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Seed Yield of Birdsfoot Trefoil Grown in Mixture with Meadow Grasses

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Abstract

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In the 2004-2006 periods, the possibility for seed production of the birdsfoot trefoil candidate variety Troyan, grown in binary mixtures with the following meadow grasses: meadow and red fescue, Kentucky bluegrass, orchardgrass, perennial ryegrass and oatgrass, was studied in the experimental field of IMSA, Troyan.

It was found that during the whole study period, all tested mixtures were characterized by a high and stable seed yield of birdsfoot trefoil. The highest seed yield was obtained from the mixed stands of birdsfoot trefoil with red fescue and Kentucky bluegrass and on average for the study period; the increase over the control was 79.7% and 77.0%, which had very good statistical significance.

Birdsfoot trefoil mixed with red fescue had the highest values of pod number per raceme and raceme number per stem and seeds per pod.

Key words: birdsfoot trefoil, seed productivity, mixtures with meadow grasses

Introduction

Successful sale of birdsfoot trefoil varieties on the market requires that they possess high potential of seed yield (Beuselinck, 1997; McGraw et al, 1986). Seed production depends to a great extent on adherence to some cultural measures. One of them is the sowing method.

Besides the traditional wide-row method of obtaining seeds from pure stands of birdsfoot trefoil (Stoeva, 2006), its growing in binary mixtures with meadow grasses can be successfully applied (Zemenchik et al., 2002; Robinson and Winch, 1986; McGraw et al, 1986). The species of winter type of development are suitable, such as: Kentucky bluegrass, meadow and red fescue, orchardgrass.

According to Zemenchik et al. (2001), the mixed growing decreases pod dehiscence due to leaf transpiration around the ripe pods, which results in increased relative air humidity, the semi-erect stems are

mechanically supported, the contact of the pods with soil surface is avoided and so the seed loss is smaller.

The objective of the study was to investigate the seed productivity of birdsfoot trefoil in its mixed growing with meadow and red fescue, Kentucky bluegrass, orchardgrass, perennial ryegrass and oatgrass.

Material and Methods

The trial was carried out in the experimental field of IMSA, Troyan on light grey pseudopodzolic soil in the 2004-2006 periods. The seed productivity of the birdsfoot trefoil candidate variety Troyan grown in binary mixtures with the following meadow grasses: meadow and red fescue (Albena and lokal population Troyan), Kentucky bluegrass (Bristol), orchardgrass (Dabrava), perennial ryegrass (Pleven population) and oat grass (Ambrosia), was studied. The experiment was laid out by the block method with 4 replications and harvest plot size of 5 m^2. The sowing was conducted by hand, broadcast, at 50:50 ratio of birdsfoot trefoil: grass. Phosphorus and potassium were applied as reserve fertilizing at a dose of 32 kg da^{-1} active ingredient and nitrogen every year at a dose of 6 kg da^{-1}. The sowing rate for birdsfoot trefoil in the pure stand was 1.2 kg da^{-1} and for the grasses 50% of the optimum one when growing them alone.

The first cut of the sward was harvested for forage and the second one for seeds. When 65-70% of the pods became brown and there were individual cases of dehiscence of the birdsfoot trefoil seeds, samples were taken from 0.50 m^2 to perform the structural analysis of seed yield for each variant from each replication. The following characteristics were recorded: raceme number per plant; flower number per raceme; seed number per pod; 1000-seed weight. Sward density was also observed - number of stems and branches per m^2 before harvesting of seed cut; plant height (cm) – with 40 plants per replication measured from soil surface to the apex of the tallest stem; seed yield in kg. da^{-1}.

Mathematical processing of data on seed yield was performed by the method of variance analysis (Shanin, 1977).

