RESTORATION OF GRASSLAND MULTIFUNCTIONALITY BY DIRECT DRILLING METHOD - A SOLUTION FOR SUSTAINABLE FARMING SYSTEM

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ABSTRACT

The durability of production systems is reflected both in their capacity for maintaining the level of production and the environmental quality for a long period.
Additionally to the decisive role of grasslands for animal feeding the importance of these areas for environmental and rural development (through improving soil fertility and prevention of soil erosion, land sliding and floods, conserving the biodiversity, management of the water supply and landscape conservation) has to be taken into account. The field experiments were carried out in 2004-2006 in three locations, to investigate the improvement in grass and legumes content of various degraded grasslands. The experiments were based on utilization of a direct drilling machine, MSPD 2.5 type a research result of the Research-Development Institute for Grassland – ICDP Braşov, Romania. The direct drilling method for improving degraded grasslands (over-sowing) was highly successful in increasing sown grass-legumes content in the population of indigenous plants, providing a productive sward.

Key words: direct drilling, seed mixture, low input, farming machinery, biodiversity.

INTRODUCTION

The grassland productiveness depends on the great variety of weather and soil conditions in which they are placed, on a diversity of external factors and on grassland renovation techniques.

At the same time, the grassland conditions differ from those in arable land with regard to the shallow sowing depth and competition between species during the establishment, which place special demands on sowing methods and implements (Mocanu and Hermenean, 2003).

The grassland direct drilling (over-sowing) is one of principal methods of pasture renovation for improving the degraded vegetation of grasslands. The grassland over-sowing is a less intensive method, using systems based on low inputs (Mocanu and Hermenean, 2008).

The successful use this technology includes no tillage and reduced tillage.

In comparison with cultivation and total reseeding, the over-sowing of grasslands has the following advantages:

- it can be applied on degraded grasslands, where total tillage reseeding is not possible (e. g. superficial soils, stones on the surface, high level of acidity or alkalinity within the interior layers, excess of humidity, eroded grounds etc.);
- there are less reductions of production in first operating year;
- the sowing rates are lower;
- the energy consumption and the costs are reduced (Mocanu and Hermenean, 2000).

The grassland over-sowing can be successfully applied to realise a good combination of yield with forage quality and botanical composition, by increasing the sward components within valuable grass and legumes species (Tiley and Frame, 1991).

According to Hermenean et al. (2003), for successful establishment it is necessary to remove competition of the old swards before and after sowing.

This paper presents the results of research on improving the degraded grasslands by a low input system.

MATERIAL AND METHODS

The agricultural practice proves that for implementing the grassland improvement activity and for efficient grassland farming, high performance equipment and specific farm machines are necessary. Therefore a direct drilling machine, MSPD 2.5 type, built in our institute, was used for over-sowing degraded grassland during the experimental period.

The direct drilling machine for degraded grassland over-sowing, MSPD 2.5 type, (Figure 1) is a carried machine, working on the principle of the gutter opening (Hermenean et al., 2006). It is composed of a frame (1) of fused profiles, on which the equipment of gutter opening and the equipment for sowing are assembled.

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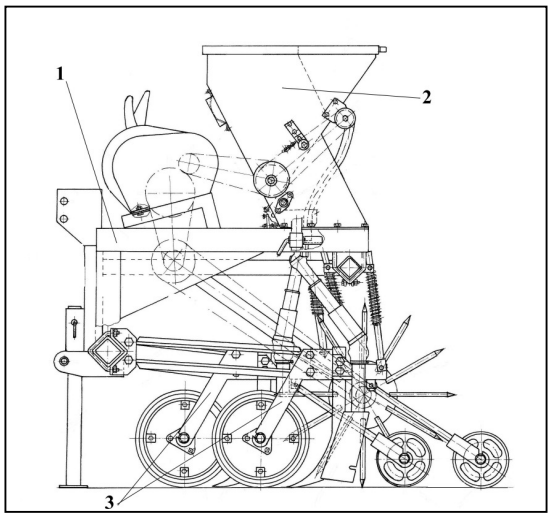


Figure 1. Constructive draft of direct drilling machine, MSPD 2.5 type

The equipment of gutter opening (3) is made of gutter opening sections disposed on two rows and assembled on the frame with two shoulder traps. Between the shoulder brace for fixing on the frame and the body of the section deformed parallelograms were assembled, activated by a spring assembled behind, which allow the copying of the ground contours and maintains a constant angle of attack of the active tools.

