EFFICACY OF HERBICIDES, HERBICIDE COMBINATIONS AND HERBICIDE TANK MIXTURES ON WINTER FORAGE PEA (*PISUM SATIVUM* L.)

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Abstract. *The research was conducted during 2015 - 2017 on pellic vertisol soil type. Under investigation was Bulgarian winter forage pea cultivar Mir (Pisum sativum var. arvense). Factor A included untreated control and 2 soil-applied herbicides – Dual gold 960 EC, Stomp aqua. Factor B included untreated control, 5 foliar-applied herbicides – Basagran 480 CL, Pulsar 40, Korum, Zencor 70 WG, Maton 600 EK and 2 herbicide tank mixtures – Zencor 70 + Targa super 5 EC, Maton 600 EK + Targa super 5 EC. Soil-applied herbicides were treated during the period after sowing before emergence. Foliar-applied herbicides were treated during 2 - 3 real leaf stage of the pea. Foliar-applied herbicides Pulsar and Korum destroy completely all annual and perennial broadleaved and graminaceous weeds and self-sown plants in winter forage pea crops. Combinations of soil-applied herbicides Dual gold and Stomp aqua with foliar-applied herbicides Basagran, Pulsar, Korum, Zencor and Maton, as well as with herbicide tank mixtures Zencor + Targa super and Maton + Targa super exhibit an additive effect on herbicidal efficacy. Treatment with foliar-applied herbicide Maton leads to high phytotoxicity in pea – rate 3 according to the scale of EWRS. Herbicide tank-mixture Maton + Targa super leads to even higher phytotoxicity in pea – rate 5 according to the scale of EWRS. Foliar-applied herbicide Zencor and herbicide tank-mixture Zencor + Targa super also leads to phytotoxicity in pea – rate 2 according to the scale of EWRS. The highest yields of winter forage pea seeds are obtained by treatment with foliar-applied herbicide Korum after soil-applied herbicides Stomp aqua and Dual gold. High yields are obtained also by treatment with foliar-applied herbicide Pulsar after soil-applied herbicides Stomp aqua and Dual gold, as well as by foliar treatment with herbicide tank-mixture Zencor + Targa super after soil-applied herbicides Stomp aqua and Dual gold.*

Key words: *winter forage pea, herbicides, herbicide combinations, efficacy, selectivity, seed yield*

INTRODUCTION

Pea is a crop that grows slowly in the first days after germination and is easily oppressed by weeds. In its crops mainly early spring weeds develop - *Sinapis arvensis* L., *Falopia convolvulus* Leve, *Raphanus raphanistrum* L., and more limited late spring weeds develop - *Chenopodium album* L., *Amaranthus retroflexus* L., etc. From perennial weeds with the widest distribution and highest density are *Convolvulus arvensis* L. and *Cirsium arvense* Scop. An important measure in pea cultivation is the removal of weeds that carry diseases - *Anthemis arvensis* L., *Cirsium arvense* Scop., *Papaver rhoes* L., as well as those weeds that are poisonous - *Solanum nigrum* L., self-sown potatoes *Solanum tuberosum* L., *Datura stramonium* L. (DANN ET AL., 1987; AUSHKALNIS AND DOVIDAITIS, 1997; DOVYDAITIS AND AUSKALNIS, 1999; SINGH, 2003).

It has made a huge progress in weed control during recent years. Conditions for complete elimination of manual labor were created (WÁGNER, 2015). Weed control is most successful in complex application of agro-technical and chemical methods (DREW ET AL., 2007; KUKHARCHIK ET AL., 2013; MAZAEVA, 2013). World experience shows that the possibilities for biological weed control are still small (MUNAKAMWE ET AL., 2012). Agro-technical methods

include: crop rotation – sowing of legumes after cereals; plowing and pre-sowing tillage adjusted to character and degree of weed infestation; adherence to the pea sowing period, etc. Chemical control is carried out with selective herbicides – soil-applied and foliar-applied. They should be selected according to the nature of the weed associations accompanying the pea crop (MIJATOVIC ET AL., 1994; TIDEMANN ET AL., 2014; BLAŽINKOV ET AL., 2015; DELCHEV, 2018).

