

Research Article

Mulch-herbicide combination approach for urban green space weed control: A case study in Iran

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Abstract: Weeds are considered one of the most significant challenges in managing urban green spaces, and controlling them is one of the most costly maintenance operations. This study aimed to investigate the feasibility of controlling weeds in rose shrub green spaces using a mulch-herbicide combination. The experiment was conducted in a randomized complete block design with 11 treatments and three replications. Treatments included: the application of trifluralin and pendimethalin herbicides alone at a dose of 2 L ha⁻¹, incorporated into the soil surface, and the application of each herbicide at the recommended dose in combination with wood chip mulch (applied to the soil surface under a 5 cm mulch layer, application of the mulch-herbicide combination on the soil surface and application of the mulch-herbicide combination incorporated into the topsoil) along with control treatments of mulch alone, hand weeding, and no weed control throughout the season. Weed sampling was performed at intervals of 15, 30, 45, and 60 days after treatment application. Based on the results, the lowest weed density and dry weight were observed in the combined mulch-herbicide treatments. Trifluralin herbicide showed greater weed control efficacy than pendimethalin, both when applied alone and in combination with mulch. The application of trifluralin and pendimethalin alone had adverse effects on rose flowering, but combining them with wood chip mulch mitigated their impact on rose growth. According to the results, combining trifluralin and pendimethalin herbicides with wood chip mulch can be an effective option for controlling weeds in green spaces, particularly in rose gardens.

Keywords: Integrated Weed Management, Pendimethalin, Trifluralin, Wood Chip Mulch

Introduction

With increasing urban land-use change and its subsequent effects on the environment, green spaces can provide numerous ecosystem services

that contribute to the health and well-being of citizens, playing a crucial role in establishing urban ecological balance and improving the quality of life in cities (Semeraro *et al.*, 2021). Therefore, urban green spaces are concentrated

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areas of nature in cities, serving as key areas for urban biodiversity and vital for people's connection with nature (Aronson *et al.*, 2017). According to the latest statistics from the Parks and Green Spaces Organization of Mashhad Municipality in 2022, the total area of green space in Mashhad was approximately 4,000 hectares (Statistical Yearbook of Mashhad, 2022), with a per capita green space of about 2.4 m² (Razaghian and Aghajani, 2023). Given the limited per capita green space and the instability of the urban water supply in Mashhad (Rahnama and Shaddel, 2015), the development and construction of new green spaces are constrained. Therefore, the scientific and principled maintenance of urban green spaces and trees is of the utmost importance.

Several factors contribute to the quality and provision of ecosystem services in urban green spaces. Among these, weeds are a significant factor that negatively affects the ecosystems of human-made environments, including urban green spaces. They cause economic damage and degrade ecosystem services in these spaces by making them unsightly, increasing maintenance costs, and triggering allergies among citizens (Bourgeois *et al.*, 2019). However, weeds are considered an unavoidable and integral part of the biodiversity of these ecosystems (Radosevich *et al.*, 2007; Archibald *et al.*, 2017). From the perspective of urban space management and the principle of uniformity in green space engineering, even a small population of weeds in urban green spaces is deemed undesirable and problematic.

On the other hand, controlling weeds is one of the most important and costly maintenance operations for urban green spaces (Mojni *et al.*, 2012). Various methods, including herbicide applications and mechanical control through weeding, are used to manage weeds in these areas. Due to limitations in weed control methods, such as the use of herbicides in urban green spaces (Harker and O'Donovan, 2013), manual weeding is currently the most effective and widely used method. Despite the risks associated with herbicide use, this method has significant disadvantages, including the vast area

of urban green spaces, time-consuming application, high costs, and the need for a large labor force (Najafi and Baghestani, 2010). On the other hand, the use of herbicides raises concerns about wind drift and potential threats to public health. Therefore, using low-risk herbicides or herbicides with reduced risks in combination with other methods could lead to effective control of these troublesome plants, reduce maintenance costs, and improve the efficiency of invasive plant management in urban green spaces. In this regard, the mulch-herbicide combination approach is currently being proposed as a viable method for use in gardens and urban green spaces (Marble *et al.*, 2015).

