INFLUENCE OF SOME TECHNOLOGICAL FACTORS ON WEED INFESTATION WITH COMMON THISTLE IN WINTER WHEAT CROP

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ABSTRACT

During the last years, weed infestation at high levels especially with common thistle (*Cirsium arvense* L. Scop), produces significant damages, so that, either the harvesting cannot be realized or the yield is compromised. At Secuieni Agricultural Research and Development Station (A.R.D.S.), as part of some experiments performed in winter wheat crop on a typical cambic chernozem (a humus content of 2.7%, a clay content of 34% and a pH of 5.6), a part of weed infestation caused with this species have been studied. It was established that the spreading of this weed was encouraged by the small grains monoculture and by the renunciation to crop rotations or their circumstantially using. Another technological factor which refers to soil tillages emphasized the fact that the soil superficial tillage encouraged the spreading of this weed (18 offshoots/m2), due to a superficial loosened soil layer (10–12 cm) and thistle roots fragmentation. The winter wheat sowing in due time and the achievement of some plant densities in which the nutrition space is entirely used, encouraged the winter wheat plant development in detriment of thistle appearance and growth which decreased from 18.5 to 2.5 offshoots/m2. The complete removing of thistle from winter wheat crop requires an integrated complex of measures, in which, the chemical control with herbicides plays the dominant role. In this sense, the choice of herbicide type is very important. The most reduced weed infestation (95–97% control) was achieved in variants with „tank-mix" Dicamba + 2,4 D (400 g/ha), Fluroxipyr + 2,4 D (530 g/ha), Bromoxinil + 2,4 D (560 g/ha) associated herbicides.

***Key words*:** common thistle, economical factors, soil tillages.

INTRODUCTION

The presence of weeds in agricultural crops is a reality in all plots in which the prevention and control methods have not been used (Anghel et al., 1972). Among the most greedy weeds, the special literature quotes: *Cirsium arvense, Elymus repens, Sinapis arvensis, Chenopodium album* (Staicu, 1969).

In the small cereal crops from South-western part of Germany, Mittnacht et al. (quoted by Vladutu et al., 1986) found out, in a period of 30 years, an important decreasing of weed species number from 124 to 61. This change was directly determined by the correct utilization of crop technologies.

During the last years, in Romania, because of weed infestation at high levels, especially with *Cirsium arvense* (L.) Scop. (thistle), significant damages have been produced, so that, either the harvesting could not been rea-lized or the yield was compromised.

The paper presents the quantification of the influence of some technological factors on weed infestation with thistle in wheat crop.

MATERIALS AND METHODS

During 1997-1999 at Secuieni Agricultural Research and Development Station, the research had in view the influence of some agrotechnical factors on thistle infestation degree in wheat crop. In order to elucidate the factors which influence the wheat infestation degree with thistle, numerical and gravimetrical observations and determinations before the herbicides application in spring, have been performed. The observations were performed both on the experimental field of the Crop Management and Mechanization Laboratory and in production plots, having in view the thistle infestation degree depending on:

– preceding crop – wheat, mustard, potato and maize;

– soil tillage – as part of stationary experiment placed on a typical cambic chernozem, with a humus content of 2.7%, a clay content of 34% and a pH of 5.6, in randomized blocks with four repetitions and with the following variants: V_1 – disking every year; V_2 – ploughing at 20 cm; V_3 – ploughing at 30 cm; V_4 – one year disking, one year ploughing at 30 cm; V_5 – two years disking, one year ploughing at 30 cm; V_6 – three years disking, one year ploughing at 30 cm;

– sowing time and density: the influence of two factors was tested:

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– A factor = sowing time: a_1 – 20th October, a_2 – 10th November;

– B factor = sowing density: b_1 – 250 germinable grains/m^2, b_2 – 400 germinable grains/m^2, b_3 – 550 germinable grains/m^2;

– herbicides utilization: the herbicides were postemergently applied in the wheat tilling stage when the thistle had 3–4 leaves.

During the vegetation period, observations at 15, 30 and 60 days after treatment were performed, in order to establish the treatment efficiency by the counting of dry offshoots. Before the wheat harvesting, the gravimetric determination was done.

The tested herbicides were:

– 2,4 D 330 g/l (SMDA) ______________________660 g/ha;
– Dicamba 75g/l + 2,4 D 325 g/l (Oltisan extra) ____400 g/ha;
– Fluroxipyr 80 g/l + 2,4 D 450 g/l (Lancet) _______530 g/ha;
– Bromoxinil 280 g/l + 2,4 D 280 g/l (Buctryl U) ___560 g/ha;
– Sulphomethmeton 75% (Granstar)_____________ 15 g/ha;
– Amidosulphurone 75% (Grodyl) ______________ 15 g/ha.

