

EFFICACY OF DIMETHENAMID-P IN CONTROLLING WEEDS IN SUGARBEET

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Gajović Dragana, Katarina Jovanović-Radovanov, Ibrahim Elezović (2003): *Efficacy of dimethenamid-p in controlling weeds in sugarbeet*. - Acta herbologica, Vol. 12, No. 1-2, 59-66, Beograd.

The objective of the study was to analyze the efficacy of dimethenamid-p (Frontier Super) for the control of annual grass and broad-leaved weeds in sugarbeet (*Beta vulgaris* L.). The trial was conducted in 2000 on the localities of Zemun Polje. Dimethenamid (Frontier 900 EC) was the control herbicide. Both efficacy and phytotoxicity were assessed according to the standard EPP0 method. The lowest application rate (0.8 l ha⁻¹) was effective (75-90%) for the species *Amaranthus retroflexus* L. and *Echinochloa crus-galli* L. Increasing the application rate to 1.0 l ha⁻¹ tended to raise the efficacy (90- 100%). Further increase of the application rate to 1.2 l ha⁻¹ proved the efficacy of the herbicide in controlling *Polygonum lapathifolium* L. as well, whereas in the case of *Chenopodium album* L. a favourable result was registered in the first assessment only. The efficacy obtained in the first assessment applying the highest application rate (1.4 l ha⁻¹) was the same as using 1.2 l ha⁻¹. However, in the second assessment the efficacy of the herbicide was low (0-75%) in controlling *P. lapathifolium* only. The efficacy of the herbicide for the control of all the other available species (*Datura stramonium* L., *Hibiscus trionum* L., *Solanum nigrum* L and *Xanthium strumarium* L.) was low even at the highest application rate (1.4 l ha⁻¹).

High resistance to the herbicide tested has most probably contributed to the unfavourable efficacy for some weed species such as: *D.stramonium*, *H.trionum*, *S.nigrum* and *X.strumarium*. Frontier Super should be applied at the lower dose rate than the control herbicide Frontier 900 EC in order to achieve the same efficacy. The reason for this is the purified active isomer dimethenamid in Frontier Super. However, Frontier 900 EC contains a mixture of isomers of the same compound. Therefore, current trends focused on decreasing the dose favour Frontier Super. The herbicide is economically justifiable and environmentally safe.

Key words: dimethenamid-p, Frontier Super, efficacy, weeds, sugarbeet

INTRODUCTION

Larger sugarbeet acreages have been recorded at the end of the 18th century (LODETA, 1993; HULINA, 1994 cit.; HERCEG, 2002). The presence of weeds in sugarbeet along with delayed weeding may contribute to severe crop losses. According to STANKOVIĆ-KALEZIĆ *et al.* (1997) sugarbeet yield may decline by 24-46% as a result of delayed weed control. Currently, in our country there is a great number of herbicides registered for the management of sugarbeet weeds (approx. 20 active ingredients formulated in about 40 preparations) (MITIĆ, 2002). The choice of the appropriate herbicide depends on the weed community, i.e. on the predominating weed species (ŠARIĆ, 1998, cit. HERCEG, 2002).

Dimethenamid-p (Frontier Super) is a novel herbicide used in the management of monocotyledonous and dicotyledonous weeds in sugarbeet. In our country, apart from the control of sugarbeet weeds the preparation has been registered for use in corn (*Zea mays* L.), sunflower (*Helianthus annuus* L.), soybean (*Glycine max* (L.) Merr.) and potato (*Solanum tuberosum* L.). In other parts of the world it is used in peanut (*Arachis hypogaea* L.), sorghum (*Sorghum bicolor* (L.) Moench) and other crops. It is a preemergence herbicide incorporated before or after sowing (ANONYMOUS, 1997 cit. SCOTT *et al.*, 1998a). Dimethenamid is a herbicide belonging to chloracetamides and has four stereoisomers. Dimethenamid-p is its active S-isomer. Smaller doses of dimethenamid are needed compared with some other herbicides from the same group in order to achieve an identical efficacy in weed management (ANONYMOUS, 1992, cit. OSBORNE *et al.*, 1995; FOY and WITT, 1997). The recommended application rates of dimethenamid range from 0,8 to 1.7 kg ha⁻¹ depending on the weed species, soil type and organic matter content (WILLIAMSON, 1993, cit. FOY and WITT, 1997). Dimethenamid-p is applied in lower rates being the purified active isomer of dimethenamid. Current trends focused on reducing the dose favour Frontier Super in comparison with preparations containing a mixture of isomers (Frontier 900EC). It is highly recommendable from the standpoint of both economic justification and environmental safety. Although the mechanism of chloracetamid action has not

