SZENT ISTVÁN UNIVERSITY

EFFICACY EVALUATIONS OF HERBICIDES INHIBITING THE ENZYME ACETOLACTATE SYNTHASE ON CULTIVATED PLANTS AND ON WEEDS WITH DIFFERENT METHODS

Theses

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1. The antecedents of the work, the aims

In the area of weed control sulfonylurea herbicides appeared first among herbicides that inhibit the enzyme acetolactate synthase (ALS) in the early 1980's, but today herbicides belonging to other chemical classes are also known to have the effect based on inhibiting the enzyme ALS. This mode of action was revolutionary new when appeared, and by now the active ingredients belonging to this group form one of the most popular herbicide classes.

The constantly growing herbicide group holds abundant possibilities in the area of efficacy evaluations of herbicides both on cultivated plants and on weeds, and furthermore their detection means continuous challenge because of their low application rate. Analytical methods need continuous improvement and further examinations are required in the area of making more perfect and more accurate of other detection methods (bioassay, immunoassay).

My work consists of some fields. I made experiments in small plots in canary grass (*Phalaris canariensis* L.) using mostly sulfonylurea herbicides. We have little information about chemical weed control possibilities in canary grass therefore it is necessary to extend the list of applicable active ingredients.

From the weeds I examined common lambsquarters (*Chenopodium album* L.), common ragweed (*Ambrosia artemisiifolia* L.), horseweed (*Conyza canadensis* L.), and cleavers (*Galium aparine* L.). The efficacy of sulfonylurea herbicides against a given weed is judged relatively uniformly in different publications, but it does not always prove to be true. Besides relatively few works were done on the susceptibility of horseweed to sulfonylurea herbicides, thus our knowledge is fairly insufficient.

When planning the experiment I wanted to use three different methods (analytical method, immunoassay and bioassay) to detect flumetsulam from soil, and I planned to compare the results owned from them. Two of the three methods were not successful, thus it was not possible to compare the methods. The bioassay however gave assessable results.

My aim was to find answers to the following questions with the help of the experiments:

1. Are there any herbicides among the herbicides examined which can be recommended for weed control in canary grass beside those that are authorized and used in practice?
2. How suitable is an evaluation method based on visual symptoms and on estimation, and how suitable an evaluation method based on measurement of certain parameters for evaluate the effect of herbicides on canary grass?
3. How uniform the effect of certain sulfonylurea herbicides against common lambsquarters (*Chenopodium album* L.), common ragweed (*Ambrosia artemisiifolia* L.), and horseweed (*Conyza canadensis* L.)?
4. How suitable is an evaluation method based on visual symptoms and on estimation, and how suitable an evaluation method based on measurement of certain parameters for evaluate the effect of herbicides on horseweed?
5. Are any of the cultivated plants used as test plants in the experiment suitable for detecting flumetsulam or its residues from soil?
6. Can the list of advantages and disadvantages of bioassays be widened?

2. Materials and methods

2.1. Efficacy evaluations experiments on cultivated plants

2.1.1. Efficacy evaluations of post emergence herbicides on canary grass (*Phalaris canariensis* L.)

The experiment was set on plots measured 10 x 2 meters. The herbicide application was done in four replicates: when canary grass was 13 – 15 cm high and its growth stage was at the end of formation of side shoots, beginning of stem elongation and most of the weeds had 2 – 6 leaves. The data of the herbicides used in the experiment are shown in table 1.

Evaluations were done at different times using two different methods. The visible phytotoxic effects on canary grass were noted using the EWRC scale eight days after treatments.

Table 1.: The data of the herbicides used in the experiment

Trade name	Active ingredient	Application rate
Arelon 75 WP	isoproturon	2,5 l/ha
Glean 75 DF	chlorsulfuron	10 g/ha
Granstar 75 DF	tribenuron-methyl	12 g/ha
Grodyl 75 WG	amidosulfuron	30 g/ha
Logran 75 WG	triasulfuron	10 g/ha
Novanox WG*	isoproturon + fluorglikofen	2 kg/ha
Pengo WG*	amidosulfuron + isoproturon	2 kg/ha
Refine 75 DF	tifensulfuron-methyl	15 g/ha
Ring 80 WG*	prosulfuron + primisulfuron	25 g/ha
Safari 50 DF	triflusulfuron-methyl	30 g/ha
Tell 75 WG*	primisulfuron	30 g/ha

*Note: Novanox is not and was never authorized in Hungary, and the authorization of Arelon, Pengo, Ring, and Tell has been withdrawn since the experiment.

