TECHNOLOGICAL ASPECTS OF PRODUCING BIRD'S FOOT TREFOIL (*Lotus corniculatus* L.) SEEDS

TEODOR CRISTEA, AUREL LĂZUREANU, GHEORGHE CÂRCIU, SIMION ALDA, ALIN DOBREI

Banat's University of Agricultural Sciences and Veterinary Medicine Timişoara
Faculty of Horticulture and Silviculture
Department of Silviculture
Calea Aradului, nr. 119, Timişoara.
cristeateodor@yahoo.com

ABSTRACT
The species *Lotus corniculatus* L., commonly named bird's-foot trefoil, is a very important perennial legume, widely spread in both Romania and abroad, being the basis for meadow and hay-making fields mixtures in the mountain and plain areas. Ensuring high-quality seeds in sufficient amounts from the cultivars with high biological value implies the development of the seed production activity and the maintenance of biological value of existing cultivars. In this paper, the authors aim at pointing out the effect of some insecticides on bird's-foot trefoil thrips (*Odontothrips loti* H.) as well as the impact of different cut methods on seed yield in bird's-foot trefoil. All insecticides used in the control of bird's-foot trefoil thrips increased mean seed production per ha compared to the control: among them, Sinoratox 1.5 l/ha proved to be the best. As for the bi-factorial trial in which we tested different cutting methods in combination with different insecticides to control bird's-foot trefoil thrips, the best proved to be the cutting method in which we used the desiccant Reglone 1 l/ha (163.66 kg/ha).

Keywords: *Lotus corniculatus* L., *Odontothrips loti* H., control, cutting methods, seed yield

INTRODUCTION

Bird's-foot trefoil is widely spread in Romania: it grows on almost all ecological areas of permanent grasslands, from the Black Sea littoral to the Alpine area (VARGA, 1998).
Though nowadays it covers smaller pure cultivation area than alfalfa (*Medicago sativa* L.) and red clover (*Trifolium pratense* L.), there are no sufficient amounts of seeds. These seeds are sometimes indispensable in complex seed mixtures destined to temporary meadows and to improve permanent meadows in the hill and mountain areas. From this point of view, the widest areas are in Transylvania, Moldavia and northern Oltenia (BĂRBULESCU, 1991).
Extending bird's-foot trefoil into cultivation on wider areas in Romania is hindered by the difficulty of producing seeds compared to alfalfa and to red clover. Seed yields are generally low (100-150 kg/ha) not because of the biological potential of the species, but because of the high degree of dehiscence of the pods during seed maturation and to the lack of a national, scientifically organised system of seed production (DRAGOMIR, 2005).
In this paper, the authors point out the effect of some technological elements on seed production in this species with a view to increase seed production both quantitatively and qualitatively.
We did this by pointing out the effect of some insecticides used in the control of bird's-foot trefoil thrips (*Odontothrips loti* H.) and by establishing the optimal cutting method.
Literature shows that, besides pod dehiscence, another cause that decreases seed production in this crop species is the attack by bird's-foot trefoil thrips (*Odontothrips loti* H.) on floral organs, attack resulting in flower abortion. Our research was meant to identify the most efficient insecticide in the control of this pest.

As for the cutting method, the final goal of this research was to find the best cut method that increases seed production both quantitatively and qualitatively taking into account that upon maturity bird's-foot trefoil has a high degree of dehiscence resulting in a quick, considerable loss of seeds.

