Possibilities of pre-emergence and post-emergence herbicide applications in *Prunella vulgaris* L. growth

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ABSTRACT: Possibilities of herbicide applications to the self-heal (*Prunella vulgaris* L.) growth were tested in 1997–1998. Experiments showed that the application of pre-emergence herbicides in the *Prunella vulgaris* L. growth was efficient when 3 l/ha of herbicide with 500 g/l isoproturon as an active ingredient were used. Herbicide applications had no influence on the emergence rate of direct seeding. Among the post-emergence herbicides it is possible to use glyphosate-IPA in 50% concentration by the wick applicator to *Elytrigia repens* (L.) Nevski. The results of these experiments can be used as a basis for testing the herbicide biological efficacy in the framework of minority indications for cultivated medicinal plants.

Keywords: *Prunella vulgaris* L.; *Lamiaceae;* pre-emergence herbicide; post-emergence herbicide; trifluralin; metobromuron; isoproturon; glyphosate-IPA; chloridazon; metolachlor; fluazifop-P-butyl; clopyralid

Weed infestation of growths of medicinal plants is one of the limiting factors of production. Species with slow emergence rate and low thousand seed weight used to be significantly damaged by weeds (DACHLER, PELZMANN 1989; PANK, MARLOW 1990; STŘELEC 1999).

Prunella vulgaris L. (self-heal), a perennial from the *Lamiaceae* family, belongs to the promising medical plants (TABBA et al. 1989; DMITRUK et al. 1985; LEE, LIN 1988; LAMAISON et al. 1990; MARKOVÁ 2001) and is suitable for introduction into the culture. There is a possibility of direct sowing, but seeds can emerge very irregularly between 42 to 257 days (NEUGEBAUEROVÁ, NAKVASIL 2003).

In this paper herbicides with trifluralin, metobromuron, isoproturon, glyphosate-IPA, chloridazon, metolachlor, fluazifop-P-butyl and clopyralid as active ingredients were evaluated.

MATERIAL AND METHODS

Experiments with herbicides (Table 1) were conducted in 1997–1998 in an experimental field of the Faculty of Horticulture at Mendel University of Agriculture and Forestry in Lednice (164 m a.s.l.) in a system of randomly organized blocks.

Total area of experimental fields was 380 m^2 and each parcel area was 10 m^2. Applications of herbicides were realized by the sprayer PILMET CP-3 (Agromet – Pilmet, Poland) with handy application frame.

Trifluralin was applied by a cultivator into a soil depth of 100 mm before *Prunella* L. sowing, the other pre-emergence herbicides were applied by the sprayer immediately after sowing.

Post-emergence herbicides were also applied by the sprayer to weeds 50–800 mm in height. Only glyphosate-IPA on *Elytrigia* Desv. was applied locally by the wick applicator. The *Prunella* L. plant height was 20–50 mm at the time of application.

Seeds of *Prunella* L. originated from the plants that were grown in the field of the Faculty of Horticulture Mendel University of Agriculture and Forestry in Lednice. Hand sowing was made into a depth of 15 mm on the 2nd April 1997.

4.2 g of seeds with emergence rate of 55% was sown to one parcel (10 m^2) in 3 rows at a 0.40 m distance. The pre-emergence herbicide application was carried out before seed sowing (2nd April 1997).

Directive EPPO No. 89/1986 for biological effectiveness evaluation of herbicides was used for evaluation of the weed population.

The weed occurrence for the testing of herbicides fluazifop-P-butyl and clopyralid and fourfold replications of trifluralin, metobromuron, isoproturon, glyphosate-IPA, chloridazon, and metolachlor was evaluated as an absolute number of weeds on randomly selected areas 0.5 m^2 in size in three replications.

The herbicide efficacy was evaluated 1, 3, and 6 weeks after *Prunella* L. emergence in 1997. In 1998 the herbicide efficacy was observed 2 and 3 weeks after their application.

Statistical analysis was performed in UNISTAT version 4.3 (Unistat, USA) by the test of homogeneity of variance – multiple comparison, test of Tukey HSD and

Table 1. List of tested herbicides

Product name	Active ingredient content (g/l)	Dose	Applications	Spectrum
Patoran FL	metobromuron 500	1–2 l/ha	pre-emergence	annual dicotyledonous weeds
Tolkan FLO	isoproturon 500	3–4.5 l/ha	pre-emergence	monocotyledonous and dicotyledonous weeds
Synfloran 48 EC	trifluralin 480	1–2 l/ha	pre-emergence	annual *Poaceae* and dicotyledonous weeds
Roundup	glyphosate-IPA 360	33–50%	post-emergence	overgrown weeds
Dual 960 EC	metolachlor 960	1.5–2 l/ha	post-emergence	*Poaceae* weeds
Burex 430 DKV	chloridazon 430	5–7.5 l/ha	post-emergence	dicotyledonous weeds
Fusilade Super	fluazifop-P-butyl 125	1–1.5 l/ha	post-emergence	grasses
Lontrel 300	clopyralid 300	0.3 l/ha	post-emergence	dicotyledonous weeds

Kruskal-Wallis analysis of ranks and median test homogeneity. The probability level at 95% was used.

RESULTS

Table 2 presents the average number of weeds per 0.5 m^2 area in 1997 according to the used herbicides and dates of evaluation.

The total number of observed weed species was 29. In 1997 *Amaranthus retroflexus* L., *Echinochloa crus-galli* (L.) Beauv., *Galinsoga parviflora* Cav. and *Portulaca oleracea* L., which all belong to the group of late spring weeds, were found as dominant species.

The tested herbicides did not affect the *Prunella* L. emergence rate.

No statistical differences in the efficacy of the tested herbicides were found.