The introduction of chemical weed control, however, solves some questions: establishment of herbicides, safe for peas and harmless to humans, animals and micro-organisms; preventing the accumulation of herbicides in plants, soil and the environment; maintaining high soil fertility, etc. (YANCHEVA ET AL., 2009 AND 2013).

The purpose of this investigation was to establish the efficacy and selectivity of some herbicides, herbicide combinations and herbicide tank mixtures on the winter forage pea by influence of different meteorological conditions.

MATERIALS AND METHODS

The research was conducted during 2015 - 2017 on pellic vertisol soil type. Under investigation was Bulgarian winter forage pea cultivar Mir (*Pisum sativum var. arvense*). Two factors experiment was conducted under the block method, in 4 repetitions; the size of the crop plot was 15 m^2. Factor A included untreated control and 2 soil-applied herbicides – Dual gold 960 EC and Stomp aqua. Factor B included untreated control, 5 foliar-applied herbicides – Basagran 480 CL, Pulsar 40, Korum, Zencor 70 WG, Maton 600 EK and 2 herbicide tank mixtures – Zencor 70 WG + Targa super 5 EC, Maton 600 EK + Targa super 5 EC. Active substances of herbicides and their doses are shown in Table 1.

Table 1

Investigated variants

№	Variants	Active substance	Doses
After sowing, before emergence			
1	Control	-	-
2	Dual gold 960 EC	S-metolachlor	1.5 l/ha
3	Stomp aqua	pendimethalin	5 l/ha
2 – 3 real leaf stage			
1	Control	-	-
2	Basagran 480 CL	bentazone	2 l/ha
3	Pulsar 40	imazamox	1.2 l/ha
4	Korum	bentazone + imazamox	1.25 l/ha
5	Zencor 70 WG	metribuzine	500 g/ha
6	Zencor 70 WG + Targa super 5 EC	metribuzine + quizalofop-P-ethyl	50 g/da + 2 l/ha
7	Maton 600 EK	2.4-D ethylhexyl ester	1 l/ha
8	Maton 600 EK + Targa super 5 EC	2.4-D ethylhexyl ester + quizalofop-P-ethyl	1 l/ha + 2 l/ha
Herbicides Pulsar 40 and Korum were used in addition with adjuvant Dash HC – 1 l/ha.			

Soil-applied herbicides were treated during the period after sowing before emergence. Foliar-applied herbicides were treated during 2 - 3 real leaf stage of the pea. All of herbicides, herbicide combinations and herbicide tank-mixtures were applied in a working solution of 200 l/ha. Mixing of foliar-applied herbicides was done in the tank on the sprayer. Due to of low

adhesion of the herbicides Pulsar 40 and Korum were used in addition with adjuvant Dash HC – 1 l/ha.

It was investigated efficacy and selectivity of herbicides, herbicide combinations and herbicide tank mixtures. It was established their influence on seed yield. Efficacy of herbicides against weeds and self-sown durum wheat was appointed according to 100 % scale of EWRS (European Weed Research Society). Selectivity of herbicides to pea plants was followed according to the 9-rate scale of EWRS (rating 1 - without damages, rating 9 - crop is completely destroyed). The mathematical processing is done with analysis of variance method.

RESULTS AND DISCUSSION

Annual broadleaved weeds in the experiment are represented by *Anthemis arvensis* L., *Chamomilla recutita* Rauchert, *Galium aparine* L., *Sinapis arvensis* L., *Raphanus raphanistrum* L., *Falopia convolvulus* Leve, *Papaver rhoes* L., *Consolida regalis* Gray, *Lamium purpureum* L., *Veronica hederifolia* L., also single plants of *Capsella bursa-pastoris* L., *Lithospermum arvense* L., *Viola tricolor* L., *Myagrum perfoliatum* L., *Stellaria media* Cyr.

Annual graminaceous weeds are *Avena fatua* L., *Alopecurus myosuroides* L., *Lolium multiflorum* L., *Bromus arvensis* L., also single plants of *Avena ludoviciana* Durien., *Apera spica-venti* P.B., *Lolium temulentum* L.

Perennial broadleaved weeds are *Cirsium arvense* Scop., *Convolvulus arvensis* L., *Cardaria draba* L. and *Sonchus arvensis* L. Perennial graminaceous weeds are single plants of *Sorghum helepense* Pers., *Cynodon dactylon* Pers. and more rarely *Agropyrum repens* L.

