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ACHIEVEMENTS AND PROBLEMS IN THE WEED CONTROL IN OIL-BEARING SUNFLOWER (*Helianthus annuus* L.)

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Abstract

Chemical control has emerged as the most efficient method of weed control. Herbicides combinations and tank mixtures of herbicides with adjuvants, fertilizers, growth regulators, fungicides, insecticides, are more effective than when they are applied alone in sunflower crops. Their combined use often leads to high synergistic effect on yield. Introduction of new sunflower Clearfield and Express Sun technologies marks a new stage in the weed control in this crop, including against Orobanche cumana Wall. Problem is a post-effect of some herbicides used in the predecessors on succeeding crops, which is directly related to the weather conditions during their degradation. Most of the information in sunflower relates to conventional technology for the weed control. On some issues are published contrary opinions, due primarily to the different conditions under which the experiments were conducted and also the biological characteristics of the investigated cultivars and hybrids. It is insufficient studied the effect of the herbicides on the sunflower yield that occurs by treatment the crop with the tank mixtures of herbicides, stimulators and fertilizers. A serious problem is also the volunteers of the Clearfield and Experess Sun sunflower. They have resistance to herbicides different from that one of conventional sunflower hybrids. There is no information still in the scientific literature to control of these volunteers.

Key words: *herbicides, seed quality, seed yield, sunflower, weed control.*

REVIEW

Regular crop rotation is an important preventative measure in the overall protection of sunflower from weeds (Crnobarac et al., 1994). According Wanikorn (1991) when the sunflower is weeded during the first four weeks after emergence, crop yields decreased from 10% to 40%.

A large number of authors examine the efficacy of large number of herbicides and herbicide combinations to fight problematic weeds in conventional technology for cultivation of sunflower (Kovacevic, 1983; Gimesi, 1986; Sarno et al., 1986; Tei, 1986; Savka, 1988; Yarovenko et al., 1988; Covarelli, 1988; Salera and Baldini, 1988; Desplantes, 1989; Petkova et al., 1990; Tei et al., 1991; Lyubenov and Milanova, 1992; Rapparini, 1986, 1993 and 1994; Zech, 1993; Milanova and Atanasava, 1994; Marocchi, 1995; Paganini and Meriggi, 1995; Archenault and Sagot, 1996; Ilieva, 1997; Retamal and Duran, 1998; Markovic et al., 1998 and 2000; Iliev et al., 1999; Michel, 2001; Ribeiro and Cavaco, 2003; Laureti, 2005; Gormonchik, 2006; Axionov, 2010; Brighenti et al., 2002, 2012 and 2012; Kirchenko and Saratov, 2012).

The results of the Deibert (1989) showed that the yields of sunflower seeds and oil content in seeds were not significantly different between tillage systems and other mechanized tillage on the one hand and systems with minimal processing and chemical weed control on the other hand. Suspension fertilizers series Lactofol ensure better physiological development of sunflower plants and increase the yield of grain. Best results are obtained when Lactofol was administered in a stage of the fourth pair of leaves of the sunflower (Pavlova et al., 1992).

The use of non-selective herbicides containing glyphosate, glyphosate-ammonium and glyphosate-trimezium are highly effective against perennial weeds such as *Cirsium arvense* Scop. and *Convolvulus arvensis* L. They have quick initials effect and duration of action and do not allow the perennial weeds to restore vegetation in the sunflower. Not reported phytotoxic events in sunflower sown after their application, since these herbicides are leafy and fallen in the soil break down very

quickly (Covarelli et al., 1991 and 1991; Covarelli and Contemori, 1998).

Jursik et al. (2011) studied in much Herbicide combinations found that the most efficient herbicide is oxyfluorfen and the most efficient combination is fluorochloridone + acetochlor. Highest phytotoxicity (68-81%) is recorded after the vegetation applying oxyfluorfen, followed by flumioxazin (23-45%). The phytotoxicity of the herbicide fluorochloridone, acetochlor, bifenox is lower (6-27%).

According to García and Labrada (1997) in sunflower herbicide combination trifluralin + prometrin is more effective than trifluralin - used alone before sowing with incorporation and prometrin - after sowing before emergence. Grain yield increased by 30 % and profitability by 288% compared with hand hoes control. The authors found that in high rainfall efficiency of prometryn reduced by more than 58%.

Complete destruction of *Sorghum halepense* Pers. from seeds and rhizomes is possible by the application of herbicides phenoxy-ethyl, fluazifop-butyl, haloxyfop-ethoxyethyl and kuinox-ethyl height of *Sorghum halepense* Pers. 15 - 30 cm (Markovic et al., 1985; Tosev and Drazic, 1985). Herbicide Fuzilad may be applied in tank mixtures with a large number of herbicides in antibroadleaved oilseed sunflower and oil seed canola (Hemmen and Konradt, 1991).