During harvest plants from 1 m^2/plot were collected and length of straw [cm], length of ears [mm] and weight of thousand grains [g] were measured. Statistical analysis (one-way analysis of variance for each parameter measured, comparison of means using Dunnett's comparisons) was done using the software Minitab 14. The control treatment was the treatment of Granstar which was a widely used herbicide in practice at the time of the experiment, and the reason for the treated control was that the competition of weeds may have influenced the value of the measured parameters.

2.1.2. Detection of flumetsulam from soil with different methods

2.1.2.1. Bioassay

The soil samples were collected from the Trial Site of the Department of Crop Production of Szent István University. Spraying was done at three application rates and in three replicates: 75 g/ha, 100 g/ha and 125 g/ha (the herbicide used for the trial was called Broadstrike 80 WG[1] which contains 800 g/kg of flumetsulam). During the year of the trial maize was grown on the trial site.

There is a long-term soil tillage experiment on the treated area, but soil samples were taken only from plots cultivated in three ways: direct drilling, shallow disk tillage, ploughing. Soil sampling was done one year (362 days) after the treatment from the depths of 0 – 15 cm and 15 – 25 cm.

Plastic pots of 12-13 cm in diameter were filled with the soil samples. The control sample was a herbicide free humus soil collected from the same soil layer (0 – 10 cm) for each replicates. The plots were placed into an unheated glasshouse. Three pots contained the same soil samples and

[1] The herbicide authorized in Hungary is called Komondor (800 g/kg of flumetsulam)

15 seeds of sugar beet (*Beta vulgaris* L.) were sown into one of them, 15 seeds of sunflower (*Helianthus annuus* L.) were sown into the second one, and 15 seeds of rape (*Brassica napus* L.) were sown into the third one. My aim was to have even density of plants per pot, therefore after ten plants emerged every additional seedling was removed so that to have the data of measuring 10 – 10 plants. I watered the pots when it was necessary. The climate of the glasshouse, the lighting and the heating was not artificially controlled.

The assessment was done 26 days after sowing when the number of emerged plants was counted [number/pot], the height of plants [mm/plant] and the fresh weight of plants [g/pot] were measured. Statistical analysis (one-way analysis of variance for each parameter measured, comparison of means using Dunnett's comparisons) was done using the software Minitab 14.

2.1.2.2. Analytical method and immunoassay

12 – 12 soil samples were transported to the laboratory of Institute of Phytopathology, Jász-Nagykun-Szolnok County, Szolnok, for analytical analysis and immunoassay tests. When the samples were analysed, only the staff of the laboratory was present. The written principles and the methods, as well as the test kits needed were presented by the producer of the active ingredient, Dow AgroSciences. The staff of the laboratory must not have deviated from the written principles, therefore I don not publish the methodology of the tests.

2.2. Efficacy evaluations of post emergence treatments on weeds

I made experiments on several trial sites using several herbicides for three years. The summary of the trials are shown in table 2.