Self-sown plants are represented by durum wheat (*Triticum durum* Desf.), was grown as predecessor.

Soil-applied herbicide Dual gold controls 100 % of *Galium aparine* L., *Sinapis arvensis* L., *Raphanus raphanistrum* L., *Anthemis arvensis* L., *Lamium purpureum* L. (Table 2). It controls 85 - 95 % of weeds such as *Galium aparine* L. and *Papaver rhoes* L. This herbicide has low efficacy of 30 % against *Falopia convolvulus* Leve and *Veronica hederifolia* L. and is inefficacy against *Consolida regalis* Gray.

Soil-applied herbicide Stomp aqua controls 100 % of annual broadleaved weeds such *Galium aparine* L., *Sinapis arvensis* L., *Raphanus raphanistrum* L., *Anthemis arvensis* L. and *Veronica hederifolia* L. It controls 85 % of *Galium aparine* L. and *Papaver rhoes* L. This herbicide has a low efficacy of 35 – 40 % against *Falopia convolvulus* Leve and *Lamium purpureum* L.

Foliar-applied herbicides Pulsar and Korum completely control all annual broadleaved weeds available in the experiment. Herbicide Zencor is inefficacy against *Consolida regalis* Gray only. Herbicide Basagran is inefficacy against *Consolida regalis* Gray, *Raphanus raphanistrum* L., *Veronica hederifolia* L. and *Lamium purpureum* L. This herbicide has a less efficacy against *Falopia convolvulus* Leve – 92 %. Of foliar-applied herbicides, Matton is least effective against annual broadleaved weeds. It is efficacy against *Consolida regalis* Gray, *Sinapis arvensis* L. and *Raphanus raphanistrum* L. only. Maton cannot control *Galium aparine* L., *Chamomilla recutita* Rauchert, *Anthemis arvensis* L., *Papaver rhoes* L., *Falopia convolvulus* Leve, *Veronica hederifolia* L., *Lamium purpureum* L.

Soil-applied herbicides Dual gold and Stomp aqua applied in autumn, during the period after sowing before germination (ASBE) of winter forage pea, are inefficacy against *Cirsium arvense* Scop., *Convolvulus arvensis* L., *Cardaria draba* L. and *Sonchus arvensis* L., because these perennial broadleaved weeds germinate in spring (Table 3).

Foliar-applied herbicides Pulsar and Korum completely control perennial broadleaved weeds. As a contact herbicide, Bazagran destroys only the above-ground parts of perennial

Table 2

Efficacy of some herbicides, herbicide combinations and herbicide tank mixtures against annual broadleaved weeds at pea according to the 100 % visual scale of EWRS (mean 2015 - 2017)

Herbicides		**Weeds**									
Soil-applied	**Foliar-applied**	**Galiun aparine**	**Chamomilla recutita**	**Papaver rhoes**	**Consolida regalis**	**Sinapis arvense**	**Raphanus raphanistrum**	**Anthemis arvensis**	**Falopia convolvulus**	**Veronica hederifolia**	**Lamium purpureum**
-	-	0	0	0	0	0	0	0	0	0	0
	Basagran	100	100	100	0	100	0	100	92	0	0
	Pulsar	100	100	100	100	100	100	100	100	100	100
	Korum	100	100	100	100	100	100	100	100	100	100
	Zencor	100	100	100	0	100	100	100	100	100	100
	Zencor + Targa super	100	100	100	0	100	100	100	100	100	100
	Maton	0	0	0	100	100	100	0	0	0	0
	Maton + Targa super	0	0	0	100	100	100	0	0	0	0
Dual gold	-	85	100	90	0	100	100	100	30	30	100
	Basagran	100	100	100	0	100	100	100	92	30	100
	Pulsar	100	100	100	100	100	100	100	100	100	100
	Korum	100	100	100	100	100	100	100	100	100	100
	Zencor	100	100	100	0	100	100	100	100	100	100
	Zencor + Targa super	100	100	100	0	100	100	100	100	100	100
	Maton	85	100	90	100	100	100	100	92	30	100
	Maton + Targa super	85	100	90	100	100	100	100	92	30	100
Stomp aqua	-	85	100	85	30	100	100	100	40	100	35
	Basagran	100	100	100	30	100	100	100	92	100	35
	Pulsar	100	100	100	100	100	100	100	100	100	100
	Korum	100	100	100	100	100	100	100	100	100	100
	Zencor	100	100	100	30	100	100	100	100	100	100
	Zencor + Targa super	100	100	100	30	100	100	100	100	100	100
	Maton	85	100	85	100	100	100	100	40	100	35
	Maton + Targa super	85	100	85	100	100	100	100	40	100	35

