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# Application of Herbicides with Limited Dose Can Play a Major Role in Suitable Weeds Control in Saffron Fields

[2]*Parviz Golparvar,* [1]*Bahram Mirshekari and* [2]*Parvin Borhani*

[1]Department of Agronomy and Plant Breeding,
Tabriz Branch, Islamic Azad University, Tabriz, Iran
[2]East Azerbaijan Agriculture of Jahad Organization, Tabriz. Iran

**Abstract:** Saffron is a perennial and fall flowering crop and since it is a short plant with upright narrow leaves, it is not a competitive plant. In Iran, indiscriminate use of herbicides for weed control has resulted in greater environmental and health hazards, also, affecting soil microbiological activity. In order to evaluation of some herbicides application in controlling of saffron weeds in north-west of Iran, a field experiment was conducted during 2010-2011. Herbicides were Oxyflurofen, Sulfosulfuron, Met-sulfuron, Metribuzine, Haloxyfop-R-Methyle, Bentazone, 2, 4-D, Round-up alone or in dual combination with different doses and hand weeding, as control. The treatments were arranged as a randomized complete block design with 3 replicates. Effects of herbicide application on studied variables were significant at 1%. In weedy plots, differential weeds biomass between before and after spraying was positive and nearly 61% and weeds had dry weight of 530 g $m^{-2}$. Dry weight of remained weeds after spraying of 32 g.ai/ha Sulfosulfuron plus Met-sulfuron was similar to same herbicide with 40 g.ai/ha. 2, 4-D (0.48 L.ai/ha) plus Haloxyfop-R-Methyle (0.11 L.ai/ha) caused to develop the highest and Sulfosulfuron plus Met-sulfuron (32 g.ai/ha) the lowest flower number in saffron. Bentazone (1.92 L.ai/ha) plus Haloxyfop-R-Methyle (0.11 L.ai/ha) and hand weeding indicated 130% and 149% increase in dry stigma yield, respectively, compared to weedy plots. In our study, limited dose treatments causing to production of similar yield to un-weeded plots, then it could be recommended to farmers, which potentially will improve soil microbiological activity.

**Key words:** Dual combination · Fall flowering crop · Hand weeding · Stigma

## INTRODUCTION

Saffron is a precious spice which is mainly grown in Iran, India, Spain, Greece, Italy, Pakistan, Morocco and central Asian countries. Until recently, saffron was perceived only for its value as a spice. However, with recent research findings pointing to the medicinal properties of saffron such as its antimicrobial, anti-carcinogenic and antioxidant effects, interest in this plant has increased [1]. Saffron is a perennial and fall flowering crop and since it is a short plant with upright narrow leaves, it is not a competitive plant. Weed control is an important step in promoting the quantity and quality of saffron [2]. Fall weeds in saffron are usually late flowering summer weeds, or winter rosette weeds that do not grow remarkably during fall and winter. Rashed- Mohassel (1993) concluded that early spring evaluation is the best criteria for winter weeds. Except for hand weeding, no other technique is being used and this requires tremendous amounts of energy. We have to look for another low cost method of control.

In Iran, herbicide usage accounts for 41% of the total pesticide consumption. Indiscriminate use of herbicides for weed control during the past few decades has resulted in serious ecological and environmental problems, such as resistance and shifts in weed populations [3] and greater environmental and health hazards, also, affecting soil microbiological activity [4]. For example, it has been determined that Apyrus 75 WG disturbs soil homeostasis and it disrupts multiplication of some microbial groups, inhibits the activity of soil microbes and depresses yield, even if applied in a recommended dose [5].

**Corresponding Author:** Bahram Mirshekari, Department of Agronomy and Plant Breeding, Tabriz Branch, Islamic Azad University, Tabriz, Iran.

Providing a weed-free environment from the time of planting to canopy closing is important for strengthening the native groundcover's competitive ability against weed invasions. Selective herbicides kill specific targets while leaving the desired crop relatively unharmed [6]. There are normally many groups of damaging weeds in saffron fields. Application of herbicides in proper dose would reduce off-target movement of herbicide and maximize weed control [7].