Results and Discussion

There was considerably more favourable rainfall distribution (Figure.1) in July and August 2004 (64.1 and 72.8 l/m^2), which had the greater share of the rainfall during the growing season. The relative air humidity was also higher (82%), which did not allow the pods to dehisce. More frequent rains and greater rainfall amount in the time of flowering (July and August) in 2005 (253.0 and 223.9 mm) hindered the pollinator activity. In 2006, considerable rainfall amount was measured in June (191.5 mm) and July (121.8 mm). The data analysis showed that the birdsfoot trefoil density (Figure 2) in its mixed swards depended on biological characteristics and interrelations in them. In the mixtures of birdsfoot trefoil with red and meadow fescue (var. 2 and 3), the number of stems and branches/m^2 in all three years and on average for the period was the greatest (396.6 and 377.8), as compared to that in the other mixtures. That was due to the different rate of growth and development of the two crops and to their good mutual tolerance, which confirmed the statements of Laskey and Wakefield (1978). The competitiveness of perennial ryegrass (var. 6) and oatgrass (var. 7) towards birsdfoot trefoil was confirmed by the decreased num-

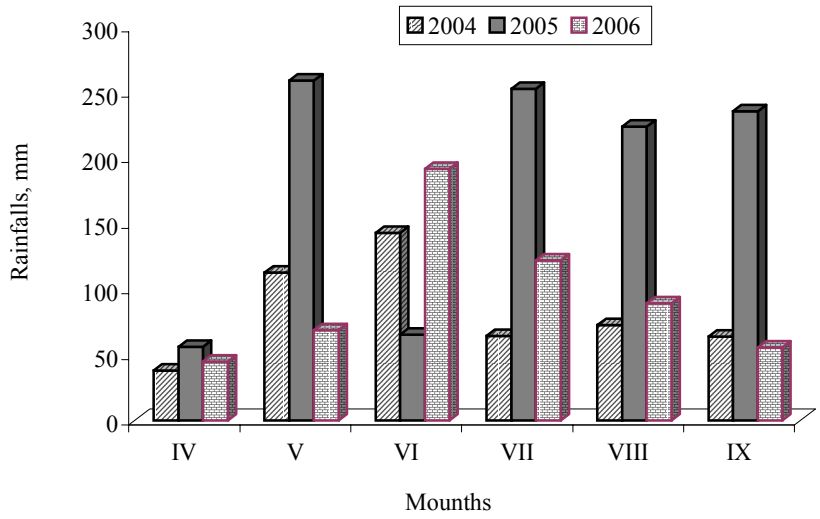

Fig. 1. Mean months sum of rainfalls, mm

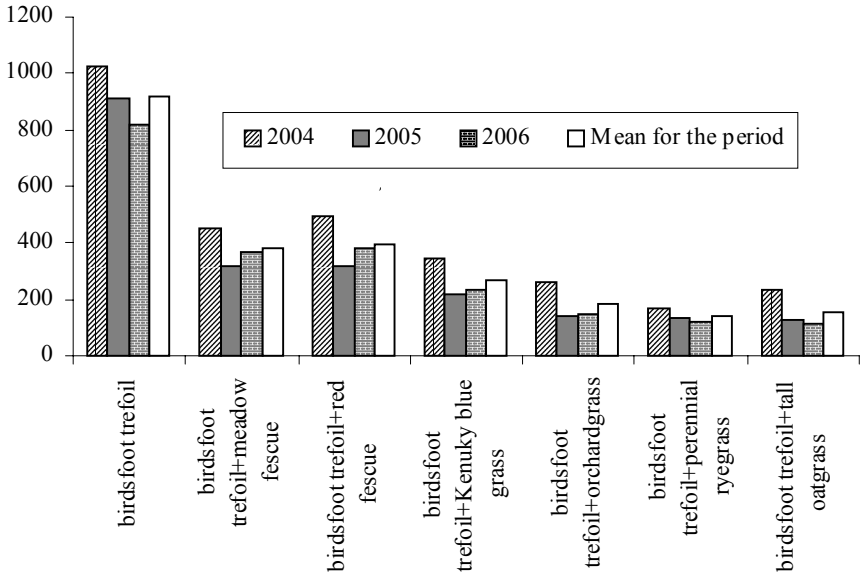

Fig. 2. Density of birdsfoot trefoil in sward-number of stems per year and mean for the period

ber of stems and branches (141 and 158.3 on average for the period).