In general, both living and non-living mulches are effective management tools for maintaining urban green spaces, pose no threat to humans or the environment, and serve multiple functions in urban vegetation cover. They are primarily used for two main reasons: first, their aesthetic appeal, and second, for their ability to retain moisture and improve soil structure (Mulumba and Lal, 2008; Safari and Kazemi, 2016; Wang *et al.*, 2021). Additionally, mulches can also play a crucial role in controlling weeds (Mechergui *et al.*, 2021). In agricultural ecosystems, numerous studies have demonstrated that combining pre-planting or pre-emergence herbicides with various mulches can extend the duration of weed control and suppress a broader spectrum of weed species (Case and Mathers, 2006; Saha *et al.*, 2019; Maghsoodi *et al.*, 2020; Hosseini-Evari *et al.*, 2022; Ahmadi *et al.*, 2022). The application of this approach to weed management in green spaces, particularly in newly established tree-based green spaces, has yielded positive results (Marble *et al.*, 2015).

Among herbicides suitable for use in urban green spaces, pendimethalin and trifluralin exhibit relatively acceptable control spectra. These soil-applied herbicides can enhance their effectiveness in long-term weed control if losses due to volatilization and photodegradation are minimized, and their persistence in the soil is increased.

Alternatively, applying organic mulches can effectively control weeds while improving soil structure (Zand *et al.*, 2022). It is hypothesized that weed control efficacy can be increased by using the organic mulch-herbicide combination approach with these herbicides (Marble *et al.*, 2015). Considering that tree pruning waste in urban green spaces is a valuable organic resource, which can be processed and chipped for use in beautification and soil enhancement, and given that no previous attempts have been made to mix it with soil-applied herbicides to optimize weed control, this study aims to investigate the possibility of using this approach to enhance the efficacy of trifluralin and pendimethalin herbicides in urban green spaces in Mashhad, Iran.

Materials and Methods

This experiment was conducted during 2020 and 2021 at the Ferdowsi University of Mashhad campus (36°15'N, 59°28'E; 985 m a.s.l.). For this purpose, a green space associated with Rosa hybrida rose gardens, where the shrubs were 4 years old and infested with a range of narrow- and broad-leaved weeds, was selected. The dimensions of each experimental plot were 2 × 3 meters. Before applying the treatments and to ensure uniformity among the experimental plots, a single manual weeding operation was performed, and the soil was loosened to a depth of 5 cm.

Experiment design

The experiment was conducted in a randomized complete block design with three replications. The treatments included:

Application of trifluralin alone, incorporated with the soil surface at a dose of 2 L ha⁻¹ (TRI).

Application of pendimethalin alone, incorporated with the soil surface at a dose of 2 L ha⁻¹ (PEN).

Application of trifluralin at a dose of 2 L ha⁻¹ under a layer of wood chip mulch (TRI + MU).

Application of pendimethalin at a dose of 2 L ha⁻¹ under a layer of wood chip mulch (PEN + MU).

Application of trifluralin at a dose of 2 L ha⁻¹, combined with wood chip mulch spread on the soil surface (TRIMU).

Application of pendimethalin at a rate of 2 L ha⁻¹, combined with wood chip mulch and spread on the soil surface (PENMU).

Application of trifluralin at a dose of 2 spread, combined with wood chip mulch and incorporated with the topsoil layer (TRIMU2).

Application of pendimethalin at a dose of 2 spread, combined with wood chip mulch, and incorporated with the topsoil layer (PENMU2).

Application of wood chip mulch alone, at a thickness of 5 cm on the soil surface (MU).

No weed control treatment throughout the season (W-Infest).

Hand weeding control treatment throughout the season (W-Free).

In the herbicide-alone treatments, the herbicides were sprayed onto the soil surface and then thoroughly incorporated to a depth of 5 cm using a harrow. In the herbicide application treatments under wood chip mulch, the herbicide solution was sprayed onto the soil surface, followed by a 3- to 5-cm-thick layer of wood chips. In the wood chip mulch treatments combined with herbicides, before spreading the wood chips in the plots, they were placed on a plastic sheet, separately sprayed with trifluralin and pendimethalin, and then evenly spread to a height of 3 to 5 cm within the plots. In the wood chip mulch treatments combined with herbicides and incorporated into the soil, the herbicide-treated wood chips were spread in a 3- to 5-cm-thick layer over the soil and then thoroughly integrated into the topsoil layer using a harrow. Herbicide spraying was performed with a backpack sprayer equipped with a lance and a drenching nozzle, operating at 210 kPa and 250 liters per hectare. The wood chip mulch used was a mixture of wood chips from urban green space trees in Mashhad, primarily consisting of a blend of plane tree *Platanus orientalis* L., Common ash *Fraxinus excelsior* L., common elm *Ulmus carpinifolia* Borkh., and White mulberry *Morus alba* L.