yet been explained, these herbicides seem to inhibit cell division and eventually cell growth (DEAL and HESS, 1980; ANOYMOUS, 1992 cit. OSBORNE, 1995). Dimethenamid has a broad spectrum of action when used in combination with other herbicides (imazetapyr, sethoxydim, flauazifot-p) showing synergistic effects (SCOTT, 1998a). Also, compared with some other herbicides (atrazine, alachlor, linuron), dimethenamid in combination with glyphosate shows no antagonistic effects (SCOTT, 1998b). Dimethenamid dissipates rapidly in the soil most probably due to microbiological activity (HARR *et al.*, 1991). Its persistence in the soil is short (RAHMAN *et al.*, 2003) and therefore it poses a risk to the succeeding crop. Corn tolerance to chloracetamide herbicides may be explained by their detoxication via conjugation with glutathione (FUERST, 1987; SCARPONI *et al.*, 1991 cit KOTOULA-SYKA *et al.*, 1996). Apart from corn, other monocotyledonous crops such as cultivated sorghum, wheat and rice are susceptible to chloracetamides including dimethenamid (HATZIOS, 1989, RIESCHER *et al.*, 1994, WILKINSON *et al.*, 1993 cit. KOTOULA-SYKA, 1996).

The objective was to study the efficacy of dimethenamid-p in controlling monocotyledonous and dicotyledonous weeds in sugarbeet on the locality of Zemun Polje on the soil type loamy calcareous chernozem.

MATERIALS AND METHODS

The efficacy of dimethenamid-p-a was studied in a trial conducted in 2000 on the locality of Zemun Polje according to the standard EPPO method (main plot size was 50 m², with four replicates). The trial was carried out on the soil type loamy calcareous chernozem. The major properties of the soil are shown in Table 1. Frontier Super was applied on 25 March 2000 after sowing and before plant emergence. The herbicide was sprayed in 250 l ha⁻¹ using Hipol Odžaci K-12 hand sprayer equipped with the Cambridge blue 03-F110 flat fan nozzle. Frontier Super was applied at rates: 0.8 l ha⁻¹; 1.0 l ha⁻¹; 1.2 l ha⁻¹; 1.4 l ha⁻¹. The herbicide was also applied at the rate of 2.8 l ha⁻¹ in order to assess phytotoxic impact. The control herbicide was Frontier 900 EC applied at rates 1.5 l ha⁻¹ and 1.7 l ha⁻¹. The control was used in order to determine weediness and herbicide efficacy. Weediness and phytotoxic effects were assessed on 24 April and 15 May 2000. Weeds were sampled on 1 m² using a 0.5 x 0.5 m frame in order to monitor the available weed species, fresh and dry matter weight. The number of plants, fresh and dry matter weight of the weeds in relation to the control treatment were used to determine efficacy. Phytotoxic effects were visually monitored. The data on the wheater conditions over the period March-July 2000 are shown in Table 2.

Table 1. - Soil analyses (Zemun Polje)

DEPTH (cm)	PH H ₂ O	CACO ₃	HUMUS (%)	NH ₄ +NO ₃	P ₂ O ₅ (mg kg ⁻¹)	K ₂ O
0-30	6.9	1.48	2.90	32.40	2.18	36.4

Table 2. - Wheater conditions (May-June 2000)

Months	Meteorological parameters	Mean air temperature (°C)	Mean maximal temperature (°C)	Mean minimal temperature (°C)	Total monthly precipitaion (mm)
March		7.4	13.1	2.3	2.49
April		15.7	12.7	9.7	4.58
May		18.5	25.9	11.4	4.72
June		22.0	28.8	14.5	0.0
July		23.3	29.3	16.1	1.27

RESULTS AND DISCUSSION

The weed community of sugarbeet belongs to the weed communities of field crops such as corn, sunflower, soybean, potato, etc. Weediness in sugarbeet tends to increase easily because sugarbeet plants have a substantial interrow spacing in the early development stages and therefore competition is insignificant. Sugarbeet plants are exposed to weeds throughout the year because compared with other field crops sugarbeet is sown early and extracted late but also due to a low habitat and low plant density. The floristic composition of the weed community, i.e. weediness is effected by climatic, edaphic, orographic and other conditions. In additon to other measures used in managing weeds (agricultural practices) the application of herbicides still predominates.