Table 2.: The application rate of the herbicides used on the trial sites

Herbicide	Active ingredient	Dány 1998.	Kartal 1997.	Gödöllő 1997., 1999.	Veresegyház 1997.
Broadstrike 800 WG	flumetsulam	-	-	100 g/ha	-
Glean 75 DF	chlorsulfuron	10 g/ha	10 g/ha	10 g/ha	10 g/ha
Logran 75 WG	triasulfuron	10 g/ha	10 g/ha	10 g/ha	10 g/ha
Granstar 75 DF	tribenuron-methyl	12 g/ha	12 g/ha	12 g/ha	15 g/ha
Grodyl 75 WG	amidosulfuron	30 g/ha	30 g/ha	30 g/ha	20 g/ha
Pengo WG	amidosulfuron + isoproturon	-	-	2 kg	-
Refine 75 DF	tifensulfuron-methyl	15 g/ha	15 g/ha	15 g/ha	15 g/ha
Ring 80 WG	prosulfuron + primisulfuron	25 g/ha	25 g/ha	25 g/ha	30 g/ha
Safari 50 DF	triflusulfuron-methyl	30 g/ha	30 g/ha	30 g/ha	30 g/ha
Tell 75 WG	primisulfuron	-	30 g/ha	-	30 g/ha
Titus 25 DF	rimsulfuron	-	-	30 g/ha	-
Motivell	nicosulfuron	1 l/ha	-	1 l/ha	-

2.2.1. The efficacy of sulfonylurea herbicides against common lambsquarters (*Chenopodium album* L.)

In the experiment described in chapter 2.1.1., examinations were done not only on the cultivated plant but on the most dominant weed, the common lambsquarters, too. The assessment of the herbicide efficacy against common lambsquarters (*Chenopodium album* L.) was done 19 days after the herbicide spraying.

2.2.2. The efficacy of sulfonylurea herbicides against common ragweed (*Ambrosia artemisiifolia* L.)

Spraying was done in canary grass, when the plants had 2 – 3 leaves, in two replicates on plots measured 17.4 m^2 (2 x 8.7 m). The active ingredients and dose rates applied are shown in table 2. Common ragweed plants had two leaves at the time of spraying. Three assessments were done: the weed control effect of the herbicides was noted using the EWRC scale 8, 15 and 34 days after treatment.

2.2.3. The efficacy of sulfonylurea herbicides against horseweed (*Conyza canadensis* L.)

I did examinations on two trial sites: Gödöllő and Veresegyház.

⇒ In Gödöllő, spraying was done in canary grass, when the plants had 2 – 3 leaves, in two replicates on plots measured 17.4 m^2 (2 x 8.7 m). *Conyza canadensis* L. plants were at the growth stage of leaf rosette at the time of spraying. The active ingredients and dose rates applied are shown in table 2. Three assessments were done: the weed control effect of the herbicides was noted using the EWRC scale 8, 15 and 34 days after treatment.

⇒ In Veresegyház, spraying was done in an uncultivated vineyard on plots measured 10 m^2 with one replication when *Conyza canadensis* L. plants were 5 – 15 cm high. The assessment was done 31 days after treatment. I used the EWRC scale to assess the efficacy of the treatments, and I measured the height and fresh weight of plants collected from 1 m^2 from each plot.

2.2.4. Examination of the efficacy of amidosulfuron against cleavers (*Galium aparine* L.)

I did two examinations on cleavers. The first trial was set in the glasshouse of Harper Adams Agricultural College (Newport, Shropshire, England). Cleavers were collected at the cotyledon stage and transplanted into plastic pot for the trial. Five cleavers were planted into each pot, altogether 200 giving 40 pots of which 36 were treated and the remaining 4 were the controls. The plants were watered every day and the climate of the glasshouse was artificially controlled.

Sprayings were done at three growth stages of the plants (at the average height of plants of 10, 20 and 30 cm). Treatments were done at three dose rates (10 g/ha, 20 g/ha and 40 g/ha) and in four replications with a herbicide containing amidosulfuron (Eagle WG[2] – 750 g ai./kg). The assessments were done 31 days after each treatment. I measured the height of plants and noted the visible symptoms.

The second experiment was done one year later in the glasshouse of the Department of Crop Protection of Szent István University. Four cleavers plants at the cotyledon stage were transplanted into plastic pots. Treatments were done at three growth stages of plants (3 – 4, 5 – 6, and 9 – 10 whorls) with two dose rates (20 g/ha and 40 g/ha of Grodyl 75 DF) in four replications. The climate of the glasshouse was not artificially controlled.

The assessment was made by measuring the height of the plants 28 days after treatment. To prove the significant differences between treatments in each experiment I have done one-way analysis of variance, and for the comparison of means I used Dunnett's and Fisher's comparisons.

[2] The registered herbicide in Hungary is known as Grodyl 75 DF.