The stem height (Table 1) was an indicator considerably varying in the study years depending on the changes in meteorological conditions. On average for the period, the stems of the pure birdsfoot trefoil stand (C) were the tallest (45.3 cm) and those of the mixtures with meadow and red fescue had almost equal values

Table 1

Seed yield structural analysis, mean for the 2004 - 2006 period

Variants	Height of plants, cm	Number of pods per racemes	Number of racemes per stems	Number of seeds in pod	Mass of 1000 number seeds
Birdsfoot trefoil (C)	35.3	2.7	6.3	16.3	1.206
Birdsfoot trefoil + meadow fescue	34.4	2.7	8.3	18.8	1.206
Birdsfoot trefoil + red fescue	34.6	2.9	9.4	21.2	1.160
Birdsfoot trefoil+ kentucky bluegrass	31.5	2.2	7.4	18.6	1.106
Birdsfoot trefoil+ orchardgrass	30.7	2.3	7.0	18.7	1.153
Birdsfoot trefoil+ perennial ryegrass	33.5	2.3	6.1	17.8	1.203
Birdsfoot trefoil+ tall oatgrass	32.1	2.4	6.2	17.9	1.193

(34.4 and 34.6 cm) and approached the control. The birdsfoot trefoil stems were the shortest in its mixture with orchardgrass - 30.7 cm.

The pod number per raceme and raceme number per stem were influenced to a considerably smaller extent by the grass component species in the mixture, from 2.2 to 2.9 for pod number per raceme and from 6.1 to 9.4 for raceme number per stem. The highest values of both characteristics were recorded in the mixture of birdsfoot trefoil with red fescue. In the other mixtures of birdsfoot trefoil, the pod number per raceme varied from 2.2 to 2.9 and the raceme number per stem from 6.1 to 6.2, being 2.7 and 6.3 for the control, respectively.

In comparison with the other characteristics of the structural elements of the yield, the seed number per pod varied to the greatest extent. The values of the seed number per pod were higher in all mixtures, as compared to the pure stand. The seed number per pod was the greatest in the mixture of birdsfoot trefoil with red fescue – 21.2 and that of the mixture with meadow fescue, Kentucky bluegrass and orchardgrass was equal - 18.8; 18.6 and 18.7.

The 1000-seed weight in the studied mixtures was 1.106 to 1.206, being 1.206 for the control. In all studied mixtures, the value of this indicator was below the level of the control and in its mixture with meadow fescue it was equal to it. It was found that in all studied mixtures of birdsfoot trefoil with meadow grasses there was slight variation of this indicator.

The meteorological conditions in 2004 favoured the formation of a normal seed yield (Table 2) from birdsfoot trefoil. All

Table 2

Seed yield per year and mean for the 2004 - 2006 period

Variants	2004		2005		2006		Mean for the period	
	kg/da $^{-1}$	%	kg/da $^{-1}$	%	kg/da $^{-1}$	%	kg/da $^{-1}$	%
Birdsfoot trefoil (C)	27.7-	100.0	23.6-	100.0	26.3-	100.1	25.8-	100.0
Birdsfoot trefoil + meadow fescue	36.2+++	130.7	31.0++	131.6	35.4+++	134.8	34.0+++	131.5
Birdsfoot trefoil + red fescue	49.6+++	179.2	43.6+++	184.1	46.0+++	175.1	46.4+++	179.7
Birdsfoot trefoil+ kentucky bluegrass	48.3+++	174.4	44.6+++	188.9	44.4+++	168.8	45.7+++	177.0
Birdsfoot trefoil+ orchardgrass	35.1+++	126.9	32.1+++	136.0	32.6++	123.9	33.2+++	128.6
Birdsfoot trefoil+ perennial ryegrass	33.0+	119.1	28.1+	119.3	26.8-	102.1	29.3+	113.8
Birdsfoot trefoil+ tall oatgrass	28.8-	104.1	27.6-	116.9	23.7-	90.3	26.7-	103.5
GD 5%	3.9	14.1	4.1	17.3	3.5	13.2	2.6	10.1
GD 1%	5.3	19.3	5.6	23.7	4.8	18.1	3.7	13.8
GD 0.1%	7.3	26.3	7.6	32.3	6.5	24.6	4.9	18.8

studied mixtures of birdsfoot trefoil with meadow grasses were superior to the control in seed productivity. The highest seed yield was obtained from the mixture of birdsfoot trefoil with red fescue followed by its mixture with Kentucky bluegrass, which was 79.2 and 74.4% more than the control. In the mixtures of birdsfoot trefoil with meadow and red fescue, Kentucky bluegrass and orchardgrass, the positive difference statistically had very good significance.