broadleaved weeds *Cirsium arvense* Scop., *Convolvulus arvensis* L., *Cardaria draba* L. and *Sonchus arvensis* L. Hormone-similar herbicide Maton also destroys only the above-ground parts of these perennial broadleaved weeds. Herbicide Zencor is inefficacy against *Cirsium arvense* Scop., *Convolvulus arvensis* L. and *Cardaria draba* L. It has low efficacy against *Sonchus arvensis* L. – destroys this perennial broadleaf weed of 60 %.

Soil-applied herbicide Dual gold is inefficacy against annual graminaceous weeds *Bromus arvensis* L., *Avena fatua* L. and *Avena ludoviciana* Durien. It has a low efficacy of 40 % against self-sown plants of durum wheat (*Triticum durum* Desf.).

Table 3

Efficacy of some herbicides, herbicide combinations and herbicide tank mixtures against perennial broadleaved, annual graminaceous weeds and self-sown plants at pea according to the 100 % visual scale of EWRS and selectivity according to the 9-rate scale of EWRS (mean 2015 - 2017)

Herbicides		**Weeds**									
Soil-applied	**Foliar-applied**	**Cirsium arvense**	**Convolvulus arvensis**	**Cardaria draba**	**Sonchus arvensis**	**Avena fatua**	**Lolium multiflorum**	**Alopecurus myosoroides**	**Bromus arvensis**	**Triticum durum***	**Selectivity**
-	-	0	0	0	0	0	0	0	0	0	1
	Basagran	78	70	80	88	0	0	0	0	0	1
	Pulsar	98	100	100	100	96	100	100	98	100	1
	Korum	100	100	100	100	96	100	100	98	100	1
	Zencor	0	0	0	60	0	100	100	0	0	2
	Zencor + Targa super	0	0	0	60	100	100	100	100	100	2
	Maton	75	68	85	82	0	0	0	0	0	3
	Maton + Targa super	75	68	85	82	100	100	100	100	100	5
Dual gold	-	0	0	0	0	0	100	100	0	40	1
	Basagran	78	70	80	88	0	100	100	100	100	1
	Pulsar	98	100	100	100	96	100	100	98	100	1
	Korum	100	100	100	100	96	100	100	98	100	1
	Zencor	0	0	0	60	0	100	100	0	0	2
	Zencor + Targa super	0	0	0	60	100	100	100	100	100	2
	Maton	75	68	85	82	0	100	100	0	0	3
	Maton + Targa super	75	68	85	82	100	100	100	100	100	5
Stomp aqua	-	0	0	0	0	95	100	100	0	0	1
	Basagran	78	70	80	88	95	100	100	0	0	1
	Pulsar	98	100	100	100	96	100	100	98	100	1
	Korum	100	100	100	100	96	100	100	98	100	1
	Zencor	0	0	0	60	95	100	100	0	0	2
	Zencor + Targa super	0	0	0	60	100	100	100	100	100	2
	Maton	75	68	85	82	95	100	100	0	0	3
	Maton + Targa super	75	68	85	82	100	100	100	100	100	5

* - self-sown plants of durum wheat

Herbicide Stomp aqua is efficacy against all annual graminaceous weeds, except for *Bromus arvensis* L. It is inefficacy against self-sown plants of *Triticum durum* Desf.

Foliar-applied herbicides Pulsar and Korum destroy completely all graminaceous weeds and self-sown plants of durum wheat. Herbicides Basagran and Maton are inefficacy against all graminaceous weeds. Herbicide Zencor is efficacy against *Lolium multiflorum* L. and *Alopecurus myosuroides* L., but inefficacy against *Avena fatua* L. and *Bromus arvensis* L. Foliar-applied herbicides Basagran, Zencor and Maton are inefficacy against self-sown plants of *Triticum durum* Desf.