The sowing equipment (2) consists of a seed box with two partitions, one for large seeds (of perennial grasses or other crops) and one for small seeds (perennial legumes), studded feed roller and stirrers for grass seeds, fluted feed roller for legume seeds, tubes for leading the seeds to the furrows and the device of motion transmission, made from a stellar wheel which follows the soil, a Northon type gear box and transmission chains between these components and the axis of feed roller and agitators. The main technical characteristics of the new over-sowing machine are: power requirement 48-59 kW; operating width 2.55 m; number of sections for gutter opening is 17; minim row spacing 15 cm; seeding depth continuously adjustable between 0.5 and 4 cm; volume of the seed box for large seed 300 dm^3; volume of seed box for small seed 55 dm^3; net weight 1035 kg.

Because a strong competition for soil nutrients from the existing pasture plants can exist, the competition control is made by mechanical methods, using clearing grassland machines, grass mowers and a high stocking density before and after seeding.

The experiments were carried out under the conditions presented in table 1.

Table 1. Conditions of direct drilling experiments

Specifications	Location		
	Stupini, Braşov	Măgurele, Braşov	Cristian, Braşov
Operating date	April 2004	August 2004	April 2005
Type of soil	Cernozeomoid	Brown molic, low leached	Cernozeomoid leached
Soil humidity in the 0-5 cm depth interval	25%	24.8%	25.5%
Existing sward	Permanent grassland	Permanent grassland	Temporary grassland established in 1999
Slope size	0°	0 - 6°	0 - 2°
Improvement reason	Not valuable species, low density of grass sward	Not valuable species, low proportion of legumes, low density of grass sward	Low density of grass sward
Density level of existing vegetation	60%	63%	67%
Seeding rates	32 $kg.ha^{-1}$	16 $kg.ha^{-1}$	24 $kg.ha^{-1}$
Constitutive species of seed mixtures	Mixture 1	Mixture 2	Mixture 3
Grassland management after over-sowing	First growth stage: harvest Next stages: grazing by milk cows	First growth stage: harvest Next stages: grazing by sheep	Meadow

Floristic composition of the old sward consisted in:

- Location 1 (Stupini): *Polygonom aviculare* 40%; *Taraxacum oficinalis* 20%; *Festuca pratensis* 10%; *Phleum pratense* 5%; *Agropyron repens* 5%; *Festuca arundinacea* 5%; *Trifolium repens* 5%; other species 10%.
- Location 2 (Măgurele): *Agrostis tenuis* 32%; *Dactylis glomerata* 17%; *Festuca arundinaceea* 12%; *Phleum pratense* 10%; *Festuca pratensis* 6%; *Achillea millefolium* 6%; *Urtica dioica* 6%; other species 11%.
- Location 3 (Cristian): *Festuca pratensis* 25%; *Dactylis glomerata* 20%; *Lolium perenne* 18%; *Festuca rubra* 15%; *Phleum pratense* 10%; *Achillea millefolium* 3%; *Urtica dioica* 2%; other species 7%.

The employed seed mixtures were:

- Mixture 1: *Lolium perenne* 10 kg.ha^{-1}; *Festuca pratensis* 8 kg.ha^{-1}; *Phleum pratense* 5 kg.ha^{-1}; *Lotus corniculatus* 6 kg.ha^{-1}; *Trifolium repens* 3 kg.ha^{-1}.
- Mixture 2: *Festuca pratensis* 10 kg.ha^{-1}; *Dactylis glomerata* 4 kg.ha^{-1}; *Trifolium repens* 2 kg.ha^{-1}.
- Mixture 3: *Dactylis glomerata* 7 kg.ha^{-1}; *Festuca pratensis* 6 kg.ha^{-1}; *Lolium perenne* 5 kg.ha^{-1}; *Trifolium pratense* 4 kg.ha^{-1}; *Trifolium repens* 2 kg.ha^{-1}.