After the application of the experimental treatments, weed sampling was conducted at 15, 30, 45, and 60 days. In each sampling, after counting the weeds by species, all the weeds within a 0.5×0.5 meter random quadrat in each experimental plot were harvested from the soil surface, then transferred to paper bags and sent to the laboratory. To determine the dry weight of the samples, the bags were placed in an oven at 75°C for 48 hours, and their dry weight was measured using a digital scale with a precision of 0.01 grams. At the end of 60 days after treatment, the number of flowers per rose bush was counted.

After determining weed species density in each sampling frame, the relative density and frequency of each weed species were calculated using Equations 1 and 2 (Ankova *et al.*, 2015).

$$\text{(Equation 1)} \quad D = \frac{(\sum Y_i)}{S} \times 100$$

$$\text{(Equation 2)} \quad F = \frac{(\sum Z_i)}{n} \times 100$$

Where: D is the relative density of the weed species, $\sum Y_i$ is the total number of each weed species in the sampling quadrates ($i = 1, 2, 3, \dots$), S is the total number of weed species in the species, F is the relative frequency of the weed species, $\sum Z_i$ is the total number of sampling quadrates containing the target weed species, n is the total number of sampling quadrates.

Statistical analysis

For data analysis, the data were averaged over the two years due to the lack of interaction and subjected to analysis of variance (ANOVA) using PROC GLM in SAS version 9.2. Mean comparisons between treatments were performed using the least significant difference (LSD) test.

Results

The weed species observed in the experiment, along with their characteristics, are presented in Table 1. Out of the total of 12 weed species belonging to nine plant families, nine species (75%) were annuals and three species (25%) were perennials. Additionally, three species

were narrow-leaved, and nine species were broad-leaved. Three species had the C4 photosynthetic pathway (all three broad-leaved species), while the remaining nine species followed the C₃ photosynthetic pathway.

Among all the species, Purslane (18.20%), Common Amaranth (17.66%), and Bindweed (15.47%) had the highest relative densities, respectively (Table 1).

Weed density

The effect of treatments on weed density was significant ($p \leq 0.01$) (Table 2) 15 days after treatment application. The highest weed density (81 plants m^{-2}) was observed in the uncontrolled treatment, followed by pendimethalin alone and its combination with wood chip mulch, which had 54 and 59 plants m^{-2} , respectively. Among the experimental treatments, the lowest weed densities were observed in the treatments with trifluralin applied alone and pendimethalin applied under mulch, with no significant difference between them (Fig. 1). No significant differences were observed among the other treatments. According to the results, using trifluralin alone and pendimethalin under wood mulch provided the most effective weed control in the rose garden at this sampling stage. In contrast, pendimethalin alone and its combination with mulch showed the lowest efficacy. The remaining treatments showed moderate weed control, with no statistically significant differences among them (Fig. 1).

Thirty days after treatment, the lowest weed density (6 plants m^{-2}) was observed in the hand weeding control treatment, which did not differ significantly from the treatments combining trifluralin and pendimethalin with mulch and soil. Additionally, the treatments consisting of trifluralin combined with mulch and incorporated into the soil surface, as well as trifluralin alone incorporated into the soil surface layer, were not significantly different ($p \leq 0.05$) (Fig. 1). application of trifluralin alone, pendimethalin combined with surface mulch, and pendimethalin under the mulch layer exhibited moderate weed control at this sampling stage.

Table 1 Weeds and their population characteristics in the experiment.

Scientific name	Family	Photosynthetic Pathway	Life cycle	Relative Density	Relative Frequency
<i>Chenopodium album</i> L.	Amaranthaceae	C3	Annual	12.77	64.00
<i>Portulaca oleracea</i> L.	Portulacaceae	C4	Annual	17.66	56.50
<i>Convolvulus arvensis</i> L.	Convolvulaceae	C3	Perennial	15.47	39.30
<i>Hordeum murinum</i> L.	Poaceae	C3	Annual	20.18	72.20
<i>Polygonum aviculare</i> L.	Polygonaceae	C3	Annual	10.22	26.90
<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	C4	Perennial	6.15	28.60
<i>Malva neglecta</i> Wallr.	Malvaceae	C3	Annual	1.96	4.50
<i>Lactuca serriola</i> L.	Asteraceae	C3	Annual	4.85	28.40
<i>Plantago major</i> L.	Plantaginaceae	C3	Perennial	1.10	3.20
<i>Solanum nigrum</i> L.	Solanaceae	C3	Annual	2.24	9.60
<i>Setaria viridis</i> L.	Poaceae	C4	Annual	5.63	47.40
<i>Senecio vulgaris</i> L.	Asteraceae	C3	Annual	1.82	8.30

† Relative density represents the proportion of total weed plants in the experimental plots occupied by the species of interest.