Ryabtsev et al. (2012) reported that the conditions of the Altai region in Siberia, the highest yields are obtained with the combination of pre-sowing introduction of Treflan + vegetation treatment with Fuzilad forte. According to the authors, 50 % of the yield is determined by herbicides. Saskevich et al. (2011) found that of the conditions Belarus 68-69% of the sunflower yield depends on chemical weed control.

Jat and Giri (2000) and Suresh and Reddy (2010) report that the use of herbicide Stomp (pendimethalin) at sunflower increases production by 56%. Herbicide Dual Gold destroys 90% of annual graminaceous and broadleaf weeds in corn and sunflowers crops (Khan and Hassan, 2003). Herbicides Dual Gold, Stomp and Trophy have high efficacy against annual weeds in sunflower (Patalaha al., 2009).

According Tracchi et al. (1998) herbicide Raft (oxadiargyl) is one of the most effective soil herbicides in conventional technology for sunflower growing.

The high efficiency of herbicides Afalon (linuron), Galigan (oxyfluorfen), Pledge (flumioxazin), Proponit (propisochlor) and Stomp (pendimethalin) introduced on different levels of fertilization is reported by Nádasy et al. (2007).

In experiments which are carried out in Thailand, Rungsit al. (1986) found that the herbicides napropamide and metolachlor and herbicide mixtures linuron + napropamide and linuron + metolachlor are highly effective against a large number of graminaceous and broadleaf weeds common in sunflower crops.

According to the results obtained from Holop and Protasov (1999), for soil and climatic conditions of the Northeast Belarus Racer (flurochloridone) is the most effective herbicide. The herbicidal combination flurochloridone + S-metolachlor had no effect and only against *Datura stramonium* L. and *Xanthium strumarium* L. (Simić et al., 2012).

Even minimal residues in the spraying tank of herbicides for the control of broadleaf weeds in cereal crops, such as dicamba, clopyralid or chlorsulfuron applied alone and in combination with antigraminaceous herbicides sethoxydim and diclofop cause strong phytotoxicity in the sunflower. The decrease in yield can reach to 40% (Derksen, 1989).

The studies of Fletcher et al. (1996) on the persistence of the four different herbicides - atrazine, chlorsulfuron, glyphosate and 2.4-D in the canola, sunflower and soybean showed that the persistence chlorsulfuron leads to a lower yield of grain in canola and soybean, in comparison with sunflower. Persistence of atrazine on these three cultures was lower.

According to trials were done by Drazic and Glusac (1988), the herbicidal mixtures atrazine + metolachlor, atrazine + alachlor, atrazine + linuron, metolachlor + linuron used in the cultivation of maize, reducing the weeds density in sunflower and wheat sown in the next growing season. The obtained results show that, in some of such mixtures there is a tendency to decrease the yield, but the differences were not statistically significant.

Zand et al. (2009) studied persistence of several herbicides containing sulfunilureya used in wheat on Subsequent rotation maize, sunflower, canola, chickpeas and soybeans. Were studied herbicides Apirus (sulfosulfuron) Megaton (chlorsulfuron) Bromitsid + Topic (bromoxynil + MCPA + clodinafop-propagril), Total (sulfosulfuron + mesosulfuron) and Atlantis (mesosulfuron + iodosulfuron). The authors found that herbicides Megaton and Total decreased sunflower yield by 15% and 50%.

Gajić-Umiljendić et al. (2012) found that the sunflower is sensitive to residues in the soil of the herbicide clomazone as compared to maize and barley.

According Caramete (1985) stability in the soil of used in sunflower herbicides in descending line is: linuron, monolinuron, metribuzin, prometrin, trifluralin. Last herbicide is degraded even by sunlight and needs immediate incorporation after its introduction in the soil. After a mechanical hoeing (cultivation) the quantities of these herbicides in soil decreased by 14-30% and after two hoes - by 25-50%.

Gosselin and Bey (1998) reported about sunflower hybrids resistant to the herbicide combination metazachlor + quinmerac.

Creation of sustainable hybrids of tribenuron-methyl allows the use of larger range of herbicides in sunflower, to a more effective chemical control of *Cirsium arvense* Scop. and some annual broadleaf weeds. Resistant genes are transferred from wild tribenuron-methyl resistant sunflower species. This new technology for weed control is economically more profitable than conventional technology (Jocić et al., 2008 and 2011).