3. Results

3. 1. Efficacy evaluations experiments on cultivated plants

3.1.1. Efficacy evaluations of post emergence herbicides on canary grass (*Phalaris canariensis* L.)

3.1.1.1. Visual assessments

Visible phytotoxic symptoms appeared on canary grass due to five treatments eight days after spraying. Leaf apex became thin, small (<1 mm) white spots and scorching symptoms appeared on the leaves after Arelon treatments. Novanox also caused the appearance of small white spots and scorching symptoms on leaves, and bleaching and dying of leaf apex was also observable. Due to treatments with Pengo plants got heavily damaged, and most of foliage got scorched. However vigorous plants recovered from the above symptoms later on. The negative effect of the treatments with Ring and Tell proved to be more lasting: heavy restriction in growth was still observable weeks later, and furthermore the stand was less dense than in other plots. Besides Ring also caused scorching of leaves, while primisulfuron on its own (Tell) caused only yellowing of leaves. Spraying with Glean, Granstar, Grodyl, Logran and Safari did not cause visible phytotoxic symptoms on the plants.

3.1.1.2. Results of measures

It can be stated with 95% of certainty that there was no significant difference between the height of plants on the untreated plot, and on the plot sprayed with Pengo compared to the control (Granstar). Canary grass showed significant reduction in growth after treatments with Ring and Tell, while plants were significantly higher after the rest of the treatments than the plants on the control plots.

It can be concluded that the length of ears decreased after each treatment and the difference from the control (Granstar) was significant (95% of certainty) in eight cases. However ears were shorter after spraying with Arelon and Glean and on untreated plots than on control plots but the difference was not statistically proved.

Comparing the average thousand grain weight to the control (Granstar) it can be stated that treatments with Ring, Tell and Arelon had significantly negative effect on the yield. After the rest of the treatments (untreated, Glean, Safari, Grodyl, Logran, Pengo, Refine and Novanox) no significant difference was observed.

3.1.2. Detecting flumetsulam from soil

3.1.2.1. Bioassay

Out of the three test plants, sugar beet showed very susceptible reactions to the presence of the active ingredient in soil samples. The plant height values differed significantly from the control in the case of all treatments and soil cultivation methods as well as both soil sampling depths. The data of the fresh weight similarly to the data of plant height shows the high degree of sensitivity of sugar beet. The fresh weight values differed significantly from the control in the case of all treatments and soil cultivation methods as well as both soil sampling depths after every treatment.

Rape did not prove to be as susceptible as sugar beet however the reduction in the plant growth and the decrease of the fresh weight was significant compared to the control in many cases. The data of plant height belonging to soil samples from the deeper soil layer were higher than those of the surface soil layer in almost every case. The conclusion can be drawn that most of the active ingredient or its biologically active residues remained in the upper 15 cm soil layer and only a smaller part of them moved to deeper soil layers. It seems to be possible since it is known from publications that due to the long-term soil tillage experiment on the trial site a compact layer has developed which hinders the vertical movement both of the roots and the soil solution.

Sunflower proved to be the least susceptible to flumetsulam and its residues. There were no significant differences compared to the control irrespective of the application rate, the cultivation method or the depth of sampling except a few samples. The fresh weigh data confirmed that sunflower is less susceptible to flumetsulam. There were no significant differences between the means of the treatments compared to each other.

3.1.2.2. Analytical analysis and immunoassay

Every sample examined gave negative results, that is to say it was not successful to detect the active ingredient or its biologically active residues with using either of the methods.

3.2. Efficacy evaluations of post emergence treatments on weeds

I found great differences between the efficacies of the herbicides against common lambsquarters (*Chenopodium album* L.). Treatments with Arelon and Pengo gave the best results (99 % and 98 % of efficacy) but Glean, Granstar, Grodyl, and Novanox proved to be good (98 % of efficacy). From the other treatments the efficacy of Refine and Ring (90% efficacy) is still acceptable for the practice, but that of Safari is doubtful (70% efficacy) and unacceptable the efficacy of Logran and Tell (70 % and 55 % efficacy).

