The Technique of Transforming Tall-Weed Fallow into Fodder Lands With Different Methods for Pure Sowing of Permanent Grasses

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ABSTRACT

In recent years, the program for food sovereignty and livestock development in the Republic of Kazakhstan caused the necessity to increase fodder production and to expand the acreage for fodder crops. In our opinion, this question should be settled at the expense of arable land withdrawn from agriculture in the early 90s of the last century. Weeding is one of the most important issues in reclaiming and regrassing these lands. This is because a large quantity of weed seeds (millions for each hectare) accumulated in topsoil during the period of fallowness. In this research paper, one can find the comparative assessment for two techniques of regrassing tall-weed fallows in the dry steppe zone of Northern Kazakhstan. These fallows are notable not only for their vegetation consisting mainly of Artemisia but also for large stocks of weed seeds accumulated during the period of fallowness. Thus, while choosing a method for regrassing, first of all it is important to solve the problem of weeding and the infestation of cultured crops sown after ploughing up. It is ascertained that the most efficient method consists in fallowing after primary deep tillage and using a preliminary crop or the undercover sowing of permanent grasses.

INTRODUCTION

According to statistics, in the early 90s the total agricultural acreage of the Republic of Kazakhstan reached 35.6 million hectares [1]. Since the mid-90s of the 20th century the acreage began to decline and reached 16.2 million hectares by 2000[2]. That is about 20 million hectares were withdrawn from agriculture, including 15 million hectares in Northern Kazakhstan. They turned to tall-weed fallows with no feeding value. The detailed inspection of 7-9-year fallows was conducted in 2000-2002 in a number of farms in Tselinograd District and Astrakhanka District of Akmola Region on the area of about 2000 hectares. The inspection showed that Artemisia prevailed in herbage (44.1-91.6%); Sonchus arvensis and Convolvulus arvensis etc. occupied a significant place [3]. That is why an important goal for the next years is to work out effective techniques of regrassing these acres and turning them into high-productive fodder lands. This would be a huge reserve for the increase of fodder production and the prospective development of livestock farming in the Republic.

These fallows are notable not only for their vegetation consisting mainly of Artemisia but also for large stocks of weed seeds accumulated during the period of fallowness. Thus, while choosing a method for regrassing, first of all it is important to solve the problem of weeding and the infestation of cultured crops sown after ploughing up. Experiments show that the dry steppe fallows of Northern Kazakhstan differs considerably from fallows described in classical agronomic literature in the composition of vegetation and the presence of weed seeds (A.V. Sovetov [4], V.R. Williams [5], I.V. Larin [6] etc. [7, 8, 9, 10, 11, 12, 13 and 14]). Consequently, another development technique should be used for them.

Location and methods:

Taking into account the urgency of the problem, a series of experiments was performed in 2006-2010. In the course of these experiments, they studied methods of transforming these acres into high-productive fodder lands. Since 2006, the first-stage experiments were aimed at studying accelerated regrassing by means of sowing permanent grasses after primary spring tillage without fallowing (the first technique). The experiments for the first technique began in 2006-2008 with time repetition at the Plant Cultivation Department of S.Seifullin Kazakh Agrotechnical University.
Kazakh Agro Technical University, in the farm of TOO “Semenovka AE” in Tselinograd District of Akmola Region on dark chestnut soil. They studied primary tillage methods for tall-weed fallows using subsurface chisel cultivator PG-3-5 at the depth of 25-27 sm, cultivator KPSh-9 at the depth of 12-14 sm, hoeing plough LDG-10 at the depth of 8-10 sm after four-track pre-tillage in all variants by hoeing plough LDG-10 at the depth of 8-10 sm for grinding tall weeds and increasing the quality of further tillage.

The following varieties of permanent grasses were sown purely and in mixture (this article contains data of pure sewing): Onobrychis arenaria Shortandinsky 83, Melilotus albus Akbas, Medicago blue-hybrid Kokshe, Agropyron cristatum Batyr, Bromopsis inermis Limanny. Fourfold repetition; the discount area is 52.5 m².

Main part:

The findings show that weeds oppressed cultivated grasses in the first and subsequent years of life. This reduced the productivity of permanent grasses: in the second year the herbage yield ranged between 32.1 and 67.7 q/ha, dry matter – between 9.2 and 19.3 q/ha, fodder units – between 6.9 and 16.8 q/ha and digestible proteins – between 0.6 and 2.2 q/ha. However, the weed proportion of the second year reached 68.8-79.5% going down in the third and fourth years till 46.3-32.5%. That means, with this method the quality of fodder obtained the full value only by the fourth year of life [15].