Knežević et al. (2011) studying the elements of the new Clearfield technology and the hybrids resistant to imidazolinones, reported that this technology for weed control is also economically more profitable than conventional technology. It is used to control all of weeds in sunflower crop with only one treatment (Konstantinovic and Meseldzija, 2004; Konstantinovic et al., 2010). Clearfield technology is more effective against weeds in comparison with the soil herbicides terbutilizan and acetochlor and tank mixtures between them (Konstantinovic et al., 2010a).

According to Al-Khatib et al. (1998), resistance to imazethapyr at imazethapyr-resistant genotypes sunflower due to changes in the acetolactate synthesis, making them 25 times more resistant to this herbicide as compared to sensitive biotypes.

Malidza et al. (2005), Mitric and Vuckovic (2008) and Vrbnicanin et al. (2008) reported that in connection with the increasing problems associated with the change of the species composition of weed problems and control of certain weed species will grow more sunflower hybrids tolerant of imidazolinone and tribenuron-methyl. In the near future some conventional soil herbicides can be banned from the market due to their long persistence and contamination of soil and water.

In production will increasingly share of Clearfield and Express Sun technologies over conventional technology. Additional advantages of the two new technologies for weed control are more flexible timetable for the implementation of herbicides and to suppress the growth of perennial and some annual weeds (Malidza et al., 2004 and 2006).

In the next crop in the rotation, special attention should be given to the control of volunteer of sunflower hybrids tolerant of imidazolinone and tribenuron-methyl, which have resistance to herbicides other than that of conventional hybrids (Malidza, 2006).

Tonev et al. (2009) found that the simultaneous introduction of herbicides Express (tribenuron-methyl) and Gallant Super (haloxyfop-methyl) together with adjuvant Trend as a tank mixture, leading to phytotoxicity in sustainable tribenuron-methyl sunflower hybrid PR64E83. Symptoms of phytotoxicity are the result of the large temperature range air 2-3 days before and after the application of the tank mixture - low night temperatures and high daily temperatures. Herbicides Pledge (fluxofenin) and Goal (oxyfluorfen) used in conventional technology, applied in the same phase, exhibit much higher phytotoxicity in the sunflower, which has a negative effect on the yield.

Herbicide Intervix (imazamox + imazapyr) used in Clearfield technology for treatment of imidazolinone-resistant sunflower hybrids has no-effect on common wheat, barley, canola, maize and sugar beet (Suzer and Buyuk, 2010).

The most effective and most cost-effective way to control *Orobanche cumana* Wall. is the creation of sunflower hybrids resistant to this weed or hybrids that are resistant to herbicides based on imidazolinones (Skoric and Jocic, 2005; Soare et al., 2005; Masirevic and Malidza, 2006). Due to the high efficiency of imazethapyr against *Orobanche cumana* Wall. the fight against this parasitic weed in imazethapyr-resistant sunflower hybrids is conducted chemically rather than selection time (Alonso et al., 1998).

In the same vein are research and Garcia-Torres and Lopez-Granados (1991) and Garcia-Torres et al. (1994). According to the authors herbicides imazethapyr, imazapyr and chlorsulfuron effective against *Orobanche cumana* Wall. The required levels of herbicide vary depending on the degree of the inoculum and of the environmental conditions. Herbicide triasulfuron, imazaquin, primsulfuron, acetochlor and metazachlor are less effective. Imazamethabenz and metolachlor are ineffective against this parasitic weed.

Horvath and Osztrogonac (1991) find that the herbicide Goal (oxyfluorfen) inhibits the development of secondary haustories of *Orobanche cumana* Wall. in sunflower and severely hampers the development of weeds. The effect is stronger in vegetation treatment, compared with soil introduction of herbicide. The vegetation treatment with Goal leads to stronger phytotoxicity in the sunflower plants.

CONCLUSIONS

Chemical control has emerged as the most efficient method of weed control.

Herbicides combinations and tank mixtures of herbicides with adjuvants, fertilizers, growth regulators, fungicides, insecticides, are more effective than when they are applied alone in sunflower crops. Their combined use often leads to high synergistic effect on yield.

Introduction of new sunflower Clearfield and Express Sun technologies marks a new stage in the weed control in this crop, including against *Orobanche cumana* Wall.

Problem is a post-effect of some herbicides used in the predecessors on succeeding crops, which is directly related to the weather conditions during their degradation.

Most of the information in sunflower relates to conventional technology for the weed control. On some issues are published contrary opinions, due primarily to the different conditions under which the experiments were conducted and also the biological characteristics of the investigated cultivars and hybrids.

It is insufficient studied the effect of the herbicides on the sunflower yield that occurs by treatment the crop with the tank mixtures of herbicides, stimulators and fertilizers.

A serious problem is also the volunteers of the Clearfield and Experess Sun sunflower. They have resistance to herbicides different from that one of conventional sunflower hybrids. There is no information still in the scientific literature to control of these volunteers.

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