenuifolius* as affected by the interaction of different herbicides and biotypes**.

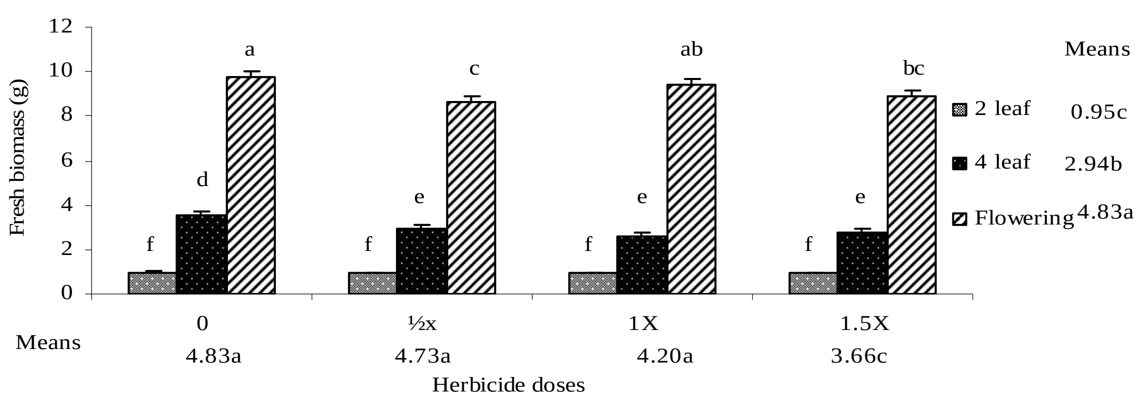


**Fig.1-b. Fresh biomass of different biotypes of A. *tenuifolius* as affected by the interaction of herbicides**

### *Dry Biomass 2005-06*

Herbicides, growth stages, and dose three way interactions differentially affected the dry biomass of A. *tenuifolius* during 2005-06 (Fig-2). In the three way interaction, the highest (4.36 g) dry weight was recorded in Mianwali biotype treated with fenoxaprop-p-ethyl at flowering stage followed by the same biotype at same growth stage treated with isoproturon (4.07 g). All the biotypes at two leaf stage showed statistically similar response to both herbicides. At four leaf stage, Mianwali biotype produced statistically similar dry weed biomass (1.816 and 1.693 g) in fenoxaprop-p-ethyl and isoproturon, respectively. Mianwali biotype was the most tolerant to the herbicides in biomass production. Whereas two leaf stage was the most susceptible growth stage of the A .*tenuifolius* to both the herbicides tested. The variability among the growth stages and biotypes showed that two leaf stage was more susceptible stage to herbicides as compared to four leaf and flowering stages. As the test species increased in size, it becomes less susceptible to herbicides depicting that tolerance in wild onion is directly proportional to the growth stage; Klingaman *et al*. 1991; Blackshaw and Harker, 1997). In another study, Puricelli *et al.* (2004) proved that with ½x the herbicides were also able to control many weed species.

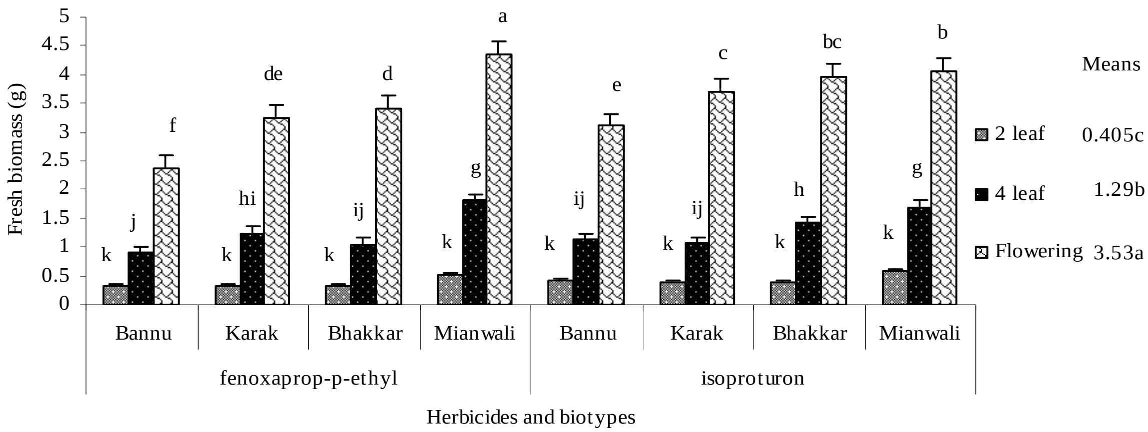


**Fig.2.** **Dry biomass of different biotypes of A. *tenuifolius* as affected by the interaction of different herbicides, biotypes and growth stages**