RESULTS AND DISCUSSION

The evaluation of over-sowing impact consisted in determining the floristic composition, forage production and quality in comparison with control areas (not seeded), after seedling establishment.

Floristic composition after over-sowing operation consisted in:

- Location 1 (Stupini): *Lolium perene* 27%; *Festuca pratensis* 21%; *Phleum pratense* 23%; *Trifolium repens* 13%; *Lotus corniculatus* 9%; other species 7%.
-Location 2 (Măgurele): *Dactylis glomerata* 23%; *Agrostis tenuis* 23%; *Festuca pratensis* 21%; *Festuca arundinacea* 11%; *Trifolium repens* 10%; *Achileea milefolium* 4%; *Urtica dioica* 3%; other species 5%.
- Location 3 (Cristian): *Festuca pratensis* 29%; *Dactylis glomerata* 22%; *Lolium perenne* 19%; *Trifolium pratense* 12%; *Trifolium repens* 8%; *Festuca rubra* 3%; *Phleum pratense* 2%; other species 5%.

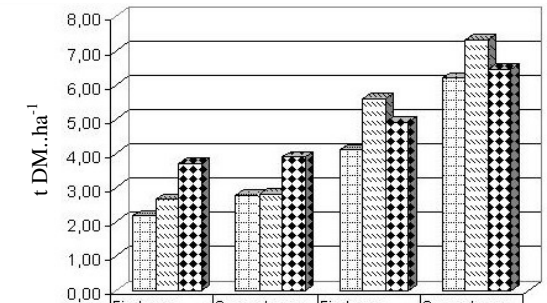
The results of over-sowing are presented in table 2.

Table 2. Results of experiments

Specifications		Location		
		Stupini, Braşov	Măgurele, Braşov	Cristian, Braşov
DM yield, control areas, t.ha^{-1}	First year	2.18	2.66	3.72
	Second year	2.78	2.82	3.90
DM yield, operated areas, t.ha^{-1}	First year	4.10	5.60	4.92
	Second year	6.20	7.30	6.45
Crude protein content, control areas, kg.ha^{-1}	First year	235.20	280.50	389.70
	Second year	283.50	310.20	378.60
Crude protein content, operated areas, kg.ha^{-1}	First year	460.50	672.00	769.50
	Second year	743.40	897.80	806.80

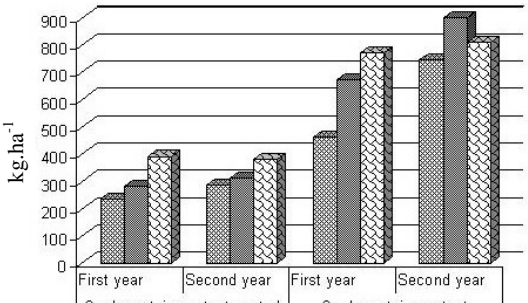
Based on the data analysis, presented in table 2, the average increase in forage production of over-sown areas in comparison with control areas was 48.5% to 134%, depending on location and years (Figure 2).

Due to the improvement of forage yield and quality of over-sown areas the crude protein yield was higher with 105 - 129% in comparison with control areas (Figure 3).



Stupini Bv	2,18	2,78	4,1	6,2
Magurele Bv	2,66	2,82	5,6	7,3
Cristian Bv	3,72	3,9	4,92	6,45

Figure 2. Dry matter yield



Stupini	235,2	283,5	460,5	743,4
Magurele	280,5	310,2	672	897,8
Cristian	389,7	378,6	769,5	806,8

Figure 3. Crude protein content

CONCLUSIONS

The direct drilling (over-sowing) of the degraded grasslands can be applied where total tillage reseeding cannot be used and includes lower costs and energy consumption, lower seed rates and reduced loss of the exploitation period.

The utilization of the specific direct drilling machine, MSPD 2.5 type, made in our institute, can successfully provide mechanization of over-sowing works by one – pass operation and can be also used for the introduction of wild species into the old sward.

The swards renovated by direct drilling method have shown progressive improvement, in the 2nd and 3rd year after seedling establishment.

The direct drilling method for improving degraded grasslands (over-sowing) was highly successful in increasing sown grass-legumes content in the population of indigenous plants, providing a productive sward.

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