Weeds such as *Holosteum glutinosum*, Downy brome and bulbous bluegrass (*Poa bulbosa*) appear in early spring while camel thorn Lambsquarters (*Chenopodium album*), Russian thistle (*Salsola kali*), knot weed (*Polygonum aviculare*) and prickly lettuce (*Lactuca serriola*) appear in late spring and summer. Abbasi [8] has conducted a series of experiments on weed control by using herbicides. Post emergence application of Haloxyfop ethoxy ethyle and Fluazifop and Metribuzine and pre-emergence application of Ethalfluralin did not have harmful effects on saffron flowering. It is noteworthy that researchers on weed control in saffron are not enough and we have need a thorough investigation concerning weed identification and its control in saffron fields. This study was aimed to evaluation of some herbicides application in controlling of saffron weeds in north-west of Iran.

## MATERIALS AND METHODS

A field experiment was conducted to study evaluation of some herbicides application in controlling of a 3 years old saffron field weeds, during 2010-2011, at Ahar, Iran, in a sandy loam soil with pH of 7.2 -7.5 and organic matter of 0.8% - 1.4%. Rate of precipitation within the experimental growing seasons was totally 102 mm. Weeds emerged in the experiment were *Convolvulus arvensis*, *Raphanus raphanistrun*, *Malva rotundifolia*, *Sinapis arvensis*, *Chenopodium album* and *Avena fatua*. Herbicides were Oxyflurofen (0.36 L.ai/ha), Oxyflurofen (0.48 L.ai/ha), Sulfosulfuron plus Met-sulfuron (32 g.ai/ha), Sulfosulfuron plus Met-sulfuron (40 g.ai/ha), Metribuzine (525 g.ai/ha) plus Haloxyfop-R-Methyle (0.11 L.ai/ha), Metribuzine (700 g.ai/ha) plus Haloxyfop-R-Methyle (0.11 L.ai/ha), Bentazone (1.92 L.ai/ha) plus Haloxyfop-R-Methyle (0.11 L.ai/ha), Bentazone (2.4 L.ai/ha) plus Haloxyfop-R-Methyle (0.11 L.ai/ha), Metribuzine (525 g.ai/ha) plus Oxyflurofen (0.36 L.ai/ha), Metribuzine (525 g.ai/ha) plus Oxyflurofen (0.48 L.ai/ha), 2, 4-D (0.48 L.ai/ha) plus Haloxyfop-R-Methyle (0.11 L.ai/ha), 2, 4-D (0.72 L.ai/ha) plus Haloxyfop-R-Methyle (0.11 L.ai/ha), Round-up (4.1 L.ai/ha) and hand weeding plot, that has named hereafter as $T_1$, $T_2$, $T_3$, $T_4$, $T_5$, $T_6$, $T_7$, $T_8$, $T_9$, $T_{10}$, $T_{11}$, $T_{12}$, $T_{13}$ and $T_{14}$, respectively. The treatments were arranged as a randomized complete block design with three replicates. The plots size was 4×6-m and each plot was divided to 2 sub-plots, one part for treatment and half another for control. Herbicides were applied at early April by a backpack sprayer with flat-fan nozzle.

Studied traits were weeds biomass before and after spraying, flower number per plant of saffron, fresh flowers weight and dry weight of stigma. All data were analyzed using the MSTAT-C software. Treatment means were separated using Fischer's Protected LSD at P= 0.05.

## RESULTS AND DISCUSSION

Effects of herbicide application treatments on studied variables were significant at 1% (Table 1). In weedy plots, differential weeds biomass between before and after spraying was positive and nearly 61% and weeds had dry weight of 530 g $m^{-2}$. Means comparison revealed that in $T_1$ weeds dry weight (WDW) reduced between two measurements up to 45% and $T_{10}$ was effective than other treatments (80% decrease in weeds dry weight) (Fig. 1).