MATERIAL AND METHOD

The trial was set at the Grassland Research-Development Station in Timisoara, on the plots destined to research, on a brown eumesobasic soil with low acidic reaction pH = 5.6 and very good phosphorus supply (P = 66.7), medium potassium supply (K = 158 ppm), very low humus content (H = 1.66%) and very low nitrogen supply (I_N = 1.57).
In this paper, we present only mean results for the three trial years.
The biological material we used was the *Livada* bird's-foot trefoil cultivar.
The trial that tried to point out the most efficient insecticides in the control of bird's-foot trefoil thrips was of the mono-factorial type, set after the randomised block method with 3 replicates and 6 variants (18 plots). The total area was 252 m^2, with some of the plots measuring 14 m^2. After the setting of the trial and after the maintenance works and the first mow, we applied the treatment against bird's-foot trefoil thrips. The application of the insecticides meant to establish the best chemical control of the pest done upon floral bud inception (July 1-10). In order to establish the control degree, we counted the insects with a metrical frame before and after applying the insecticide. The results were processed statistically by the variance analysis. Harvesting was done manually and data were processed statistically and interpreted with the variance analysis method.
The trial variants were: V_1 – Not treated (control); V_2 – Decis 0.3 l/ha; V_3 – Fastac 0.3 l/ha; V_4 – Fury 0.3 l/ha; V_5 – Sinoratox 1.5 l/ha; V_6 – Hostaquick 0.3 l/ha.
The trial that was meant to establish the best bird's-foot trefoil seed cut method was a bi-factorial one, set in the field after the subdivided plot method, on an area of 9,000 m^2.
The trial factors were: factor A – cut method: a_1 – no turning the swath; a_2 – turning the swath; a_3 – desiccation with Reglone 1 l/ha; factor B – insecticide: b_1 – not treated (control); b_2 – Sinoratox 1.5 l/ha; b_3 – Fastac 0.3 l/ha; b_4 – Fury 0.3 l/ha.
The trial was organised in 3 replicates, each replicate having 3 graduations of the factor A – cut methods, each of the graduations having 4 variants of the factor B – protection substances. Each variant corresponded to a plot of 250 m^2 (5 m x 50 m), the size chosen corresponding to the size of the harvesting equipment (the entire trial was carried out in production conditions).
After setting the trial and after applying the first maintenance works and the first mow, we applied the treatments against bird's-foot trefoil thrips – using the insecticides under study – when the crop was in the stage of floral bud inception.
Upon pod maturing (50-60% of the pods are brown), we harvested as follows:
- In the variant a_1 – no turning the swath, the plants were cut with a wind rover early in the morning to avoid seed shedding after cutting. After 3 days of drying, the plants were threshed directly from the field with a Fortschritt E-514 combine.
- In the variant a_2 – turning the swath, the plants were cut with a wind rover early in the morning, the second day they were turned with a mechanical rake, and the third day they were threshed with a Fortschritt E-514 combine.
- In the variant a_3 – desiccation with Reglone (1 l/ha), we applied the desiccant Reglone manually with a Vermorel apparatus, and the third day we threshed directly from the field with a Fortschritt E-514 combine.

In all three variants, seed recovery was done in the combine bunker, from the mixing spindle. The seeds obtained after threshing were sun-dried until their moisture content was 10%, after which they were selected with a Petkus selector. Data were processed statistically and interpreted by the variance analysis method.

RESULTS

Literature supplies little information on the efficiency of the different cutting methods and for pest control in bird's-foot trefoil seeds, they are equally scarce.

Mean results concerning the impact of the protection substance on bird's-foot trefoil seed yield during the research interval are shown in *Table 1*.

Table 1. Impact of the plant protection substance on bird's-foot trefoil seed yield

Variant	Yield (kg/ha)	Difference (kg/ha)	Relative yield (%)	Significance
V_1 – (control) Not treated	323.33	-	100.00	Control
V_2 – Decis 0.3 l/ha	484.66	161.67	150.00	XXX
V_3 – Fastac 0.3 l/ha	524.33	201.00	162.16	XXX
V_4 – Fury 0.3 l/ha	396.99	73.66	122.78	XXX
V_5 – Sinoratox 1.5 l/ha	567.99	244.66	175.67	XXX
V_6 – Hostaquick 0.3 l/ha	456.66	133.33	141.23	XXX

DL 5% = 3.26 kg/ha; DL 1% = 4.64 kg/ha; DL 0.1% = 6.72 kg/ha

In the variants in which we applied the plant protection substances under study we obtained very significant differences in yield compared to the control (not treated). The best result was achieved with the variant V_5 – Sinoratox 1.5 l/ha in which the difference in yield was of 244.66 kg/ha, followed by the variant V_3 – Fastac 0.3 l/ha with a difference in yield of 201 kg/ha. On the contrary, in the variant V_4 – Fury 0.3 l/ha, the difference in yield was only 73.66 kg/ha compared to the control (not treated).

Table 2 shows the impact of the chemical treatments on the bird's-foot trefoil thrips per m^2.