Beginning with 2008, after the specialists received the evidences of comparatively low effectiveness of the first technique, they started a new series of experiments of regrassing tall-weed fallows after preliminary fallowing (the second technique). After preliminary tillage and fallowing they studied the undercover and open ways of sowing and sowing permanent grasses after preliminary crop. The experiments were performed in the same station as the first technique using the above mentioned method. The same crops and grasses were sown because they showed their competitiveness and high productivity in regrassing such fallows [16]. Oats sown for green fodder were chosen as a cover and preliminary crop. The experiment was conducted with three backgrounds of preliminary tillage: deep subsurface (PG-3-5 at the depth 25-27 sm), shallow (KPSh-9 at the depth 12-14 sm and hoeing plough LDG-10 at the depth 8-10 sm) with further fallowing. During summer, two fallow tillage sessions were performed – in late June with hoeing plough LDG-10 at the depth 8-10 by four tracks and in the second half of August with cultivator KPSh-9 at the depth 12-14 sm. The seeding rate of cover and preliminary crops (fodder oats) is 2.5 million viable seeds. It was sown in early June with seeding machine SZS-2.1 at the depth 6-7 sm. Cover and preliminary crops were harvested in late July with harvester ZhVN-6. Permanent grasses were sown using undercover and open methods in early June. After preliminary crops (fodder oats) they were sown without any pre-seeding tillage, with seeding machine SZS-2.1 at the depth 3-4 sm in late July. (This article contains the comparative assessment data of findings obtained while performing accelerated regrassing and sowing, and fallowing using PG-3-5 for deep tillage with the first and the second techniques.)

Undercover sowing method, along with negative influence on first-year permanent grasses, had a positive role promoting the purification of weeds. In the first year of life, the quantity of annual and permanent weeds under the cover of oats was 2.9-8.8 times less as compared with accelerated regrassing without fallowing and open sowing. The botanical composition of weeds was also different: on an average 29 pc/m² (21 pc/m² of permanent weeds and 8 pc/m² of annual weeds) with undercover and open methods against the background of deep tillage of fallow; 132 pc/m² (96 and 36 pc/m²) with open method. Permanent weeds prevailed after preliminary crop on an average 15 pc/m².

In the second year of life, the quantity of weeds ranged between 35 and 63 pc/m² with undercover method after fallowing; between 102 and 128 pc/m² with open method; between 98 and 114 pc/m² with sowing after preliminary crop (for comparison: there were 162-271 pc/m² with the first technique of accelerated regrassing, see Figure 1).

So, fallowing promoted the reduction of infestation in crops of the first and the second year of life on an average in 1.5-4.5 times as compared with accelerated regrassing without preliminary fallowing.

Regrassing methods: 1-open without fallowing, 2-undercover over the fallow, 3-open over the fallow, 4-open after preliminary crop

In the first year of life, permanent grasses sown after fallowing got into more favourable conditions than without fallowing. Feed germination rate increased by 7.8-9.5% as compared with methods without fallowing. A somewhat greater quantity of plants remained on an average per unit of area: legumes from 168 (Medicago) to 226 (Onobrychis) pc/m²; grasses from 111 (Bromopsis) to 168 (Agropyron) pc/m²; and with the first technique respectively from 126 (Medicago) to 144 (Onobrychis) pc/m²; from 65 (Agropyron) to 100 (Bromopsis) pc/m² (See Table 1).

In the first year of life, the main problem in regrassing tall-weed fallows is to form herbage with optimal structure and to obtain such quantity of plants so that the thickness of second-year herbage approximates to optimal in certain conditions and so that this thickness can compete with weeds. Besides, it is important to create conditions for maximum leaf area, photosynthetic potential, net productivity of crops, and in the long run – maximum crop capacity.
In the second year, this tendency continued even after fallowing (the second technique), in spite of the fact that some plants miss in herbage due to unfavourable conditions and self-regulation of thickness. The quantity of plants on an average was: legumes from 92 (Medicago) to 141 (Onobrychis) pc/m²; grasses from 87 (Bromopsis) to 129 (Agropyron) pc/m²; and with the first technique respectively: from 89 (Medicago) to 101 (Onobrychis) pc/m²; from 41 (Agropyron) to 100 (Bromopsis) pc/m².

In the second year of life, permanent grasses sown with the second technique formed thicker bushes that could successfully compete with weeds for water, light and nutrients. Average quantity of generative stems with undercover sowing ranged between 307 (Agropyron) and 477 (Onobrychis) pc/m²; with open sowing – between 525 (Agropyron) and 570 (Medicago) pc/m²; with sowing after preliminary crop – between 671 (Agropyron) and 885 (Medicago) pc/m², or on an average 5.2-7.2 pc of generative stems per one plant, while without preliminary fallowing the quantity of generative stems were less by 40-45%.

Leaf area with the second technique was: after preliminary crop from 12.8 (Agropyron) km²/ha to 36.7 (Medicago) km²/ha; photosynthetic potential was respectively: from 256 (Bromopsis) to 734 (Onobrychis) km²/ha. These indexes were higher with open method than with undercover method and rated respectively: from 12.4 (Agropyron) to 35.4 (Medicago) km²/ha; and from 248 (Bromopsis) to 708 (Onobrychis) km²/ha. Agropyron showed the highest index of net photosynthetic productivity: 8.0-9.3 g/m² per day after preliminary crop. When using the first technique, relatively high photosynthetic activity was observed in crops with deep tillage: net photosynthetic productivity rated from 4.2 (Bromopsis) to 7.7 (Agropyron) g/m² per day.