The experimental data were processed by the ANOVA.

RESULTS AND DISCUSSION

The influence of preceding crop

During 1997–1999, the dynamics of wheat crops weed infestation depending on different preceding crops (wheat, mustard, potato and maize), was tested. Analysing the obtained data, presented in table 1, it is evident that in the rotation of wheat with other crops 13 weed genera were determined, *Cirsium* genus having the biggest numerical and gravimetrical frequence. Thus, in wheat cropped after wheat, the biggest weed number/m^2, 171 respectively, from which 22 thistle offshoots, was registered.

Liubenov, in his research performed in 1982, indicated that one of the main causes of thistle infestation in small cereals is the monoculture during many years. By the wheat cultivation in rotation with mustard, potato and maize, a considerable decreasing of thistle offshoot number/m^2 is achieved. The most reduced thistle infestation (4 offshoots/m^2) was registered by the cultivation of wheat in rotation with mustard. When the wheat was sown after potato or maize the thistle offshoot number/m^2 was of ten. In the case of wheat sown in rotation with other crops, these changes are due to the agrotechnical measures applied to the crops which alternate between them.

The influence of soil tillages

The research performed by Ionescu-Sisesti (1955) and Sin and Ionita (1986) showed the role of soil tillages in the weed infestation reduction.

On the basis of the results obtained at Secuieni during 1997–1999, the contribution of soil tillage, by the sowing time and ploughing depth, to the reduction of thistle infestation degree can be pointed out. The determinations performed at those three times of soil tillages application demonstrated that the most reduced thistle infestation, 1.6 offshoots/m^2, was registered when the ploughing was made after the preceding crop harvesting and followed by diskings till wheat sowing. The thistle offshoot number/m^2 increased to nine in the variant ploughed in summer without disking. In

Table 1. Weed infestation degree in winter wheat after different preceding crops. Secuieni, 1997–1999

Genus and species	Number/m^2				Mean	Dry matter/m^2				Mean
	Wheat	Mustard	Potato	Maize		Wheat	Mustard	Potato	Maize	
Cardaria draba	1	4	2	3	2.5	0.9	1.6	1.8	2.0	1.6
Cirsium arvense	22	4	10	10	11.5	220.3	28.1	104.1	118.7	117.8
Convolvulus arvensis	15	9	7	10	10.3	11.3	7.5	4.5	6.3	7.4
Fumaria officinalis	12	5	4	3	6.0	4.9	2.8	1.8	2.6	3.0
Galeopsis tetrahit	17	4	2	7	7.5	27.5	4.5	2.5	2.9	9.4
Galium aparine	15	7	9	5	9.0	20.7	9.8	9.5	2.9	14.1
Matricaria inodora	10	-	-	-	2.5	22.7	-	-	-	5.2
Polygonum convolvulus	29	8	5	7	12.3	100.2	7.1	3.6	6.9	10.1
Sinapis arvensis	10	3	5	4	5.5	17.6	6.1	7.9	3.5	29.4
Sonchus arvensis	5	-	1	10	4.0	49.7	-	2.5	18.2	9.6
Stellaria media	20	7	10	11	12.3	9.5	13.9	13.8	19.1	24.1
Thlaspi arvense	10	2	2		3.5	3.2	1.7	1.9		3.3

the variant ploughed in autumn before sowing, the infestation degree registered the highest value, of 10.7 offshoots/m^2 (Figure 1).

As regards the soil tillage depth, the data obtained showed that the ploughing depth difference from 20 cm and 30 cm contributed to the diminution of weed total number and of thistle infestation.