Table 2. Impact of the chemical treatments on the bird's-foot trefoil thrips/m^2

Variant	Thrips/m^2 before treatment	Thrips control/m^2	Control rate (%)	Difference	Significance
V_1 – (control) Not treated	37.66	0.00	0.00	0.00	Control
V_2 – Decis 0.3 l/ha	37.33	32.33	86.60	32.33	XXX
V_3 – Fastac 0.3 l/ha	33.33	29.99	89.97	29.99	XXX
V_4 – Fury 0.3 l/ha	35.66	25.99	72.88	25.99	XXX
V_5 – Sinoratox 1.5 l/ha	35.33	33.66	95.27	33.66	XXX
V_6 – Hostaquick 0.3 l/ha	35.66	27.99	78.49	27.99	XXX

DL 5% = 1.53 thrips/m^2; DL 1% = 2.17 thrips/m^2; DL 0.1% = 3.15 thrips/m^2

Analysing *Table 2*, we can see that in all variants in which we used chemical treatments the differences compared to the control are very significant. The best result was achieved with the variant V_5 – Sinoratox 1.5 l/ha with a control percentage of 95.27%, followed by the variants V_3 – Fastac 0.3 l/ha with 89.97% and V_2 – Decis 0.3 l/ha with 86.60%. On the contrary, the variant V_4 – Fury 0.3 l/ha recorded a control percentage of only 72.88%.

The trial concerning the application of the different cutting methods in parallel with the application of different insecticides aimed at finding the best harvesting technology and the best insecticide in the control of bird's-foot trefoil thrips.

The impact of factor A – cutting methods – on bird's-foot trefoil seed yield is shown in *Table 3*.

Table 3. Impact of the cutting method on bird's-foot trefoil seed yield

Cut method	Yield (kg/ha)	Difference (kg/ha)	Relative yield (%)	Significance
a_1 – Not turning the swath	145.75	-	100.00	Mt
a_2 – Turning the swath	123.75	-22.00	84.90	000
a_3 – Desiccation Reglone 1 l/ha	163.66	17.91	112.28	XXX

DL 5% = 0.91 kg/ha; DL 1% = 1.51 kg/ha; DL 0.1% = 2.83 kg/ha

Mean results show that the best cutting method is the one in which we used desiccation with Reglone 1 l/ha, followed by the not turning the swath method.

Table 4 shows mean results from the point of view of the impact of the factor B – protection substances – on bird's-foot trefoil seed yield.

Table 4. Impact of the protection substance on bird's-foot trefoil seed yield

Variant	Yield (kg/ha)	Difference (kg/ha)	Relative yield %	Significance
b_1 – Not treated (control)	117.99	-	100.00	Mt
b_2 – Sinoratox 1.5 l/ha	167.44	49.44	141.91	XXX
b_3 – Fastac 0.3 l/ha	152.44	34.44	129.19	XXX
b_4 – Fury 0.3 l/ha	139.66	21.66	118.36	XXX

DL 5% = 1.31 kg/ha; DL 1% = 1.80 kg/ha; DL 0.1% = 2.45 kg/ha

In the case of the protection substances also there are very significant differences between trial variants and the control variant: the best variant proved to be b_2 – Sinoratox 1.5 l/ha, followed by the variants b_3 – Fastac 0.3 l/ha and b_4 – Fury 0.3 l/ha.

The interaction between factor A – cutting methods for the same graduation of the factor B – protection substance – is shown in *Table 5*. Mean results over the 3 trial years allowed us to draw the conclusion that all the combinations between variant a_3 – desiccation with Reglone 1 l/ha – and the variants b – insecticides – result in very significant increases in yield: to note the combination a_3b_2 (desiccation with Reglone – Sinoratox 1.5 l/ha) with an increase in yield of 30.66 kg/ha.

Table 5. The interaction between factor A – cut methods for the same graduation of the factor B – protection substance

Cut method	Protection substance	Yield (kg/ha)	Variant	Difference (kg/ha)	Relative yield %	Significance
a_1 – Not turning the swath	b_1 – Not treated	114.66	-	-	100.00	$Control_1$
	b_2 – Sinoratox	167.00	-	-	100.00	$Control_2$
	b_3 – Fastac	157.66	-	-	100.00	$Control_3$
	b_4 – Fury	143.66	-	-	100.00	$Control_4$
a_2 – Turning the swath	b_1 – Not treated	103.66	a_2b_1-a_1b_1	-11.00	90.40	000
	b_2 – Sinoratox	137.66	a_2b_2-a_1b_2	-29.33	82.43	000
	b_3 – Fastac	133.32	a_2b_3-a_1b_3	-24.34	84.56	000
	b_4 – Fury	120.33	a_2b_4-a_1b_4	-23.33	83.76	000
a_3 – Desiccation with Reglone 1 l/ha	b_1 – Not treated	135.66	a_3b_1-a_1b_1	20.99	118.31	XXX
	b_2 – Sinoratox	197.66	a_3b_2-a_1b_2	30.66	118.35	XXX
	b_3 – Fastac	166.33	a_3b_3-a_1b_3	8.66	105.49	XXX
	b_4 – Fury	154.99	a_3b_4-a_1b_4	11.33	107.88	XXX