A statistical difference was found only between the control area and the area treated with isoproturon.

The average number of weeds in 1998 is shown in Table 3a (application on 20th April 1998) and Table 3b (application on 12th June 1998).

As dominant weeds in 1998 *Elytrigia repens* (L.) Nevski., *Capsella bursa – pastoris* Med., *Sonchus oleraceus* L., *Stellaria media* (L.) Viv and *Urtica urens* L. were recorded (at applications of glyphosate-IPA, metolachlor and chloridazon).

At the application time of fluazifop-P-butyl and clopyralid (June 12th 1998) *Echinochloa crus-galli* (L.) Beauv., *Galinsoga parviflora* Cav., *Sonchus oleraceus*

Table 2. The average number of weed plants (indiv./0.5 m^2) in June–July 1997 (application on 12th April 1997)

Product name	Active ingredient content (g/l)	1. evaluation 12. 6. 1997 (indiv./0.5 m^2)	2. evaluation 26. 6. 1997 (indiv./0.5 m^2)	3. evaluation 17. 7. 1997 (indiv./0.5 m^2)
Patoran FL	metobromuron 500	50.30	100.00	94.00
Tolkan FLO	isoproturon 500	43.25	51.75	64.75
Synfloran 48 EC	trifluralin 480	48.25	118.50	71.00
Control	*	71.25	126.25	131.50

Table 3a. The average number of weed plants (indiv./0.5 m^2) in April–May 1998 (application on 20th April 1998)

Product name	Active ingredient content (g/l)	1. evaluation 20. 4. 1998 (indiv./0.5 m^2)	2. evaluation 12. 5. 1998 (indiv./0.5 m^2)
Roundup	glyphosate-IPA 360	29.63	6.25
Dual 960 EC	metolachlor 960	19.00	24.50
Burex 430 DKV	chloridazon 430	12.25	7.50
Control	*	26.71	21.75

Table 3b. The average number of weed plants (indiv./0.5 m^2) in June 1998 (application on 12th June 1998)

Product name	Active ingredient content (g/l)	1. evaluation 12. 6. 1998 (indiv./0.5 m^2)	2. evaluation 23. 6. 1998 (indiv./0.5 m^2)	3. evaluation 29. 6. 1998 (indiv./0.5 m^2)
Fusilade Super	fluazifop-P-butyl 125	28.67	27.33	23.00
Lontrel 300	clopyralid 300	26.33	26.66	24.33
Control	*	27.33	28.17	29.17

L., and *Urtica urens* L. were confirmed as dominant species.

The effects of chloridazon and metolachlor were statistically different, chloridazon also had significant effects compared to the control treatment.

On the other hand, no differences in the effects on weed occurrence were detected between metolachlor, clopyralid, fluazifop-P-butyl and control.

Prunella L. was particularly damaged by the application of chloridazon. Brown necrotic spots on leaves, yellow colour of leave rests and leaves crisping were observed. However, plants overcame these injuries and continued their growth.

DISCUSSION

The effects of applied herbicides on the self-heal were comparable to the results obtained in the growths of plants of the family *Lamiaceae*, e.g. *Majorana hortensis* Moench.

All herbicides tested in 1997 showed similar effects, which led to the insignificant differences between the tested active ingredients. Table 2 shows that compared to the control plots the number of weeds was reduced by applications of pre-emergence herbicides.

The most important effect was shown by herbicides with glyphosate – IPA and chloridazon tested in 1998. Herbicides with metolachlor and fluazifop-P-butyl affect the family *Poaceae*, clopyralid is effective in the control of *Matricaria* L., *Tripleurospermum* Schultz-Bip. and others. During applications of herbicides the occurrence of such weeds was minimal, which contributed to small differences in treatment effectiveness compared to the control.

CONCLUSION

The results show that herbicide application in *Prunella vulgaris* L. is efficient in case the herbicide in a dose of 3 l/ha with isoproturon in a dose of 500 g/l as an active ingredient is exploited during pre-emergence application.

On the other hand, post-emergence local application to *Elytrigia repens* (L.) Nevski. can be successfully made by glyphosate – IPA in 50% concentration by handy application frame.

No adverse effects of the evaluated herbicides on the rate of seed germination and emergence were found.

Brown necrotic spots, yellowing and curling of *Prunella* L. leaves were found after chloridazon application. These results can contribute to the testing of biological effectiveness of herbicides within minor crops (RŮŽIČKA 2002) for cultivated medicinal plants.

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Received for publication February 27, 2004

Accepted after corrections June 10, 2004

Možnosti aplikace preemergentních a postemergentních herbicidů v kultuře *Prunella vulgaris* L.

ABSTRAKT: V letech 1997–1998 byly zkoušeny možnosti použití herbicidů při pěstování černohlávku obecného (*Prunella vulgaris* L.). Z výsledků pokusů vyplývá, že aplikace herbicidů v kultuře *Prunella vulgaris* L. je účinná při preemergentním použití herbicidu s účinnou látkou isoproturon 500 g/l v dávce přípravku 3 l/ha. Aplikované herbicidy neovlivnily termín vzcházení

Prunella L. Z postemergentních herbicidů lze aplikovat glyphosate-IPA 50% lokálně, knotovým aplikátorem na *Elytrigia repens* (L.) Nevski. Výsledky pokusů mohou sloužit jako podklad pro zkoušení biologické účinnosti herbicidů v rámci minoritních indikací pro pěstované léčivé rostliny.

Klíčová slova: *Prunella vulgaris* L.; *Lamiaceae*; preemergentní herbicidy; postemergentní herbicidy; trifluralin; metobromuron; isoproturon; glyphosate-IPA; chloridazon; metolachlor; fluazifop-P-butyl; clopyralid

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