‡ Relative abundance indicates the proportion of the number of experimental plots in which the presence of the species in question was recorded.

Table 2 Mean squares for weed density data under the effect of treatments.

Source of variation	df	15 DAT	30 DAT	45 DAT	60 DAT
Block	2	4.45 ^{ns}	3.69 ^{ns}	8.1*	8.26*
Treatment	10	43.37**	35.94**	39.89**	40.25**
Error	22	2.81	2.33	1.29	1.31
Coefficient of variation (C.V.)		13.9	15.1	20.7	15.4

^{ns} non-significant effect; * significant effect by $0.01 \geq P \text{ value} \geq 0.05$; ** significant effect by $0.01 > P \text{ value}$.

DAT, Days after treatments.

Based on the results obtained 45 days after the application of treatments, the highest weed density (89 plants m^{-2}) was observed in the uncontrolled treatment, which showed significant differences from the other treatments (Fig. 1). In contrast, the lowest weed density was observed in the hand weeding control treatment (8 plants m^{-2}), which also differed significantly from the other treatments. Among the herbicide-only treatments and those combining herbicides with wood chip mulch, the treatment with wood chip mulch treated with trifluralin showed lower weed density (15 plants m^{-2}) than the other treatments, with no significant difference compared to the treatments with trifluralin alone, wood chip mulch treated with pendimethalin or the combination of wood chip mulch and trifluralin incorporated with soil surface (Figure 1). According to the results from this sampling stage, the application of trifluralin alone and in

combination with wood chip mulch (including applications under the mulch, combined with wood chip mulch, and wood chip mulch-trifluralin combinations incorporated with soil) successfully suppressed weeds in the rose garden, with no significant differences among these treatments.

Sixty days after sampling, the lowest weed density was observed in treatments combining trifluralin with wood chip mulch spread on the soil surface, and pendimethalin with mulch incorporated into the soil, with 9 and 10 plants m^{-2} , respectively. These treatments did not differ significantly from trifluralin applied alone or under mulch. Moreover, no significant differences were observed between the other experimental treatments and the hand-weeding control (Fig. 1). In the samplings before 60 days, the application of trifluralin alone and in combination with wood chip mulch (applied

under the mulch, trifluralin combined with wood chip mulch, and trifluralin combined with wood chip mulch and incorporated into the soil) effectively suppressed weeds.

Weed dry weight

The effect of weed control treatments on the dry weight of weeds was significant ($p \leq 0.01$) (Table 3). Based on mean comparisons, 15 days

after treatment application, the lowest weed dry weight was observed in the treatment combining wood chip mulch with trifluralin (13 g m^{-2}). This treatment differed significantly from the others. In contrast, no significant differences were found among the treatments consisting of wood chip mulch alone (46.5 g m^{-2}), pendimethalin alone (50 g m^{-2}), and the combination of pendimethalin with wood chip mulch (40 g m^{-2}).