### *Fresh Biomass (2006-07)*

Fresh weed biomass of A. *tenuifolius* was differentially affected by herbicides, biotypes, and their interactions during 2006-07 (Fig-3). The main effects of biotypes showed that maximum (4.74 g) fresh weight was recorded in Mianwali biotype while rest of the biotypes showed statistically similar response. In the interaction of herbicides and biotypes minimum (4.01, 4.73 g) fresh weight was recorded in Bannu and Karak biotype, respectively, treated with fenoxaprop-p-ethyl while maximum (4.86 g) fresh weight was observed in Mianwali biotype treated with fenoxaprop-p-ethyl. However, it was statistically at par with Karak biotype (4.73 g) treated with isoproturon. Mianwali biotype showed maximum tolerance to both herbicides while Karak biotype also showed a good tolerance against isoproturon. Herbicides doses being the most important factor in the experiment, made it clear that highest dose of herbicides reduced the weed biomass better as compared to the rest of the doses at all the growth stages. But for the environment safety or if there is a narrow margin in tolerance between the crop and weeds, reduced dose are preferred (Defelice *et al*. 1989). Reduced dose technology is an approach to lower costs that can provide effective control of susceptible species and decrease weed seedling vigour of less susceptible species to give the crop competitive growth advantage (Vangessel and Westra, 1997). However, in our study 1⁄2X gave an adequate control of wild onion at 2 leaf stage. Defelice *et al*. (1989) were also of the view that ½x reduced the fresh and dry biomass of the weed species.

### *Dry Biomass (2006-07)*

Growth stages and herbicides doses differentially affected dry biomass of A. *tenuifolius* for the year 2005-06 (Fig-4a). The main effects of herbicide doses showed that minimum (1.43 g) dry weight was observed at 1.5X dose of herbicides, while maximum (2.0 and 1.96 g) dry weight was recorded in untreated check and ½x dose of herbicides, respectively. Among the growth stages, minimum (0.41 g) dry weight was recorded at two leaf stage of wild onion and maximum (3.59 g) dry weight was recorded at flowering stage followed by four leaf stage (1.32 g). In the interaction of herbicides doses and growth stages, minimum (0.23 and 0.34 g) dry biomass was observed at two leaf stage at 1X and 1.5X doses of herbicides while maximum (3.75, 3.61 and 3.76 g) dry biomass was observed at flowering stages at ½x and 1X doses of herbicides and in the untreated check, respectively. The herbicide fenoxaprop-p-ethyl decreased the weed biomass more as compared to isoproturon. While in biotypes, Mianwali biotype produced maximum biomass as compared to the rest of the biotypes while Bannu biotype produced the least biomass and was more susceptible to fenoxaprop-p-ethyl. Thus, for controlling wild onion, the prevalent biotype will need to give a due consideration in adjusting the dose of herbicide.

Herbicides, biotypes, growth stages and their interactions differentially affected the dry weed biomass of A. *tenuifolius* for the second term, 2006-07 (Fig-4b). In the interaction of biotypes and herbicides minimum (0.321 g) dry biomass was recorded in Bannu biotype treated with fenoxaprop-p-ethyl at two leaf growth stage however, it was statistically similar with rest of the biotypes treated with both the herbicides at the same growth stage while, highest (4.43 g) dry biomass was observed in Mianwali biotype treated with fenoxaprop-p-ethyl. However, it was statistically at par with the same biotype treated with isoproturon at flowering stage of wild onion. At the four leaf growth stage maximum (1.84 g) dry biomass was observed in Mianwali biotype treated with either of the herbicides while minimum (0.92 g) dry biomass was recorded in Bannu biotype which was statistically at par with same biotype treated with isoproturon and also with Karak biotype treated with isoproturon and Bhakkar biotype treated with fenoxaprop-p-ethyl. These findings are supported by Zoschke (1994), Zhang *et al.* (2000), Bostrom and Fogelfors (2002), O' Donovan *et al*. (2003), Walker *et al.* (2002) and Beckie and Kirkland (2003). These workers concluded that the risk associated with reduced herbicide doses increased in the absence of other weed management practices such as higher crop seed rate or competitive cultivars.