The weed control effect against common ragweed (*Ambrosia artemisiifolia* L.) developed the fastest in case of spraying with Pengo. The experienced weed control effect was already 97 % ten days after spraying. Broadstrike, Glean, Granstar, Safari, Ring, Refine and Grodyl showed an effect of over 80 %. But the efficacy of only three herbicides from these seven reached the level of good (Broadstrike 92 % and Refine 93 %) or the level of very good (Ring 99 %). Apart from spraying with Pengo, which had an outstandingly stable effect, treatments with Broadstrike, Ring, Refine and Grodyl provided to kill more than 95 % of the weed.

Efficacy of Ring, Pengo, Refine, Grodyl, Broadstrike, Titus and Logran treatments was getting stronger and stronger during a month after the treatments. The low efficacy of Titus in the beginning (about 57 %) first stagnated then increased suddenly. By the time of the third assessment it reached 82 % which is yet not good enough for practice but the increase is remarkable. The efficacy of Motivell changed just in the opposite direction. The early efficacy of 75 % decreased to 30 % in a month, so common ragweed recovered well after the initial stress.

Young horseweed (*Conyza canadensis* L.) plants at the growth stage of leaf rosette are relatively uniformly and remarkably sensitive to the sulfonylurea class. The plants which survived the treatment stopped developing and most of them perished after a shorter or a longer period.

In case of a higher (5 – 15 cm) horseweed stand, the results of a herbicide class with relatively uniform efficacy so far differed from each other considerably. Granstar, Ring and Tell showed good effects and the results of Glean were still acceptable. The rest of the herbicides (Logran, Grodyl, Refine, and Safari) do not control horseweed desirably at this growth stage.

The measurements made the picture more difficult. Spraying with Granstar resulted in the greatest restriction of growth while in case of those plants that were sprayed with Glean, Safari or Refine it happened to a lesser level, and the average height of the plants was almost double than that of the previous plants by the time of measurement. I expected that the results from measuring the weight of plants would show the same trend as the results of plant heights. According to the expectations, plants sprayed with Granstar were the lightest, but the weight of plants did not follow the trend formed by plant heights in case of the other treatments.

3.3 New scientific results

1. In field experiment of the effect of sulfonylurea herbicides on canary grass (*Phalaris canariensis* L.) some treatments (Tell and Ring) caused significant reduction in plant height compared to the standard control (Granstar) while plants were significantly higher after spraying with Novanox, Grodyl, Safari, Refine, Glean, Logran and Arelon.
2. In field experiment of the effect of sulfonylurea herbicides on canary grass (*Phalaris canariensis* L.) ears became significantly shorter compared to the standard control (Granstar) due to eight treatments (Refine, Safari, Grodyl, Tell, Novanox, Ring, Pengo, and Logran).
3. In field experiment of the effect of sulfonylurea herbicides on canary grass (*Phalaris canariensis* L.) some treatments (Ring, Tell and Arelon) caused significant reduction in thousand grain weight compared to the standard control (Granstar).
4. In the experiment on detecting flumetsulam residues from soil bioassay was suitable to detect the herbicide residues in contrast to using analytical method or immunoassay. Sugar beet proved to be susceptible enough from the test plants.
5. Examining the effects of sulfonylurea herbicides, having the same mode of action, on common lambsquarters (*Chenopodium album* L.) in field experiment, the herbicides showed great differences in efficacy.
6. Examining the effects of sulfonylurea herbicides, having the same mode of action, on common ragweed (*Ambrosia artemisiifolia* L.) in field experiment, the herbicides showed great differences in efficacy and in the dynamics of development of the effect.
7. To assess the experiment on the herbicide efficacy against horseweed (*Conyza canadensis* L.) measuring the fresh weight of plants gave more reliable results than measuring the height of plants.
8. It can be stated in the examination of the effect of amidosulfuron on cleavers (*Galium aparine* L.) that young plants having 3 – 4 whorls developed new shoots from the base of plants. More developed plants (having 5 – 6 or 9 – 10 whorls) developed new shoots close to the inhibited growing tips.