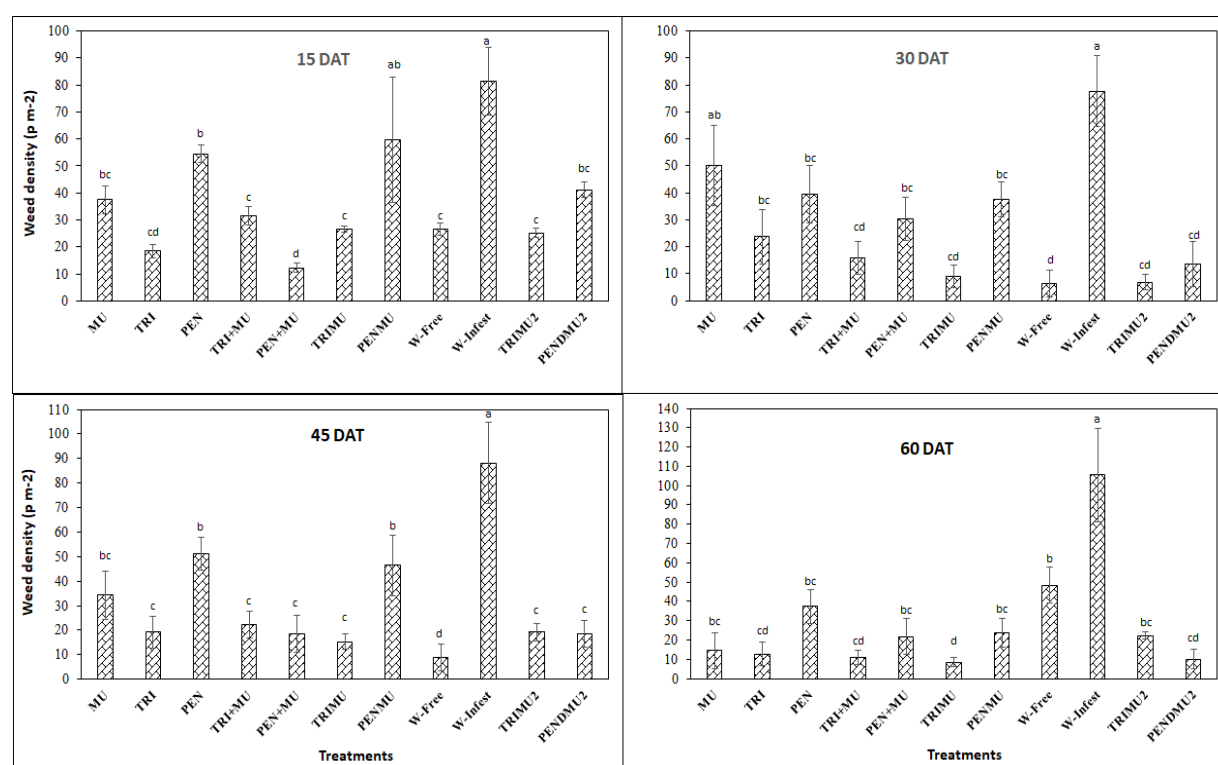


Figure 1 The effect of different mulches and herbicide treatment on weed density days after treatment (DAT): Mulch (MU), Trifluralin (TRI), Pendimethalin (PEN), Spraying trifluralin under mulch (TRI + MU), Spraying pendimethalin under mulch (PEN + MU), mulch combined with trifluralin (TRIMU), mulch combined with pendimethalin (PENMU), weed free (W-Free), weed infest (W-Infest), mulch combined with trifluralin and incorporated to soil (TRIMU2), mulch combined with pendimethalin and incorporated to soil (PENMU2).

Table 3 Mean squares for weed dry weight and number of rose flowers per plant.

Source of variation	df	15 DAT	30 DAT	45 DAT	60 DAT	Number of flowers per plant
Block	2	7.32 ^{ns}	8.85 ^{ns}	9.9*	14.48*	0.92 ^{ns}
Treat	10	36.40**	44.1**	49.4**	72.1**	4.70*
Error	22	1.16	1.40	1.56	2.29	0.9
Coefficient of variance (C. V.)		14.9	17.1	27.5	17.7	14.5

^{ns} non-significant effect; * significant effect by $0.01 \geq P \text{ value} \geq 0.05$; ** significant effect by $0.01 > P \text{ value}$.
DAT, Days after treatments.

Thirty days after the treatment applications, the lowest weed dry weight (3 g m^{-2}) was observed in the hand-weeding control treatment. This treatment did not show a significant difference from the treatments combining wood chip mulch with trifluralin and the treatment with a pendimethalin -wood chip mulch combination incorporated into the soil (Fig. 2). According to the results of this sampling stage, the application of trifluralin combined with wood chip mulch on the soil surface, as well as the combination of wood chip mulch - trifluralin combination incorporated with the soil, was as effective in controlling weeds as the hand weeding treatment.

Forty-five days after treatment application, the lowest dry weight of weeds (8.5 grams m^{-2}) was observed in the hand-weeding control treatment, which did not show a significant difference from the treatments with wood chip mulch combined with trifluralin (9.5 grams m^{-2}) and wood chip mulch-trifluralin combined and incorporated into the soil ($12.3 \text{ grams m}^{-2}$). The combination of pendimethalin with wood chip mulch resulted in greater weed dry weight reduction than pendimethalin applied alone. According to the results, the application of trifluralin combined with wood chip mulch (including treatments under mulch, mulch combined with trifluralin, and mulch chips with trifluralin incorporated into the soil) was equally practical, without significant differences, in suppressing weeds in the rose garden.