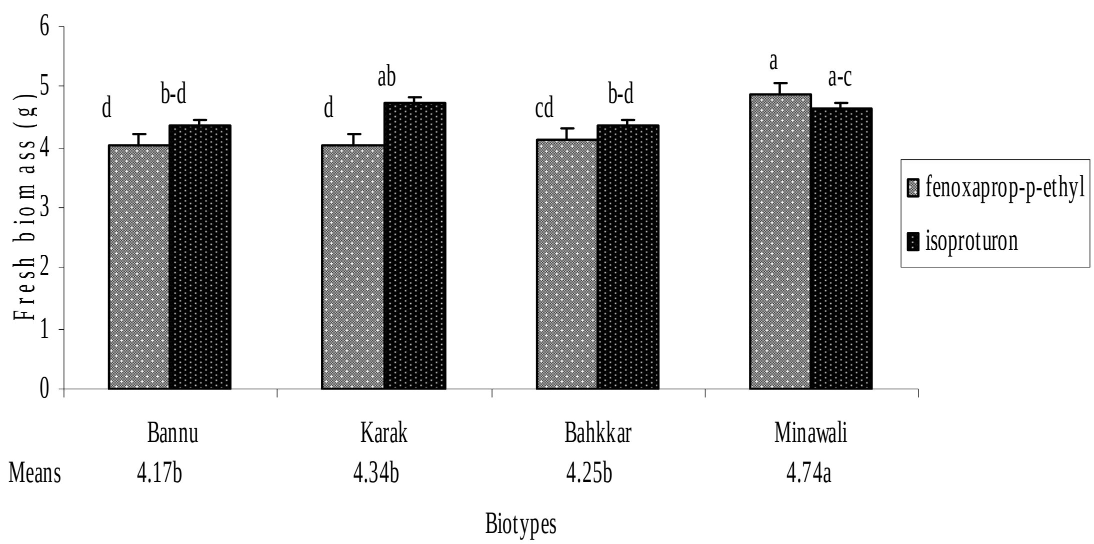


**Fig.3. Fresh biomass of biotypes of A. *tenuifolius* as affected by the interaction of herbicides and biotypes**

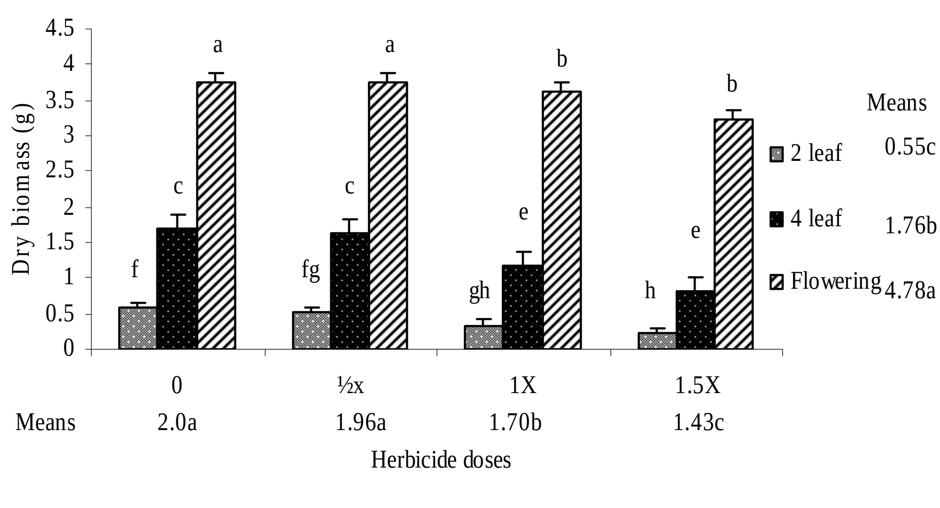


**Fig. 4. Dry biomass of different biotypes of A. *tenuifolius* as affected by the interaction of herbicides doses and growth stages.**

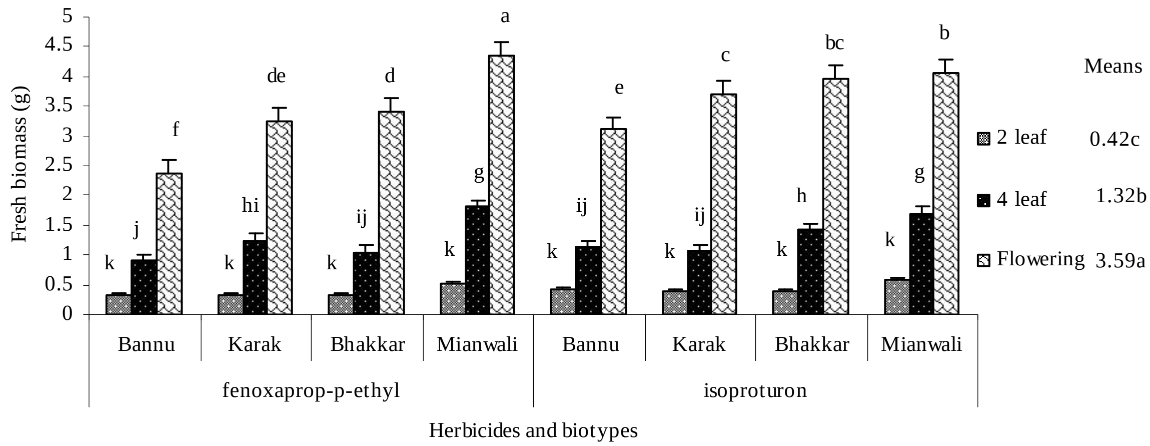


**Fig.4-b.** **Dry biomass of different biotypes of A. *tenuifolius* as affected by the Interaction of different herbicides, biotypes and growth stages**

## CONCLUSION AND RECOMMENDATIONS

Herbicides are good tools for minimizing the weed biomass and ultimately their control. The herbicides provided very good results on high doses. This does show that for weed control in field situation the herbicides must be integrated with other control practices for the effective management of the weeds under field condition. Fenoxprop-p-ethyl produced very good results at high doses as compared to isoproturon.

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