Tank mixtures of antibroadleaved herbicides Zencor and Maton with antigraminaceous herbicide Targa super are control all graminaceous weeds and self-sown plants of durum wheat.

Combinations of soil-applied herbicides Dual gold and Stomp aqua with foliar-applied herbicides Basagran, Pulsar, Korum, Zencor and Maton, as well as with herbicide tank mixtures Zencor + Targa super and Maton + Targa super do not reduce herbicide efficacy. These combinations have an additive effect.

From the herbicides included in the experiment, the use of foliar-applied herbicide Maton leads to high phytotoxicity on pea - rating 3 by scale of EWRS (Table 3). For the herbicide Maton, selectivity is on a physical basis - there must be no physical contact between the leaves and the herbicide solution, i.e., there must be a thick wax cast on the pea leaves. This results in a lower selectivity of the herbicide, especially in years with more rainfall, which wash part of the wax coating of pea leaves. Maton treatment should not be performed a few days after watering or rain to allow the peas to form again a thick wax coating on its leaves.

Herbicide tank mixture of Maton with Targa super leads to even less selectivity - rating 5 by scale of EWRS. The reason for this is that the adhesives of antigraminaceous herbicide Targa super further facilitate penetration of hormone-similar herbicide Maton into the pea plants and increases the phytotoxicity of the herbicide mixture. To combined treatment of herbicide Maton with antigraminaceous herbicides in the form of tank mixtures should be done in extreme need only. When it is necessary, hormonal herbicides based on 2.4-D or 2M-4X are to be applied separately from antigraminaceous herbicides – first treat it with the antigraminaceous herbicide and after 4 - 5 days when it penetrates into the pea, treat it with the hormone-similar herbicide. In such cases, an even better option is to replace the hormone-similar herbicide with a selectivity based on a physical basis with another antibroadleaved herbicide with selectivity on a physiological basis.

Use of foliar-applied herbicide Zencor and herbicide tank mixture Zencor + Targa super also leads to phytotoxicity on pea - rating 2 by scale of EWRS. This means that Zencor has a weaker physiological selectivity for pea plants.

Signs of phytotoxicity are the same as the alone use of herbicides Maton and Zencor and thank mixtures Maton + Targa super and Zencor + Targa super, as well as their combinations with the soil-applied herbicides Dual gold and Stomp aqua. They are difficult to overcome by peas and lead to a reduction in seed yield.

Soil-applied herbicides Dual gold and Stomp aqua, foliar-applied herbicides Basagran, Pulsar and Korum, as well as their combinations have very high pea selectivity - rating 1 by scale of EWRS.

Data for the influence of investigated herbicides, herbicide combinations and herbicide tank mixtures on seed yield of winter forage pea (Table 4) show that the lower yield is obtained by alone use of herbicide tank mixture Maton + Targa super – 97.2 % compared to untreated control. Low yields are also obtained by alone use of herbicide Maton and by combined use of herbicide tank mixture Maton + Targa super with soil-applied herbicides Dual gold and Stomp aqua. Their use does not increase seed yield compared to untreated control, despite their very

good herbicidal effect against both graminaceous and broadleaved weeds. The reason for this is their higher phytotoxicity against pea.

Alone use of soil-applied herbicides Dual gold and Stomp aqua does not proven increase seed yield compared to untreated control, because these herbicides cannot control the perennial weeds and a part of annual weeds.

Alone use of foliar-applied herbicides Pulsar and Korum increases seed yields because the all of weeds and self-sown plants are destroyed by these herbicides. Seed yields of Korum are higher than those of Pulsar. The reason for this is the longer effect of Korum and its longer

Table 4

Influence of some herbicides, herbicide combinations and herbicide tank mixtures on seed yield of pea (2015 - 2017)