4. Discussion

4.1.1. Efficacy evaluations of post emergence herbicides on canary grass (*Phalaris canariensis* L.)

Examining solely the data of height of plants, it can be concluded that plants were significantly higher after every treatment except four treatments. These four treatments were spraying with Tell, Ring, and Pengo and the unsprayed plots of which the latest two did not cause significant difference compared to the control (Granstar), but due to the first two plants were significantly shorter.

I got a totally different picture during the examination of ear length. Most of the herbicides had negative effect on ear length, and the only exceptions were the untreated plots and treatments with Glean and Arelon. The conclusion can be drawn that there is no strong relations between the height of plants and the size of ears, thus the same can be expected in connection with the yield and the height of plants which was confirmed by the thousand grain weight data.

The observed deviations of the height of plants and of the size of ears indicate that the effect of the herbicides must be taken into consideration. This effect is may not be considerable in some cases but if the weather conditions turn into critical or other stress factors (eg. plant disease, nutrient supply difficulties) appear it can be much greater. Thus the negative effect of herbicides with residual effect on the early development of plants or on the fresh weight of young plants can cause severe yield loss in adverse circumstances.

Drawing the conclusions, it can be said that Glean, Logran and Grodyl are recommended for weed control in canary grass in a reduced dose rate, but further examinations are needed with Refine and Safari, while Arelon, Novanox, Pengo, Ring and Tell are not recommended for weed control in canary grass, on the other hand they can be useful in succeeding crops controlling voluntary canary grass plants, switching off their competitive abilities.

4.1.2. Detecting flumetsulam from soil

I have not observed any specific symptoms which would only be resulted by the effect of flumetsulam on the test plants. The visible symptoms matched to those of the general symptoms caused by herbicides inhibiting the ALS enzyme: retaining growth, inhibition of growing tips, yellowing of growing tips. On the basis of the data of plant heights and fresh weights two of the three examined test plants (rape and sunflower) proved to be unsuitable for being a test plant. The slight, mostly insignificant inhibition of growth is not a convincing result.

I found more severe inhibition of growth and reduction of fresh weight of sugar beet compared to the control, which would probably negatively effect the yield, too, however I have not made examinations on this area.

The soil samples used for analytical analysis and for bioassay were handled, taken and stored the same way until they were used. Since test plants detected the active ingredient or its biologically active residues in the soil samples, the negative result of the analytical analysis can be explained with one of the following reasons or the presence of some of the factors together:

- ⇒ the amount of the active ingredient or its biologically active residues in the samples was less than the detection limit of the method
- ⇒ the method used is not suitable for detecting flumetsulam or its biologically active residues
- ⇒ it was not successful to take into solutions the active ingredient or its residues during the preparation of the samples
- ⇒ the method is suitable to detect flumetsulam but it is not suitable to detect its biologically active residues

It is easier to find the reasons for the negative results of the immunoassay. At the time of the experiment the test kits were close to their guaranteed time. Furthermore it was discovered during a personal consultation with the producer of the test kits that the method had not been tested on soil

samples thus it can be possible that they are not suitable for the detection of the active ingredient from soil.

4.2. Efficacy evaluations of post emergence herbicides on weeds

During the experiments I realised that the sulfonylurea herbicides gave very different weed control effect against a given weed however their efficacy was considered to be quite uniform earlier. The presence of 1.5 – 2-fold difference between the efficacies of the active ingredients against common lambsquarters contradicts the former relatively uniform opinion. Granstar, Grodyl, and Pengo showed an efficacy matching the published data. On the other hand common lambsquarters is considered to be moderately sensitive to Glean which showed 98 % efficacy in my experiments – this level suits rather to the category of sensitive -, moreover to Logran and to Safari which showed 70 % efficacy and to Ring which showed 55 % efficacy. This contradiction can be clarified only after thorough examinations if the reasons of the different classifications are the differences in the growth stages of weeds and in the application rates. If we want to compare the results of different trials, we have to take into consideration the growth stage of weeds at the time of spraying. The sensitivity of a weed to an active ingredient may vary to a great extend depending on the growth stage of the weed. It is particularly applicable to weeds which may develop thick layer of wax like common lambsquarters.