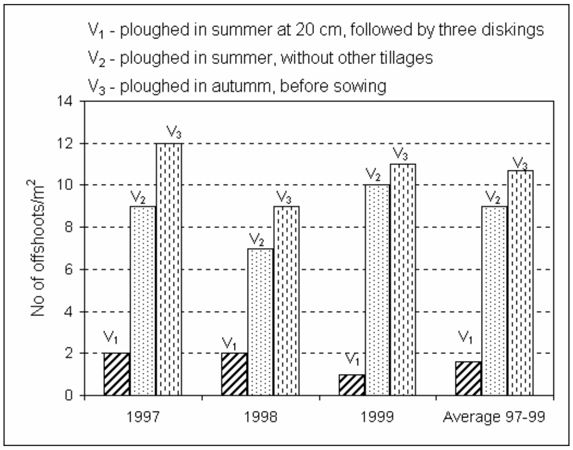

Figure 1. Influence of soil tillage time on thistle offshoot number

Thus, in the variant in which the ploughing was made at 20 cm depth, the thistle infestation was of 4 offshoots/m^2, while in the variant ploughed at 30 cm, was of 2 offshoots/m^2. Soil superficial tillage, year by year and following the thistle roots fragmentation, encourages the thistle infestation, in a number of 18 offshoot/m^2 in the variant disked every year, and of 11 offshoots/m^2 in the variant disked three years followed by ploughing at 30 cm (Table 2).

Influence of sowing time and density

From the average observations presented in table 3, it is evident that the sowing technology by crop density and sowing time had decisive effects on weed infestation degree.

Thus, in the case of late sowing time (10th November), the total wheat weed infestation increased from 108 to 129 weeds/m^2 and the thistle offshoot number increased by 2.2 times.

This thing can be explained by the weak covering of field with wheat plants because of small spike number/surface unit. As follows of low competition of wheat plants and reduced growing vigour, the thistle had a high sprouting degree because of improved light, water and mineral nutrition conditions (Table 4).

The sowing in due time, in Moldavia (1st-20th October), ensured a wheat density at which the nutrition and light space was entirely utilized by wheat plants, contributing to the weed infestation diminution.

It is also evident an obvious decreasing of thistle offshoot number from 18.5 to 2.5/m^2, in the sowing variants with 550 germinable grains/m^2.

Concomitantly with the increasing of sowing density, the field covering degree increased, too. As follows, the growth conditions of thistle and of other weeds worsened.

Table 2. Influence of soil tillage system on wheat infestation (determinations in spring, stationary experiment)

Variants	1997		1998		1999		Average (1997–1999)	
	Total weed no/m^2	*Cirsium* no/m^2	Total weeds no/m^2	*Cirsium* no/m^2	Total weeds no/m^2	*Cirsium* no/m^2	Total weed no/m^2	*Cirsium* no/m^2
1. Disking every year	420	18	399	16	375	21	398	18.3
2. Ploughing at 20 cm	125	6	144	2	170	4	146	4.0
3. Ploughing at 30 cm	110	1	165	3	158	2	144	2.0
4. One year disking, one year ploughing at 30 cm	206	5	227	7	199	4	211	5.3
5. Two years disking, one year ploughing at 30 cm	224	8	293	6	287	6	268	7.3
6. There years disking, one year ploughing at 30 cm	317	11	375	10	333	14	342	11.7
LSD 5%							4.9	2.7

Table 3. Influence of sowing time and density on weed infestation degree in wheat crop (1997–1999)

Time (A)	First time						Second time						B average		
Density (germinable grains/m^2 (B)	Weeds/m^2						Weeds/m^2								
	total	diff.	sign.	*Cirsium*	diff.	sign.	total	diff.	sign.	*Cirsium*	diff.	sign.	*Cirsium*	diff.	sign.
250	186	control	–	13	control	–	220	control	–	24	control	–	18,5	control	–
400	95	–91	ooo	3	–10	°°°	110	–110	°°°	6	–18	°°°	4,5	–14	°°°
550	44	–142		1	–12	°°°	58	–162	°°°	4	–20	°°°	2,5	–16	°°°
A average	108			5			129			11					
Dif.		control			control			21			6				
Signif.			–			–			**			***			

LSD 5%: (A) 4.1 1.9
(B) 10.8 3.6
(A x B) 13.0 5.1
(B x A) 15.3 5.9

Table 4 . Influence of sowing time and density on wheat infestation degree (1997-1999)

A factor (Sowing time)	B factor (Densities)	Weed infestation degree at the factors interaction	Average number of spikes/m^2
A_1. 20th October	b_1 - 250	186 (13 *Cirsium*)	490
	b_2 - 400	95(3)	510
	b_3 - 550	44(1)	564
A_2. 10th November	b_1 - 250	220(24)	279
	b_2 - 400	110(10)	392
	b_3 - 550	58(4)	505

Influence of herbicides

The results obtained during 1997–1999, presented in table 5, emphasize a diminution of thistle infestation till 97%, in treated variants as compared with the untreated control.

During the three years of experimentation, the best results of control (95–97%) were obtained in variants in which the „tank-mix" Dicamba + 2,4 D – 400 g/ha; Fluroxipyr + 2,4 D - 530 g/ha; Bromoxinil + 2,4 D – 560 g/ha associated herbicides, were used.