In all herbicides treatments WDW experienced significant reduction compared to control. Different between $T_5$ and $T_6$ due to effect on reduction in WDW was not significant. It seems that saffron producers could effectively control weeds with limited dose of Metribuzine (525 g.ai/ha). Metribuzine is a two-purpose herbicide and in combination with Haloxyfop-R-Methyle could control all narrow and broad leaves weeds. Mousavi [9] in an evaluation on some post emergence herbicides resulted that only Metribuzine spraying could control 60% of weeds flora. Dry weight of remained weeds after spraying of 32 g.ai/ha Sulfosulfuron plus Met-sulfuron ($T_3$) was similar to same herbicide with 40 g.ai/ha ($T_4$) (Table 2). Sulfunyle-urea herbicides family such as Sulfosulfuron plus Met-sulfuron are from those weedicides with higher bioactivity in plants body and weed plants response them in limited application dose [10]. Similarly, combined application of 0.11 L.ai/ha Haloxyfop-R-Methyle plus Bentazone resulted in economize of nearly 0.5 L.ai/ha in recommended dose of Bentazone and there was a additive effect between these two herbicides. These herbicides have been previously tested safe on well established saffron plants. In an experiment conducted by Raje et al. [11] on saffron, Bentazone plus Fusalide or Bentazone plus Haloxyfop-R-Methyle had a good control effect on weeds flora. In the present study, we resulted good mortality response of weeds to $T_1$ than $T_2$.

Table 1: Mean squares of studied variables at different herbicide treatments

| | | Mean Squares | | | |
|---|---|---|---|---|---|
| SV | df | Weeds biomass after spraying | Flower number per plant | Fresh flowers weight | Dry weight of stigma |
| Replication | 2 | 873.073 | 94.306 | 30.889 | 0.956 |
| Treatment | 13 | 35943.818** | 1457.291** | 245.818** | 11.972** |
| Error | 26 | 580.983 | 126.716 | 29.563 | 0.944 |
| CV (%) | - | 15.00 | 26.60 | 22.02 | 19.87 |

** means significant difference at 1% probability level

Table 2: Means comparison of effects of herbicides application on weeds dry weight and flower number in saffron plant.

| Treatments | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ | $T_{10}$ | $T_{11}$ | $T_{12}$ | $T_{13}$ | $T_{14}$ (Hand weeding) | LSD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Weeds dry weight reduction after treatment (%) | 74.6b | 75.0b | 60.9d | 79.9ab | 87.0a | 80.7a | 74.0b | 73.2bc | 76.5b | 82.4a | 71.6c | 76.0b | 63.5d | 81.7a | 6.95 |
| Flowers number in saffron plant ($m^{-2}$) | 37.0e | 61.7ab | 0.2g | 0.5g | 64.0a | 52.7bc | 58.0b | 41.0de | 38.4e | 50.4c | 69.7a | 18.4f | 35.4e | 66.7a | 7.85 |

Values within each row with the same letter have not significant difference at 1% probability level

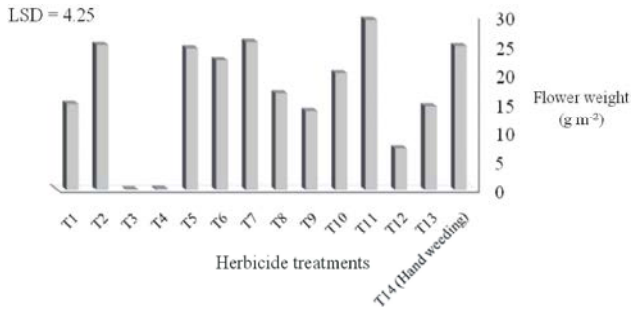


Fig. 1: Mean comparisons of fresh weight of saffron flowers at different herbicide application treatments