Sixty days after the application, the lowest weed dry weight was observed in treatments combining wood chip mulch with pendimethalin and incorporating it into the soil, as well as wood chip mulch with trifluralin. There was no significant difference in weed control effectiveness among the other treatments (Fig. 2).

Number of rose flowers

Among the experimental treatments, the highest number of rose flowers ($8 \text{ flowers plant}^{-1}$) was observed in the wood chip mulch alone treatment, which did not show a significant difference from the treatments with wood chip mulch combined with pendimethalin and incorporated into the soil, as well as from the application of pendimethalin under the mulch. In contrast, the lowest number of

flowers ($2 \text{ flowers plant}^{-1}$) was observed in the control treatment without weed control, which did not differ significantly from the treatments with herbicides applied alone or the combination of trifluralin with wood chip mulch (Fig. 3). According to the results, the application of the pendimethalin and trifluralin herbicides, either alone or in combination with wood chip mulch, had adverse effects on rose flowering. However, the combination of pendimethalin with mulch, applied under the mulch layer, reduced its adverse effects, whereas trifluralin did not show any significant impact. Based on the results on the effects of treatments on weed density and dry weight, the combined application of pendimethalin or trifluralin with wood chip mulch appears to be a suitable option for controlling weeds in rose gardens, as it balances weed control with minimal adverse effects on rose flowering.

Discussion

All weed species observed in the experimental plots are recognized as significant weeds in urban green spaces across Iran, particularly in tree and shrub green spaces, as highlighted in other studies (Najafi and Baghestani, 2010; Majeni *et al.*, 2011).

Dinitroaniline herbicides are widely used to control weeds in various crops, including soybeans, sesame, chickpeas, and medicinal plants such as cumin and saffron (Grichar, 2006; Maqsoodi *et al.*, 2019; Hosseini *et al.*, 2022; Ahmadi Kakavandi, 2022). These herbicides are effective in controlling weeds in numerous studies (Marbel *et al.*, 2011). On the other hand, the use of mulch, either alone or in combination with soil-applied herbicides, has proven effective in weed management in tree and shrub green spaces (Chen *et al.*, 2013; Marbel *et al.*, 2015). Barche *et al.* (2015) highlighted several benefits of using mulches in crops, including increased yield, early maturity, improved moisture retention, and limiting weed growth. However, reports indicate that combining pre-emergence herbicides with mulch can reduce their effectiveness. In this experiment, it was demonstrated that the combined application of trifluralin and pendimethalin with wood chip mulch effectively controlled weeds.