Beside the growth stage of weeds at the time of treatment, the species of the cultivated plant may considerably influence the results and may cause that the efficacy of an active ingredient to the same weed can be considered very differently. The shading and weed suppressing ability of the cultivated plant can basically influence the efficacy of certain herbicides, thus it can happen that a herbicide gives good results in a dense stand with good weed suppressing ability but not in a rare stand. A herbicide which is effective enough in a dense winter wheat stand may give poor results in a rare winter wheat stand or in spring barley and canary grass which have poor weed suppressing ability. It is also true that the results given in spring sown canary grass with poor weed suppressing ability must be better in other stands. The conclusions are similar in the case of *Conyza canadensis* L. examined in an uncultivated vineyard, the results will possibly be the similar on uncultivated areas and on other sites they may positively differ.

It can be concluded that the good results gained in a crop with poor weed suppressing abilities can be expected in other crops, too, but it is not certain inversely. The post emergence herbicides which were tested only in dense stands and in optimal circumstances may cause surprises in certain cases, when poor results are not definitely caused by bad circumstances of application but it is more possible that the herbicide can kill weeds only with the help of the cultivated plant.

The experiments on common lambsquarters verified the opinion that none of the sulfonylurea herbicides have outstanding effect against the weed. On the other hand it is not true that these active ingredients would be uniformly ineffective. The trials showed that some herbicides (Glean, Granstar, Grodyl, Refine and Ring) have an effect that is acceptable for the practice, while others (Safari, Logran and Tell) can not be recommended for the practice on areas infected with common lambsquarters. The unacceptable efficacy, however, holds important information (as a side effect) when making tank-mixes.

Great differences appeared also in the efficacy against common ragweed of the herbicides that inhibit the enzyme ALS, but there were differences not only in the efficacy of the herbicides but in the changes of the efficacy as time went by. There was almost twofold difference between the two extreme values (Pengo 97 % and Titus 57 %) at the time of the first assessment, which increased threefold by the time of the third assessment. The reason for this was that the efficacy of Motivell decreased seriously while the efficacy of most of the herbicides remained at the level that developed during the first two weeks or even increased. The initial moderate efficacy of Motivell halved probably because the twenty days after the second assessment were enough for common ragweed to recover from the depression.

Horseweed (*Conyza canadensis* L.) plants sprayed at the growth stage of leaf rosette were relatively uniformly and remarkably sensitive to sulfonylurea herbicides. Spraying later (5 - 15 cm tall plants) this uniform sensitiveness disappeared and due to ramification of plants great differences were observed between the efficacy of the herbicides.

The inhibition of growth developed the fastest when plants of leaf rosette stage were sprayed with Granstar, while the average height of plants treated with Glean, Safari and Refine were almost double than that of the previous plants. I expected that the results from measuring the weight of plants would show the same trend as the results of plant heights. According to the expectations, plants sprayed with Granstar were the lightest, but the weight of plants did not follow the trend formed by plant heights in case of the other treatments. This also shows that neither the efficacy against horseweed of sulfonylurea herbicides examined nor the duration of this effect is uniform.

The differences which are sometimes remarkable can be explained with that some plants became overgrown due to treatments while others developed lateral shoots below the perished growing tips. However the latest plants were shorter but they were very spready and had greater weight. Both measures (plant height and fresh weight, too) are important but in this case I believe that the fresh weight values are more important since the presence of ramified, spready plants indicates that the former weed problem is not solved even increased in certain cases. Stressed plants tend to develop more seeds to ensure their propagation than normally.

From the methodological point of view the trials with cleavers and amidosulfuron draw the attention to the experimental circumstances. Conclusions must be drawn carefully and the results can only be applied on circumstances that are similar to the experimental circumstances. The identity and the differences in the circumstances must be taken into consideration when comparing the results of two experiments.

5. The publications of the author connecting to the dissertation

Revised articles in foreign languages:

Sárfalvi B., Fejős Z. és Németh I. 2002. Testing the impact of sulfonylurea herbicides on canary grass (*Phalaris canariensis L.*). Journal of Plant Disease and Protection. XVIII. 955 – 960.