Herbicides		**2015**		**2016**		**2017**		**Mean**	
Soil-applied	**Foliar-applied**	**kg/ha**	**%**	**kg/ha**	**%**	**kg/ha**	**%**	**kg/ha**	**%**
-	-	2314	100	2890	100	2580	100	2595	100
	Basagran	2586	111.8	3299	114.2	2842	110.2	2909	112.1
	Pulsar	2762	119.4	3390	117.3	2944	114.1	3032	116.8
	Korum	2841	122.8	3480	120.4	3003	116.4	3108	119.8
	Zencor	2511	108.5	3244	112.2	2755	106.8	2837	109.3
	Zencor + Targa super	2684	116.0	3355	116.1	2924	113.3	2988	115.1
	Maton	2377	102.7	2777	96.1	2691	104.3	2615	100.8
	Maton + Targa super	2280	98.5	2688	93.0	2597	100.7	2522	97.2
Dual gold	-	2378	102.8	2992	103.5	2666	103.3	2679	103.2
	Basagran	2654	114.7	3413	118.1	2967	115.0	3011	116.0
	Pulsar	2841	122.8	3503	121.2	3068	118.9	3137	120.9
	Korum	2906	125.6	3589	124.2	3099	120.1	3198	123.2
	Zencor	2571	111.1	3355	116.1	2866	111.1	2931	112.9
	Zencor + Targa super	2754	119.0	3468	120.0	3044	118.0	3089	119.0
	Maton	2441	105.5	2890	100.0	2812	109.0	2714	104.6
	Maton + Targa super	2340	101.2	2803	97.0	2712	105.1	2618	100.9
Stomp aqua	-	2414	104.3	3030	104.8	2691	104.3	2712	104.5
	Basagran	2670	115.4	3439	119.0	2980	115.5	3030	116.8
	Pulsar	2867	123.9	3534	122.3	3081	119.4	3161	121.8
	Korum	2911	125.8	361.0	124.9	3106	120.4	3209	123.7
	Zencor	2596	112.2	3381	117.0	2879	111.6	2952	113.8
	Zencor + Targa super	2762	119.4	3480	120.4	3057	118.5	3100	119.4
	Maton	2462	106.4	2922	101.1	2825	109.5	2736	105.4
	Maton + Targa super	2356	101.8	2829	97.9	2712	105.1	2632	101.4
LSD 5 %		106	4.6	173	6.0	132	5.1		
LSD 1 %		139	6.0	220	7.6	170	6.6		
LSD 0.1 %		174	7.5	269	9.3	212	8.2		

control over the secondary-emerged weeds. The differences in yields between the herbicides Korum and Pulsar are mathematically unproven, because after the herbicide treatment, the pea develops rapidly, covers the whole soil surface, competes with weeds and almost prevents secondary weed infestation.

Herbicide Basargan increases yield less because of its inefficacy against graminaceous weeds and part of annual broadleaved weeds. Herbicide Zencor increases yield less because of its inefficacy against perennial broadleaved weeds and its higher phytotoxicity to pea plants.

The highest seed yields are obtained by treatment with foliar-applied herbicide Korum after soil-applied herbicide Stomp aqua– 123.7 % and by Korum after soil-applied herbicide Dual gold – 123.2 % above the untreated control. High yields are obtained also by treatment with foliar-applied herbicide Pulsar after soil-applied herbicides Stomp aqua and Dual gold – 121.8 % and 120.9 % respectively, as well as by foliar treatment with herbicide tank-mixture Zencor + Targa super after soil-applied herbicides Stomp aqua and Dual gold 119.4 % and 119.0 % respectively.

Combining the soil-applied herbicides Dual gold and Stomp aqua with the foliar-applied herbicides Basagrain, Pulsar, Korum, Zencor and Maton and with the herbicide tank mixtures Zencor + Targa super and Maton + Targa super always results in a higher yield increase compared to the alone use of the respective herbicides and herbicide tank mixtures during the three years of the investigation.

CONCLUSIONS

Foliar-applied herbicides Pulsar and Korum destroy completely all annual and perennial broadleaved and graminaceous weeds and self-sown plants in winter forage pea crops.

Combinations of soil-applied herbicides Dual gold and Stomp aqua with foliar-applied herbicides Basagran, Pulsar, Korum, Zencor and Maton, as well as with herbicide tank mixtures Zencor + Targa super and Maton + Targa super exhibit an additive effect on herbicidal efficacy.