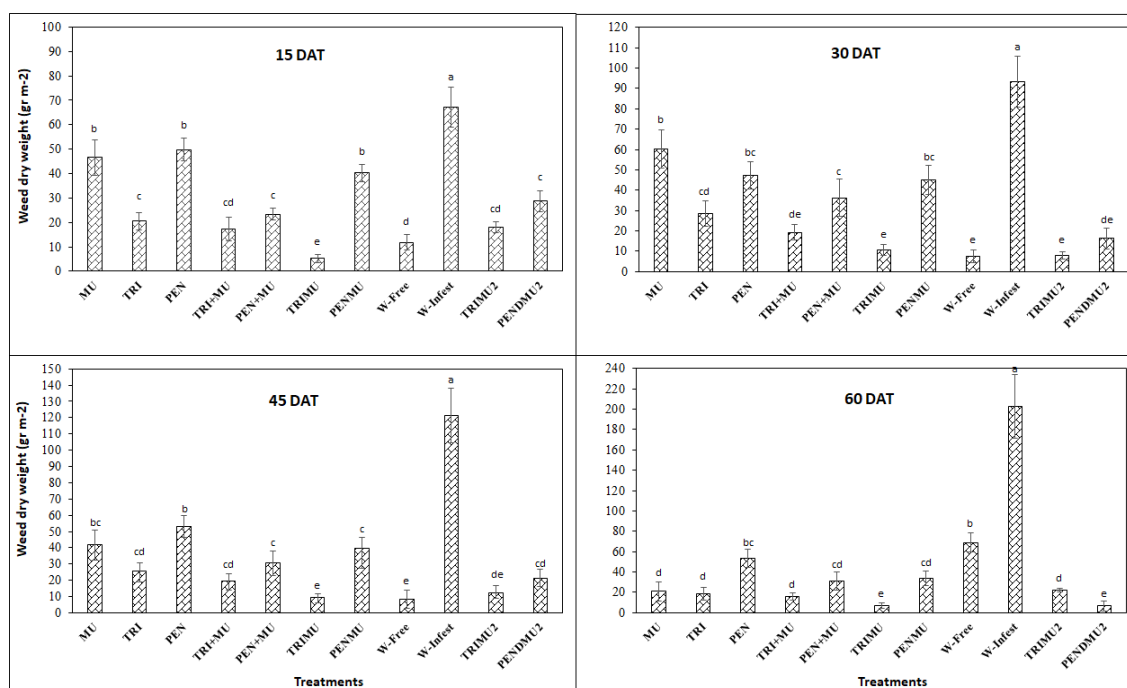


Figure 2 The effect of different mulches and herbicide treatment on weed dry weight days after treatment (DAT): Mulch (MU), Trifluralin (TRI), Pendimethalin (PEN), Spraying trifluralin under mulch (TRI + MU), Spraying pendimethalin under mulch (PEN + MU), mulch combined with trifluralin (TRIMU), mulch combined with pendimethalin (PENMU), Weed free (W-Free), Weed infest (W-Infest), mulch combined with trifluralin and incorporated to soil (TRIMU2), mulch combined with pendimethalin and incorporated to soil (PENMU2).

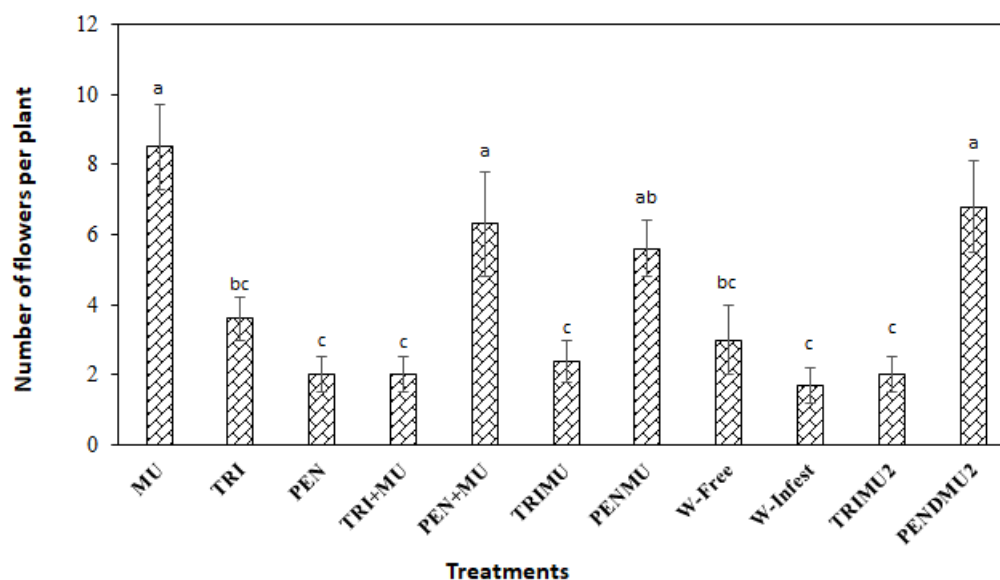


Figure 3 The effect of different mulches and herbicide treatment on rose flower number: Mulch (MU), Trifluralin (TRI), Pendimethalin (PEN), Spraying trifluralin under mulch (TRI + MU), Spraying pendimethalin under mulch (PEN + MU), mulch combined with trifluralin (TRIMU), mulch combined with pendimethalin (PENMU), Weed free (W-Free), Weed infest (W-Infest), mulch combined with trifluralin and incorporated to soil (TRIMU2), mulch combined with pendimethalin and incorporated to soil (PENMU2).

According to the results, the efficacy of trifluralin and pendimethalin treatments in combination with mulch increased significantly over time. This outcome may be attributed to the decomposition of mulch residues and the potential release of allelopathic substances, which could have contributed to enhanced weed control. Alternatively, the release of herbicides absorbed by mulch components into the environment could also influence this outcome, which warrants further investigation.