DL 5% = 2.16 kg/ha; DL 1% = 3.05 kg/ha; DL 0.1% = 4.40 kg/ha

The comparison between the factor B – protection substances – for the same graduation of the factor A – cut methods – is shown in *Table 6.* Analysing data shown in *Table 6,* we can see very significant differences in yield in the combinations of cutting methods and plant protection substances.

Table 6. Comparison between the factor B – plant protection substances – for the same graduation of the factor A – cutting methods

Cut method	Protection substance	Yield (kg/ha)	Variant	Difference (kg/ha)	Relative yield (%)	Significance
a_1 – Not turning the swath	b_1 – Not treated	114.66	-	-	100.00	Control
	b_2 – Sinoratox	167.00	a_1b_2-a_1b_1	52.33	145.64	XXX
	b_3 – Fastac	157.66	a_1b_3-a_1b_1	43.00	137.50	XXX
	b_4 – Fury	143.66	a_1b_4-a_1b_1	28.99	125.29	XXX
a_2 – Turning the swath	b_1 – Not treated	103.66	-	-	100.00	Control
	b_2 – Sinoratox	137.66	a_2b_2-a_2b_1	34.00	132.79	XXX
	b_3 – Fastac	133.32	a_2b_3-a_2b_1	29.66	128.61	XXX
	b_4 – Fury	120.33	a_2b_4-a_2b_1	16.66	116.08	XXX
a_3 –Desiccation with Reglone 1 l/ha	b_1 – Not treated	135.66	-	-	100.00	Control
	b_2 – Sinoratox	197.66	a_3b_2-a_3b_1	62.00	145.70	XXX
	b_3 – Fastac	166.33	a_3b_3-a_3b_1	30.67	122.60	XXX
	b_4 – Fury	154.99	a_3b_4-a_3b_1	19.33	114.24	XXX

DL 5% = 2.27 kg/ha; DL 1% = 3.11 kg/ha; DL 0.1% = 4.24 kg/ha

The highest difference in yield compared to the control was in the combination a_3b_2 (desiccation with Reglone and Sinoratox 1.5 l/ha) 62 kg/ha, followed by the combination a_1b_2 (not turning the swath and Sinoratox 1.5 l/ha), 52.33 kg/ha and by the combination a_1b_3 (not turning the swath and Fastac 1.3 l/ha), 43 kg/ha.

CONCLUSIONS

Results of research concerning the production of bird's-foot trefoil (*Lotus corniculatus* L.) seed allow us to draw the following conclusions of particular practical importance:

- All studied insecticides used to control bird's-foot trefoil thrips (*Odontothrips loti* H.) resulted in an increase of the mean production of seed per ha compared to the control (not treated), particularly the insecticide Sinoratox 1.5 l/ha.
- As far as pest control is concerned, the best results were again after application of the insecticide Sinoratox 1.5 l/ha.
- As for the bi-factorial trial in which we tested different cut methods in combination with different chemicals used in the control of bird's-foot trefoil thrips, the best cutting method was the one in which we used the desiccant Reglone 1 l/ha (163.66 kg/ha).
- All the substances used to control bird's-foot trefoil thrips proved efficient, particularly the insecticide Sinoratox 1.5 l/ha which resulted in the highest increases in yield compared to the control (41.91 %).
- The different levels of seed production in the two types of trial, i.e. between 323.33 kg/ha and 567.99 kg/ha in the crop harvested manually and between 114.66 kg/ha and 197.66 kg/ha in the crop harvested mechanically show that it is very difficult to reach the genetic potential of seed production in bird's-foot trefoil.

REFERENCES

BĂRBULESCU C. et al. (1991): Cultura pajiştilor şi a plantelor furajere, Ed. Didactică şi Pedagogică, Bucureşti.

DRAGOMIR N. (2005): Pajişti şi plante furajere, Tehnologii de cultivare, Ed. Eurobit, Timişoara.

VARGA P. et al. (1998): Ameliorarea plantelor furajere şi producerea seminţelor, Ed. Lumina.