The herbage capacity of cover and preliminary crops was 64.0-67.0 q/ha, dry matter – 18.3-19.1 q/ha, fodder units – 14.3-14.9 q/ha and digestible protein – 1.3-1.4 q/ha. So, the additional amount of fodder was obtained in the first year of life of permanent grasses when they do not yield harvest of economic value. This was achieved by means of cover and preliminary crops.

In all, the herbage capacity with undercover method (owing to cover and preliminary crop, and second-year permanent grasses) for two years rated on an average: 116.1-129.8 q/ha; dry matter – 33.2-37.1 q/ha; fodder units – 25.5-31.6 q/ha and digestible protein – 2.3-3.6 q/ha; with open method taking into account the harvest of preliminary crop respectively: 135.7-146.6 q/ha, 38.7-41.9 q/ha, 29.6-35.7 q/ha and 2.8-4.2 q/ha. Only one harvest of second-year permanent grasses was obtained for two years with open method of sowing: herbage – 80.5-88.5 q/ha, dry matter – 23.0-25.3 q/ha, fodder units – 17.1-29.2 q/ha and digestible protein – 1.8-2.6 q/ha (See Table 2.)
Findings:

So, when using undercover method of sowing and sowing permanent grasses after preliminary crop, we obtained additional dry matter and fodder units (as compared with open method) respectively: 18.3-19.1 and 14.3-14.9 q/ha. Total two-year productivity of crops without preliminary fallowing in regrassing tall-weed fallows was 1.3-4.5 times lower than in experiments with fallowing. After falling the percentage of weeds in harvest did not exceed 25.3-36.7 %, while in accelerated regrassing without fallowing – 68.8-79.5%. That is the findings of the second technique should be considered quite satisfactory because the infestation will continue in 3-4 years of life.

Table 2: Comparative productivity of permanent grasses totally for 2 years depending on techniques used, q/ha.

<table>
<thead>
<tr>
<th>Regrassing methods</th>
<th>Dry matter, q/ha</th>
<th>Fodder units, q/ha</th>
<th>Digestible protein, q/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>total oats +/-</td>
<td>total oats +/-</td>
<td>total oats +/-</td>
</tr>
<tr>
<td>Legumes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First technique:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open without fallowing</td>
<td>17.4 0.0 -</td>
<td>14.8 0.0 -</td>
<td>2.1 0.0 -</td>
</tr>
<tr>
<td>Second technique:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open with fallowing</td>
<td>23.5 0.0 +6.1</td>
<td>20.0 0.0 +5.2</td>
<td>2.8 0.0 +0.7</td>
</tr>
<tr>
<td>Undercover with falling</td>
<td>36.2 18.3 +18.8</td>
<td>29.6 14.3 +14.8</td>
<td>3.4 +1.3</td>
</tr>
<tr>
<td>After preliminary crop with falling</td>
<td>41.4 19.1 +24.0</td>
<td>33.9 14.9 +19.1</td>
<td>4.1 +2.0</td>
</tr>
<tr>
<td>Grasses</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>First technique:</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Open without fallowing</td>
<td>15.8 0.0 -</td>
<td>11.7 0.0 -</td>
<td>1.1 0.0 -</td>
</tr>
<tr>
<td>Second technique:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open with fallowing</td>
<td>23.9 0.0 +10.2</td>
<td>17.8 0.0 +6.1</td>
<td>1.7 0.0 +0.6</td>
</tr>
<tr>
<td>Undercover with falling</td>
<td>35.4 18.3 +21.6</td>
<td>27.0 14.3 +15.3</td>
<td>2.4 1.3 +1.3</td>
</tr>
<tr>
<td>Under preliminary crop with falling</td>
<td>40.7 19.1 +26.9</td>
<td>31.0 14.9 +19.3</td>
<td>3.0 1.4 +1.9</td>
</tr>
</tbody>
</table>

Conclusion:

1. In the first year of life of permanent grasses sown after fallowing tall-weed fallows the quantity of weeds reduced in 2.9-8.8 times as compared with crops without preliminary fallowing. In the second year, their quantity reduced respectively in 2-6 times.
2. More favourable conditions for herbage formed with sowing permanent grasses after fallowing (the second technique) using open and undercover methods and after preliminary crops.
3. The capacity of fodder units, taking into account the harvest of second-year permanent grasses and cover crop, with the second technique increased by 12.5-15.3 q/ha; digestible protein – 0.9-1.3 q/ha; after preliminary crop respectively by 16.6-19.3 q/ha and 1.5-2.0 q/ha; with open method of sowing – by 4.8-5.2 q/ha and 0.4-0.7 q/ha, as compared with the first technique.

REFERENCES