In the variants in which the herbicides belonging to sulphorilureic (sulphomethon) group were only applied, the control percentage was lower (73%) and in variants in which only amidosulphurone was applied (15 g/ha), the efficiency in thistle control was absent. These results emphasize the importance of herbicides choosing as part of control strategies elaboration for certain weed species.

Table 5 . Efficiency of herbicides in thistle control from wheat crop (1997–1999)

Herbicides	Dose (g active ingredient/ha)	Thistle, kg active ingredient/ha			Control (%)	Wheat yield	
		Aerial mass	Underground mass	Total		kg/ha	%
Untreated	-	848	1286	2134	-	1910	100
2,4 D	660	88	202	290	87	5075	265
Dicamba/2.4D	400	12	77	89	96	5300	277
Fluroxipyr/2.4D	530	16	65	81	97	5380	282
Bromoxinil/2.4D	560	22	79	101	95	5270	276
Sulphomethmeton	15	340	795	1135	47	3450	181
Amidosulphurone	15	735	1270	2005	6	2110	110

LSD: 5% = 790 kg/ha
1% = 1084 kg/ha
0.1% = 1476 kg/ha

CONCLUSIONS

The main factor which contributed to the thistle infestation of small grains was rotation of cereals and especially monoculture. The introduction, as part of rotation, of some crops which compete thistle as regards the grown conditions (mustard) as well as of some row-crops (potato, maize) contributed to the diminution of thistle infestation degree from 22 to 4, respectively 10 offshoots/m^2.

The soil tillages influenced the thistle infestation degree, in the sense that the most reduced infestation (2 offshoots/m^2) was registered in the variants ploughed in summer at 20 cm followed by three diskings. The soil superficial tillage encouraged the spreading of this weed (18 offshoots/m^2), because of a superficial loosened soil layer (10–12 cm) and of the thistle roots fragmentation (10–12 cm layer).

The wheat sowing in due time and the achievement of some plant densities with the nutrition space entirely utilized, encourage the wheat plants development in detriment of thistle appearance and growth. In this case, the thistle number decreased from 18.5 to 2.5 offshoots/m^2.

The most reduced thistle infestation (95–97%) was achieved in the variants in which the „tank-mix”, Dicamba + 2,4 D (400g/ha); Fluroxipyr + 2,4 D (530 g/ha); Bromoxinil + 2,4 D (560 g/ha) associated herbicides, were used.

REFERENCES

Anghel, Gh., Chirilã, C., Ciocârlan, V., Ulinici, A., 1972. Buruienile din culturile agricole ºi combaterea lor. Edit. Ceres, Bucureºti: 1–80.

Ionescu ªiºeºti, Gh., 1955. Buruienile ºi combaterea lor. Edit. Agro-Silvicã de Stat, Bucureºti: 74–77.

Liubenov, I.G., 1982. Problema buruienilor perene cu rizomi ºi cu lãstãrire din rãdãcini, în Bulgaria ºi cãile de rezolvare a ei. Combaterea chimicã a buruienilor perene din culturile de câmp, viþã de vie ºi pajiºti. Bucureºti: 17–23.

Sin, Gh., Ioniþã, St., 1986. Influenþa unor factori agrotehnici asupra îmburuienãrii culturilor de grâu ºi porumb. Folosirea raþionalã a erbicidelor, Constanþa: 23-30.

Staicu, I., 1969. Agrotehnica. Edit. Agro-Silvicã, Bucureºti: 368–376.

Vlãduþu, I., Fritea, T., ªarpe, N., 1986. Efectul aplicãrii erbicidelor în cadrul unui asolament specific podzolului argilo-iluvial din nord-vestul þãrii. Folosirea raþionalã a erbicidelor, Constanþa: 46–59.

Table 1. Reproduction ability of the *E. integriceps* recent generations, as compared with multiannual average (1970-2000) and with the specific years: favourable (1986) and unfavourable (1989).

Natural generation of *E. integriceps*	Prolificacy (egg/female)		
	under field conditions	under controlled conditions	
		average	maximum/female
1970-2000	40.2	57.9	311
1986	56.3	71.3	298
1989	18.8	27.1	87
1996	47.1	69.9	302
1997	46.6	68.6	197
1998	37.5	53.8	209
1999	38.8	54.5	219
2000	39.3	55.7	208

Table 2. Prolificacy level of some *E. integriceps* populations (fertile females), from generations with different fat body levels, collected from the field, at the beginning of migration and studied under controlled conditions.