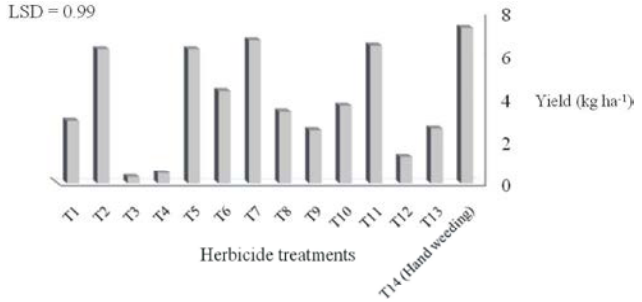


Fig. 2: Mean conparisons of dry stigma yield of saffron at different herbicide application treatments

2,4-D (0.48 L.ai/ha) plus Haloxyfop-R-Methyle (0.11 L.ai/ha) caused to develop the highest and Sulfosulfuron plus Met-sulfuron (32 g.ai/ha) the lowest flower number in saffron. Treatments of $T_{11}$ and $T_{14}$ (hand weeding) had significant increase in flower yield compared to weed-infested plots (Table 2). It is noteworthy that, $T_3$ and $T_4$ were not recommended to saffron weeds control due to intensity of damage on crop plants. Saffron in treatments of $T_2$, $T_5$, $T_6$, $T_7$, $T_{10}$ and $T_{11}$ produced similar flower yield to hand weeding and probably are recommended to saffron weeds control. Norouzzadeh et al. [12] has been introduced Metribuzine for better weeds control in saffron.

Means comparison (Fig. 1) indicated that T11 caused to produce higher (29.5 g $m^{-2}$) and T3 and T4 lower (0.13 g $m^{-2}$) fresh flower yield in saffron. Because of greater damage on saffron plants due to T3 and T4, Sulfosulfuron plus Met-sulfuron treatment is not recommended for saffron weeds controlling. In our experiment, over-dose application of 2, 4-D (T12) damaged saffron plants by chlorosis symptoms in leaves after flowers harvesting. Therefore, T11 also, is recommendable for saffron weeds control.

Galavi *et al*. [13] reported that herbicides of 2, 4-D and MCPA intensively damaged in saffron as chlorosis and stem elongation, due to epinasty. In hand-weeded

plots saffron produced 0.73 g $m^{-2}$ yield (dry stigma) and T3 with 0.03 g $m^{-2}$ yield. T7 and T14 indicated 130% and 149% increase in yield, respectively, compared to weedy plots (Fig. 2). In Soufizadeh *et al*. [14] opinion, hand weeding is a cost-effective method for weeds control in saffron. In Morocco chemical weeds control in saffron fields with Round-up, Granstar and 2, 4-D are prevalent by farmers at summer. Metribuzine, when applied post emergence (0.7 kg.ai/ha) or pre-emergence (0.7 kg.ai/ha), also Fluazifop-p-butyle (0.25 L.ai/ha), Haloxyfop ethoxy ethyle (0.25 L.ai/ha) plus Metribuzine (0.7 kg.ai/ha), Atrazine (0.8 kg.ai/ha) and Ethalfluralin (1.16 L.ai/ha) controlled graminaceous weeds and had a pronounced effect on wild barley. Bentazon (1.92 L.ai/ha) had a remarkable effect on broad leaves but not narrow leaves. Combination of Bentazon (1.92 L.ai/ha) and atrazine (0.8 kg.ai/ha) controlled tansy mustard effectively [8]. Abbasi [15] in another experiment resulted a better degree of weeds control in wide spectrum in saffron field by application of Metribuzine as a pre-emergence or post-emergence and Haloxyfop-etoxy-ethyle and Bentazone as post-emergence herbicides, that is in good agreement by our research results.

## CONCLUSION

In our study, limited dose treatments of $T_2$, $T_5$, $T_7$ and $T_{11}$ causing to production of similar yield to un-weeded plots, then it could be recommended to farmers, which potentially will improve soil microbiological activity.

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