The efficacy of dimethenamid-p in controlling annual grass weeds and broad-leaved weeds in sugarbeet was studied on the locality of Zemun Polje. The herbicide studied was applied at rates 0.8 l ha⁻¹; 1.0 l ha⁻¹; 1.2 l ha⁻¹ and 1.4 l ha⁻¹. Phytotoxic effects were monitored using the application rate of 2.8 l ha⁻¹. The lowest dimethenamid-p application rate (0.8 l ha⁻¹) was effective (75-90%) in controlling *A.retroflexus* and *E.crus-galli*. Increasing the application rate to 1.0 l ha⁻¹ tended to increase the efficacy (90-100%) as well. Further increase of the application rate to 1.2 l ha⁻¹ tended to raise the efficacy in controlling the species *P.lapathifolium* as well. In the case of *Ch. album* the same result was registered in the first assessment only. In the first assessment the efficacy was the same using either the highest application rate (1.4 l ha⁻¹) or 1.2 l ha⁻¹. In the second assessment the efficacy was low (0-75%) for *P.lapathifolium* only. As for all the other registered weed species, even the highest application rate (1.4 l ha⁻¹) contributed to a low efficacy (given as the number of plants). Considering dimetenamid to be effective in controlling *S.nigrum* (MITIĆ, 2002) dimethenamid-p was also expected to be as effective. However, the results obtained in the study proved the opposite. Poor efficacy of dimethenamid-p in controlling *S.nigrum* may be attributed to the drought which was registered following the application of the herbicide. However, the efficacy of dimethenamid-p for this species *S. nigrum* (given as the fresh and dry matter weight) was favourable even at the application of 1.2 l ha⁻¹. A more

favourable efficacy in controlling *S.nigrum* with regard to the fresh and dry matter weight in relation to the number of plants per m² may be explained by the fact that the herbicide provoked no wilting but retarded plant growth. The efficacy of dimethenamid-p was given as the number of plants, fresh and dry matter weight (Fig. 1, 2, 3). Dimethenamid is very often applied in combination with other herbicides showing thereby synergistic effects. For example, in combination with sethoxydim and imazetapir, dimethenamid tended to improve the control of *E.crus-galli* (SCOTT, 1998a). FOY and WITT (1997) studied the possibility of using the herbicide for the control of the atrazin resistant *A.hybridus* L. Thereby, dimethenamid contributed to the control of 60-93% of the resistant weed species. Visual assessment showed that dimethenamid-p had no phytotoxic impact on sugarbeet plants. Also, according to JORDAN and WOOLEY (1993) and WILLIAMSON (1993) hybrid corn can tolerate up to 5 kg ha⁻¹ of dimethenamid under field conditions (KOTOULA-SYKA *et al.*, 1996).