The second year of the experimental period was relatively unfavourable for the seed productivity of birdsfoot trefoil. The great rainfall amount in July and August (253.0 and 223.9 mm) delayed seed ripening and their timely harvesting. The seed yields varied from 23.6 kg da^{-1} to 44.6 kg da^{-1}. Birdsfoot trefoil had a higher seed yield than the control in all mixtures and except for its mixture with oatgrass; all the rest had statistically significant differences.

In the third year, the mixture of birdsfoot trefoil with red fescue was distinguished for the highest productive potential and that with Kentucky bluegrass approached it. The seed yield was 46.0 and 44.4 kg da^{-1}, respectively, being superior to the control by 75.1 and 68.2%. The rainfall amount in June during formation of the cut for seeds, favoured the birdsfoot trefoil development and the sunny and warm

days in the time of flowering activated the pollinator activity. That was a prerequisite for the higher seed yield in that year. Only the mixture of birdsfoot trefoil with oatgrass did not exceed statistically significantly the pure birdsfoot trefoil stands in seed yield.

On average for 3 years of study, the highest seed yield was obtained from the mixture of birsdfoot trefoil with red fescue - 46.0 kg/da or 79.7% more than the control. Its mixture with Kentucky bluegrass ranked second in seed yield of birdsfoot trefoil - 45.7 kg da^{-1} or 77.0% over the control. The higher seed yield of birdsfoot trefoil in all studied mixtures, as compared to its pure stand, was of interest. The seed yield in its mixture with oatgrass had the lowest and closest yield to that of the control - 26.7 kg da^{-1}.

Conclusions

In birdsfoot trefoil growing for seed production in mixtures with perennial grasses, good conditions were created for birdsfoot trefoil development and harvesting losses decreased, so the seed yields from the mixed stands were higher than the pure birdsfoot trefoil. The mixtures of birdsfoot trefoil with red fescue and Kentucky bluegrass gave 79.7% and 77.0% higher seed yield, as compared to the seed yield of pure bird-sfoot trefoil.

The mixed growing of birdsfoot trefoil with red fescue improved the morphological structure of birdsfoot trefoil and the structural elements determining the yield, such as pod number per raceme, raceme number per stem and seed number per pod, were higher in comparison with the pure birdsfoot trefoil.

References

Beuselinck, P. R., 1997. Lotus corniculatus L. birdsfoot trefoil in North America, pp. 351-360; in D.T.

McGraw, R. L. and P. R. Beuselinck, 1983. Growth and yield characteristics of birdsfoot trefoil. *Agronomy Journal*, **75**: 443-446.

McGraw, R. L., P. R. Beuselinck and K. T. Ingram, 1986. Plant population density effects on seed yield of birdsfoot trefoil. *Agronomy Journal*, **78**: 201-205.

Robinson, S. and J. Winch, 1986. Birdsfoot trefoil production, Ontario Ministry of Agriculture and foot. Omaera Factsheet, pp. 86-100.

Shanin, Y., 1977. Methodology of the Field Trial. Sofia, BAS. 124 pp. (Bg).

Stoeva, K., 2006. Influense of the sowing rate and inter-row spaning on the seed yield of trefoil (*Lotus corniculatus* L.). *Plant Science*, **43** (1): 74-77 (Bg).

Zemenchik, R. A., K. A. Albrecht and M.K. Schultz, 2001. Nitrogen replacement value of Kura clover and birdsfoot trefoil in binary mixture with cool-season grass. *Agronomy Journal*, **93**: 451-458.

Zemenchik, R. A., K. A. Albrecht and M.K. Schultz, 2002. Improved nutritive value of Kura clover and birdsfoot trefoil-grass mixtures compared with grass monocultures. *Agronomy Journal*, **94:** 1131-1138.

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