Except for the fourth sampling stage (60 DAT), where no significant difference was observed between the different treatments of herbicide and wood chip mulch, during the three sampling stages (15, 30, and 45 DAT), the combination of trifluralin with wood chip mulch showed better control of weeds compared to the application of each individually and the pendimethalin herbicide treatments (Figs. 1 and 2).

In this study, trifluralin demonstrated greater weed control efficacy, especially during early sampling stages, compared to pendimethalin, both when used alone or in combination with mulch. However, this increased efficacy was also associated with negative effects on rose plant reproduction at the end of the season. Other research has shown that when herbicides are mixed with organic mulches such as pine tree wood or pine leaf and fruit residues, a portion of the herbicide binds to the mulch. Over time, this results in a gradual release of the herbicide into the environment, extending the period of weed control. However, using pre-emergence herbicides on mulch-covered planting beds has several advantages, including reducing herbicide loss due to irrigation. This helps maintain the herbicide's effectiveness (Knight *et al.*, 2001; Saha *et al.*, 2019).

Overall, combining herbicides with organic mulches, especially during pre-emergence, can improve weed control and help maintain crop health. However, some adverse effects may arise over the long term.

Conclusion

The results demonstrated that when trifluralin and pendimethalin were applied in combination with

wood chip mulch, weed control was significantly improved and their negative effects on rose growth and reproduction were reduced. The lowest weed density and weed biomass, as well as the lowest negative effect of treatments on rose growth and reproduction, were recorded in the weed-free plots, which were statistically similar to those of treatments when pendimethalin was applied at a rate of 2 L ha⁻¹ under 5 cm of wood chip mulch or in combination with wood chip.

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ارزیابی کارایی استفاده از رهیافت مخلوط مالچ و علفکش در کنترل علفهای هرز فضای سبز شهری: مطالعه موردی در ایران

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چکیده: علفهای هرز به‌عنوان یکی از مهم‌ترین چالش‌ها در مدیریت فضاهای سبز شهری محسوب می‌شوند که کنترل آن‌ها از پرهزینه‌ترین عملیات نگهداری این فضاها می‌باشد. این تحقیق با هدف بررسی امکان کنترل علفهای هرز فضای سبز درختچه‌ای گل‌رز با استفاده از رهیافت کاربرد مخلوط مالچ چیپس چوب و علفکش‌های تریفلورالین و پندیمتالین اجرا شد. آزمایش در قالب طرح بلوک‌های کامل تصادفی با ۱۱ تیمار در سه تکرار انجام شد. تیمارهای آزمایشی شامل: کاربرد علفکش‌های تریفلورالین و پندیمتالین به مقدار ۲ لیتر در هکتار به‌صورت مخلوط با خاک و کاربرد هر یک از آن‌ها در مقادیر توصیه در تلفیق با کاربرد مالچ چیپس چوب (کاربرد در زیرلایه ۵ سانتی‌متری مالچ، کاربرد به‌صورت آغشته با مالچ و روی سطح خاک و آغشته به علفکش و مخلوط با خاک لایه سطحی) به‌همراه تیمارهای شاهد کاربرد مالچ به‌تنهایی، وجین تمام فصل علفهای هرز و عدم کنترل بودند. برای تحلیل نتایج آزمایش، نمونه‌برداری از علفهای هرز در فواصل زمانی ۱۵، ۳۰، ۴۵ و ۶۰ روز پس از اعمال تیمارها انجام شد. براساس نتایج آزمایش، کم‌ترین تراکم و وزن خشک علفهای هرز در تیمارهای تلفیقی مالچ-علفکش مشاهده شد. علفکش تریفلورالین نسبت به علفکش پندیمتالین به‌تنهایی و در تلفیق با مالچ، کارایی بیشتری در کنترل علفهای هرز داشت کاربرد تریفلورالین و پندیمتالین به-تنهایی، اثرات منفی در گل‌دهی و زادآوری گل‌رز به‌دنبال داشت اما تلفیق کاربرد آن‌ها با مالچ چیپس چوب، اثرات سوء آن‌ها بر زایش گل‌رز کاسته شد. با توجه به نتایج حاصل، کاربرد تلفیقی علفکش‌های تریفلورالین و پندیمتالین همراه با مالچ چیپس چوب می‌تواند گزینه مناسبی برای کنترل علفهای هرز فضای سبز با محوریت گل‌رز باشد.

واژگان کلیدی: مدیریت تلفیقی علفهای هرز، پندیمتالین، تریفلورالین، مالچ چیپس چوب