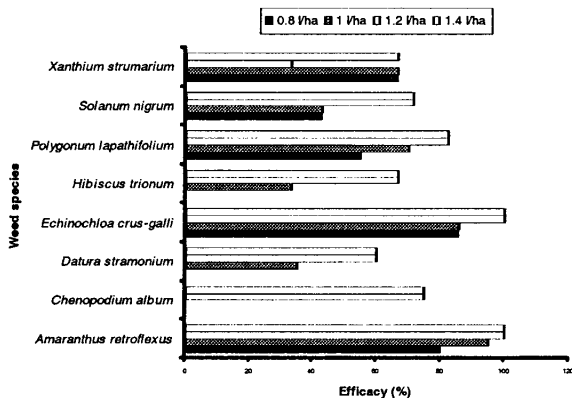


Fig. 1. - Efficacy of Frontier Super in relation to the number of plants per m²

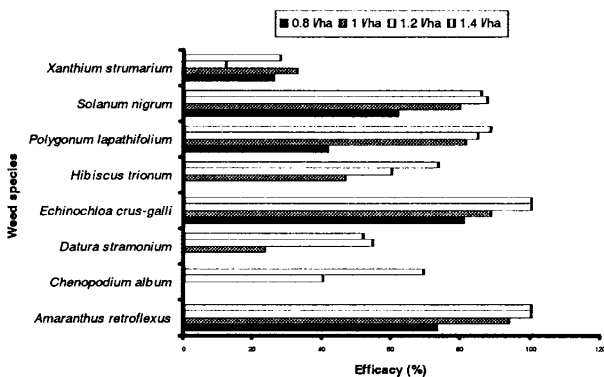


Fig.2. - Efficacy of Frontier Super in relation to fresh matter weight

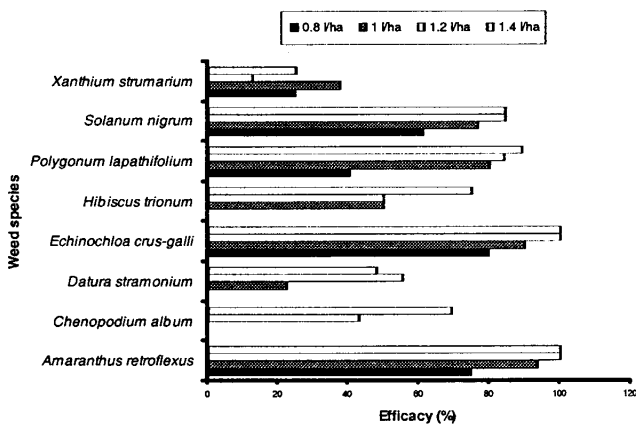


Fig. 3. - Efficacy of Frontier Super in relation to dry matter weight

CONCLUSIONS

- The following weed species predominated on the trial site: *Amaranthus retroflexus*, *Chenopodium album*, *Datura stramonium*, *Echinochloa crus-galli*, *Hibiscus trionum*, *Polygonum lapathifolium*, *Solanum nigrum*, *Xanthium strumarium*.
- The herbicide applied at the lowest application rate (0.8 l ha⁻¹) was effective (75-90%) in controlling *Amaranthus retroflexus* and *Echinochloa crus-galli*. A good efficacy (90-100%) was recorded at the dose rate of 1.0 l ha⁻¹. The application rate of 1.2 l ha⁻¹ contributed to an effective control of *Polygonum lapathifolium* as well, whereas in the case of *Chenopodium album* this efficacy was registered in the first assessment only. The first assessment showed an identical efficacy using either 1.4 l ha⁻¹ or 1.2 l ha⁻¹. In the second assessment a poor efficacy (0-75%) was registered for the control of *Polygonum lapathifolium* only. Even the highest application rate (1.4 l ha⁻¹) contributed to a poor efficacy for the control of all the other available species.
- Poor efficacy in controlling some weed species: *Datura stramonium*, *Hibiscus trionum*, *Solanum nigrum* and *Xanthium strumarium* was most probably the result of the highly developed resistance to the herbicide tested.

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Received March 3, 2003
Accepted August 21, 2003

EFIKASNOST DIMETENAMID-P-a U SUZBIJANJU KOROVA U USEVU ŠEĆERNE REPE

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I z v o d

U ovom radu ispitivana je efikasnost dimetenamid-p-a (preprat Frontier super) u suzbijanju jednogodišnjih uskolisnih i širokolisnih korova u šećernoj repi. Ogled je postavljen 2000. godine na lokalitetu Zemun Polje. Kao standard korišćen je dimetenamid (preparat Frontier 900 EC). Efikasnost i fitotoksičnost je utvrđena u skladu sa standardnom EPPO metodom. Za vrste *Amaranthus retroflexus* L. i *Echinochloa crus-galli* L. efikasnost je bila zadovoljavajuća (75-90%) za najnižu količinu primene (0.8 l ha⁻¹), dok je sa povećanjem količine primene na 1.0 l ha⁻¹ efikasnost bila dobra (90-100%). Daljim povećanjem količine primene na 1.2 l ha⁻¹ efikasnost je bila zadovoljavajuća i za vrstu *Polygonum lapathifolium* L., dok je za *Chenopodium album* L. takav rezultat konstatovan samo kod prve ocene. Pri najvećoj količini primen od 1.4 l ha⁻¹, kod prve ocene, postignuta je ista efikasnost kao i za količinu od 1.2 l ha⁻¹, dok je u drugoj oceni samo za *P. lapathifolium* efikasnost bila slaba (0-75%). Za ostale detektovane vrste: *Datura stramonium* L., *Hibiscus trionum* L., *Solanum nigrum* L. i *Xanthium strumarium* L. efikasnost je bila slaba čak i pri najvećoj količini primene (1.4 l ha⁻¹).

Rezultat nezadovoljavajuće efikasnosti na neke korovske vrste kao što su: *D.stramonium*, *H.trionum*, *S.nigrum* i *X.strumarium* je verovatno posledica njihove visoke otpornosti na dati herbicid. Frontier super se primenjuje u nižoj količini primene od standarda Frontier 900 EC da bi se postigla ista efikasnost, zahvaljujući tome što Frontier super sadrži prečišćen aktivni izomer dimetenamida, dok preparat Frontier 900 EC sadrži smešu izomera istog jedinjenja. U skladu s tim Frontier super se uklapa u savremene tendencije usmerene u pravcu smanjenja količina primene, tako da je prihvatljiviji u ekonomskom pogledu kao i sa stanovišta zaštite životne sredine.

Primljeno 3. marta 2003.
Odobreno 21. avgusta 2003.