Sárfalvi B., Németh I. és Cserepes A. 2002. Phytotoxic effects on crops after flumetsulam treatments. Journal of Plant Disease and Protection. XVIII. 961 – 966.

Sárfalvi B., Németh I. és Szabó R. 2002. Detecting flumetsulam in soil using test plants in greenhouse. Journal of Plant Disease and Protection. XVIII. 1059 – 1063.

Revised articles in native language:

Németh, I. és Sárfalvi, B. 1998. Gyomfelvételezési módszerek értékelése összehasonlító vizsgálatok alapján. Növényvédelem 34. 1. 15-22 old.

Németh, I. és Sárfalvi, B. 2000. Tesztelések szulfonilurea típusú herbicidekkel különböző gyomnövényeken. Növényvédelem 36. 12. 657-665 old.

Foreign conference contributions:

Kiss, J., Németh, I. és Sárfalvi, B. 1997. Methodical changes in weed surveys with respect to harmonisation. 10th EWRS Symposium. Összefoglaló 21. old.

Cserepes, A., Németh, I. és Sárfalvi, B. 1998. Examination of re-shooting capacity of cleavers (*Galium aparine*) after amidosulfuron treatments. 6th EWRS Mediterranean Symposium Összefoglaló 371. old.

Németh, I., Németh, S. és Sárfalvi, B. 1998. Studies on *Conyza (Erygeron) canadensis* in vineyards. 6th EWRS Mediterranean Symposium Összefoglaló 383. old.

Native conference contributions:

Németh, I. és Sárfalvi, B. 1997. Szőlőben és gabonában végzett gyomfelvételezések módszertani értékelése. Növényvédelmi Tudományos Napok 1997. Összefoglaló 155. old.

Németh, I. és Sárfalvi, B. 1997. Szulfonilurea típusú herbicidek fitotoxikus hatásának tesztelése fénymag (*Phalaris canariensis*) növényeken. Növényvédelmi Tudományos Napok 1997. Összefoglaló 156. old.

Fejős Z., Németh, I. és Sárfalvi, B. 1998. További vizsgálatok fénymagban *(Phalaris canariensis)* szulfonilurea típusú herbicidekkel. 44. Növényvédelmi Tudományos Napok Összefoglaló 149. old

Németh, I., Németh, S. és Sárfalvi, B. 1998. *Erygeron canadensis* elleni védekezési lehetőségek vizsgálata szőlőültetvényekben. 44. Növényvédelmi Tudományos Napok Összefoglaló 164. old

Sárfalvi B., Fejős Z. és Németh I. 1999. Herbicidek fitotoxicitásának és utóhatásának vizsgálata fénymagban. 45. Növényvédelmi Tudományos Napok Összefoglaló 157. old

Sárfalvi B., Fejős Z. és Németh I. 1999 Gyomirtószerek és az általuk okozott tünetek vizsgálata fénymagon és gyomnövényeken. 45. Növényvédelmi Tudományos Napok Összefoglaló 158. old

Sárfalvi B. és Németh I. 2000. Flumetszulám okozta fitotoxikus tünetek kultúrnövényeken. 46. Növényvédelmi Tudományos Napok Összefoglaló 155. old

Sárfalvi B. és Németh I. 2000. Flumetszulám maradék kimutatása talajból bioteszteléssel. 46. Növényvédelmi Tudományos Napok Összefoglaló 156. old

Dornerné Fejős Z. és Sárfalvi B. 2000. Mennyire egységes a szulfonilkarbamidok hatása egyes kétszikű gyomnövények ellen? 46. Növényvédelmi Tudományos Napok Összefoglaló 169. old

Other publications:

Sárfalvi, B. 1996. Gyomfelvételezések során felmerülő módszertani problémák vizsgálata őszi búzában és szőlőben. TDK dolgozat. XXIII. Országos Tudományos Diákköri Konferencia. Agrártudományi szekció.

Sárfalvi, B. 1996. Szulfonilurea típusú herbicidek fitotoxikus hatásának tesztelése fénymagban. TDK dolgozat. Gödöllői Agrártudományi Egyetem