Fat body	Generation	Prolificacy (egg/female)	
		average	maximum
23.4	1989-1990	32.1	97
22.5	1972-1973	33.4	127
26.5	1971-1972	46.4	148
27.9	1977-1978	67.5	186
28.0	1984-1985	83.6	210
29.7	1985-1986	95.3	234
29.8	1994-1995	104.7	246

Table 3. Level and stages of fat body diminution at *E. integriceps* (multigeneration average).

Stages	Fat body level		Diminution	
	limits	average	limits	average
Diapause beginning	33.03-37.58	35.69	0	0

End of diapause	21.97-27.64	25.43	24.57-36.33	27.39
End of oviposition	8.12-10.39	8.78	66.50-78.69	74.43

Table 4. Mortality registered at the *Eurygaster integriceps* populations, during diapause in different generations, from Romanian area

E. integriceps natural population	Mortality (%)	
	Limits in counties	Total area (mean)
2000-2001	4.6-35.7	8.7
1995-1996	3.7-36.4	10.2
2001-2002	5.1-32.3	12.7
1985-1988	3.8-41.2	14.8
1999-2000	4.8-97.6	24.5
1973-1974	11.6-85.0	39.5
1988-1989	17.5-68.4	48.2

Table 5. Fat body value at *Eurygaster integriceps* populations, established on female groups, distributed in weight classes, at the beginning of diapause (multigeneration average).

Weight (mg)	% from the total of population		Fat body (%)	
	limits	average	limits	average
below 0.110	3.7-7.7	5.6	26.2-26.6	26.4
0.111-0.118	7.6-23.1	13.3	26.5-28.8	28.7
0.119-0.126	15.9-24.7	19.7	32.8-33.5	33.6
0.127-0.134	32.5-34.8	33.7	34.9-36.4	35.4
over 0.145	22.4-30.8	28.6	35.7-39.8	38.7

Table 6. Fat body value at *Eurygaster integriceps* populations, established on male groups, distributed in weight classes, at the beginning of diapause (multigeneration average).

Weight (mg)	% from the total of population		Fat body (%)	
	limits	average	limits	average
below 0.105	7.0-19.7	12.3	25.3-26.7	26.2
0.106-0.113	16.8-19.9	17.3	27.2-28.5	27.7
0.114-0.121	20.3-29.5	23.7	29.4-33.8	31.5
0.122-0.129	19.2-32.7	28.5	31.2-35.5	32.6
over 0.130	15.5-23.9	19.4	31.4-36.6	33.8

Table 7. Mortality (%) registered at *Eurygaster integriceps* female populations, depending on the fat body (multigeneration average).

Fat body (%)	Mortality (%)			
	During August-October		During November-March	
	limits	average	limits	average
26.4	17-22	20.4	59-64	61.3
28.7	13-15	12.9	43-54	47.6
33.6	9-17	12.5	41-52	46.2
35.4	4-11	6.6	29-34	33.6
38.7	4-7	5.8	26-35	30.9

Table 8. Mortality (%) registered at *Eurygaster integriceps* male populations, depending on the fat body (multigeneration average).

Fat body (%)	Mortality (%)			
	During August-October		During November-March	
	limits	average	limits	average
26.2	22-31	22.6	62-71	67.1
27.7	11-24	20.4	53-62	57.4
31.5	12-19	14.3	39-47	44.0
32.6	9-18	12.7	30-44	37.6
33.8	5-14	9.1	24-45	32.3

Table 9. Sterility and prolificacy registered at the *Eurygaster integriceps* populations, depending on the fat body (multigeneration average).

Fat body (%)	Females sterility (%)		Mean prolificacy (egg/female)		
	limits	aver-age	limits	aver-age	maxi-mum
26.4	100	100	0	0	0
28.7	60-72	63.5	4.1-6.6	5.4	42
33.6	54-63	57.3	16.2-22.8	19.5	78
35.4	35-44	39.1	26.4-33.1	30.3	135
38.7	25-32	29.8	38.9-51.7	45.8	194

Table 10. Multiplication index at the *Eurygaster integriceps* populations, depending on the fat body (multigeneration average).

Fat body (%)	Multiplication index (egg/female)	
	limits	average
26.4	0	0
28.7	0.37–2.47	1.54
33.6	4.54–9.62	6.95
35.4	28.57–40.18	35.22
38.7	49.38–64.83	56.47