Treatment with foliar-applied herbicide Maton leads to high phytotoxicity in pea – rate 3 according to the scale of EWRS. Herbicide tank-mixture Maton + Targa super leads to even higher phytotoxicity in pea – rate 5 according to the scale of EWRS.

Foliar-applied herbicide Zencor and herbicide tank-mixture Zencor + Targa super also leads to phytotoxicity in pea – rate 2 according to the scale of EWRS.

The highest yields of winter forage pea seeds are obtained by treatment with foliar-applied herbicide Korum after soil-applied herbicides Stomp aqua and Dual gold.

High yields are obtained also by treatment with foliar-applied herbicide Pulsar after soil-applied herbicides Stomp aqua and Dual gold, as well as by foliar treatment with herbicide tank-mixture Zencor + Targa super after soil-applied herbicides Stomp aqua and Dual gold.

BIBLIOGRAPHY

AUSHKALNIS, A., DOVIDAITIS, V., 1997 – Effect of herbicides for weed control in pea's influence of herbicides on peas yields. Fundamental Library of the Latvia University of Agriculture, 68 - 71.

BLAŽINKOV, M., ŠNAJDAR, A., BARIĆ, K., SIKORA, S., RAJNOVIĆ, I., REDŽEPOVIĆ, S., 2015 – The Influence of Herbicides on Growth of Pea (*Pisum Sativum* L.) Nodulating Rhizobial Strains. Agronomy Journal, 76 (4-5): 183 - 192.

DANN, P., THOMAS, A., CUNNINGHAM R., MOORE. P., 1987 – Response by wheat, rape, and field peas to pre-sowing herbicides and deep tillage. Australian Journal of Experimental Agriculture, 27(3): 431 - 437.

DELCHEV, GR., 2018 – Chemical control of weeds and self-sown plants in eight field crops. Monograph, ISBN: 978-613-7-43367-6, LAP LAMBERT Academic Publishing, Saarbrücken, Germany, pp. 397.

DOVYDAITIS, V., AUSKALNIS, A., 1999 – Weed control in peas by means of harrowing and herbicides. Zemdirbyste, №65: 14-26.

DREW, E., GUPTA, V., ROGET, D., 2007 – Herbicide use, productivity and nitrogen fixation in field pea (*Pisum sativum*). Australian journal of agricultural research, 58 (12); 1204-1214.

KUKHARCHIK, V., KURILOVICH, V., RYBAK, A., 2013 – Efficiency of herbicides application in seed-growing sowings of peas. Zemledelie i zaŝita rastenij, №2: 56-58.

MAZAEVA, E., 2013 – Weedy coenosis regulation in green pea by the chemical method. Zemlârobstva ì ahova raslìn, №3: 56-59.

MIJATOVIC, M., MARINKOVIC, N., DJORDJEVIC, R., OBRADOVIC, A., 1994 – Efficacy of some herbicides used for weed control in pea crop. Pesticidi (Beograd), 9(3): 107-109.

MUNAKAMWE, Z., HILL G., MCKENZIE B. 2012 – Yield Response to Pea (*Pisum sativum* L.) Genotype, Population and Sowing Date. The Open Agriculture Journal, 6: 47-56.

SINGH, G. 2003 – Weed Management in Peas (*Pisum Sativum* L.) Agriculture Research, 24 (3): 217-222.

TIDEMANN, B., HALL, L., JOHNSON, E., BECKIE, H., SAPSFORD, K., RAATZ, L., 2014 – Efficacy of Fall- and Spring-Applied Pyroxasulfone For Herbicide-Resistant Weeds in Field Pea. Weed Technology, 28(2): 351-360.

WÁGNER, G., 2015 – Competition and Herbicide Effect Studies with Green Pea. Thesis of PhD Dissertation. Keszthely, Hungary.

YANCHEVA , S., DIMITROVA, M., CHERADZHIEVA. H., 2009 – In vitro test to determine the selectivity of soil herbicide Prometrin 500 SC to winter forage pea. Plant Sciences, 46: 251-254.

YANCHEVA , S., DIMITROVA, M., CHERADZHIEVA. H., 2013 – In vitro test to determine the selectivity of fodder peas to the soil herbicide Pelican 50 SC to winter forage pea. Plant Sciences, 50: 89-93.