

Einböck

**When grassland care
is joy!**

THE GRASSLAND CARE HANDBOOK

A MANUAL FOR GRASSLAND OVERSEEDING, RESTORATION AND RENEWAL
TIPS AND TRICKS FOR WORKING WITH GRASSLAND WEEDING TECHNOLOGY
SUCCESS WITH FARM POWER



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PREFACE



In order to increase the yield capacity of grassland, it must be maintained correctly and, more importantly, consistently. The annual maintenance or restoration of pastures and meadows increases fodder quality and therefore also subsequent milk production.

For over 25 years, we have been providing the right technology for grassland care and have been working with our international customers to continue the further development of our machines and adapt them to the user's needs. We have also been able to gain lots of experience through many years of testing that we now want to share with you.

With many years of practical experience behind us, we want to change the structure of farming for the better, so that future generations can enjoy the diverse bounties nature has to offer.

A stylized, handwritten signature in black ink, which appears to be 'Einböck'.

The Einböck Family
Managed by the 3rd and 4th generation

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**This handbook is a guide, not a guarantee for success.
Farmers should record their own practical experience in order to get the best results for the
specific conditions on their farm.**

**Do you have any practical tips and experience?
Send us an email to info@einboeck.at, so that we can exchange ideas.**

1. PROBLEMS

1.1 Stress factors for grassland

- » **Gaps:** Gaps in the sward must be avoided at all costs as they are the first areas to be conquered by weeds. (Image 1, 2, 3, 4)
- » **Molehills:** Molehills can be effectively levelled off with the front levelling plate. (Image 5, 6, 7)
- » **Moss:** Moss growing in the meadow or pasture indicates that there is a lack of nutrients in the soil and potentially also water logging. (Image 8, 9)
- » **Mouse infestations**

1.2 Damage in summer/autumn

- » **Uneven fertilisation**
- » **Cutting times** were too late
- » **Incorrect grazing** (Image 10)
- » **Sward damage**
- » **Drought** (Image 11)

1.3 Incorrect cultivation methods

- » **Cut too deep** (e.g. below 7 cm) or raked: Any work on the ground that goes too deep, e.g. during raking, should be avoided at all costs. (Image 12)
- » **Fertilisation and use** do not go together: Intensive use requires intensive fertilisation, otherwise common grasses may be ousted by less valuable plants.
- » **Soil compression:** Compression by driving over damp ground inhibits the growth of valuable forage grasses. Vehicle tracks can often still be seen in the second growth. (Image 13)
- » **Liquid manure** was applied in a too concentrated form or during unfavourable weather conditions.
- » **Grass** was too short or too long during the winter (Image 14): This increases the risk of snow mould and encourages the growth of the mouse and mole populations.



The balance of grasses and herbs is lost!



Image 1: Gaps in the sward



Image 2: Gaps in the sward



Image 3: Gaps in the sward



Image 4: Gaps in the sward



Image 5: Molehills



Image 6: Molehills



Image 7: Molehills can be effectively levelled off with the front levelling plate



Image 8: Moss



Image 9: Moss



Image 10: Incorrect grazing



Image 11: Drought



Image 12: Deep raking should be avoided



Image 13: Soil compression



Image 14: Sward grows too long in winter

1.4 The "special problem" with rough meadow-grass:

The amount of rough meadow-grass usually has to be determined from the forage yield. You do not see a significant drop in yield in the first cut. However, in the second and third cut, the forage yield of rough meadow-grass decreases by up to 100%. Another big problem: the nutritive value of rough meadow-grass is very low.



Rough meadow-grass quickly fills in any open gaps if they are not oversown.



Rough meadow-grass is easy to pull out.



A three-year temporary meadow in which rough meadow-grass has filled in the gaps left after the populations of red clover, lucerne and some other species of grass have died. The yield loss of these areas is around 50 %.

1.5 Driving back rough meadow-grass

Tackling rough meadow-grass is the key to successful grassland farming. If the rough meadow-grass is replaced by fodder plants, the yield and protein potential can be fully exploited and nothing more will stand in the way of high-yield permanent grassland. With the right follow-up management, the rough meadow-grass can be kept at a tolerably low level.



**Rough meadow-grass:
"An aggressive gap-
filler that is easy to
pull out!"**

2. DIFFERENT SOLUTIONS

Successful and long-lasting grassland requires perfect management. In practice, however, not everything goes perfectly and corrections often have to be made. Most of the time, overseeding with high-quality grasses is the only alternative!

The difference from grasslands from 20 years ago?

- » The cutting frequency has massively increased.
- » Grasses that could seed before can no longer do so today.

The problem here is that unwanted types of grass always get more light and air, and that allows them to establish themselves. This, combined with irregular rainfall and increasingly frequent droughts during the summer months, is making the problem much worse. Incorrect grazing and the proliferation of rough meadow-grass, an aggressive gap-filler, are also some of the reasons behind this. Molehills, trampling and white grubs are also amongst the grassland yield decimators.

2.1 Solutions for improving your grassland:

1. Reseeding with ploughing
2. Grassland restoration without ploughing – with thick tined weeder
3. Overseeding – with thick tined weeder



Grassland MUST be maintained properly and on an annual basis!



Well and poorly managed grassland: left = ACTUAL, right = TARGET

2.2 Identification & Evaluation:

Unwanted species must first be identified and evaluated:

Unwanted grasses:

- » Rough meadow-grass (aggressive gap-filler)
- » Annual meadow grass
- » Meadow soft grass
- » Couch grass

Unwanted herbs:

- » Dandelion
- » Ribwort plantain
- » Greater plantain
- » Dock

Damage thresholds – Which measures should I implement?

Damage threshold	Measures
> 50 % unwanted species	Reseeding with ploughing
20-50 % unwanted herbs and grasses	Restoration of the plant population
< 20 % unwanted herbs and grasses	Overseeding
10-15 % sward damage	Overseeding
30 % rough meadow-grass	Restoration of the plant population
20-30 white grubs/m ²	Reseeding with ploughing
Damage caused by mice	Reseeding or restoration

With plant populations that have not been maintained properly for several years, it is almost always necessary to restore the plant population by passing over it several times with a thick tined weeder. Only in a very few cases must the plant population be ploughed.

These measures are particularly effective in tackling the following weeds:

	Dock	Dandelion	Hogweed	Cow parsley	Ground elder	Caraway	Buttercup	Thistle	Yarrow	Nettle	Symphytum	Rushes	Couch grass	Rough meadow-grass	Soft brome	Tufted hairgrass
Avoid sward damage	✓	✓	✓	✓					✓						✓	
Intensive grazing		✓	✓	✓	✓				✓						✓	
Avoid soil compression								✓				✓				
Weeding + overseeding														✓		
Drainage							✓				✓	✓				
Avoid over-fertilisation	✓	✓	✓	✓												
Increase cutting frequency			✓	✓	✓					✓			✓			
Earlier cutting time	✓	✓	✓	✓		✓		✓	✓	✓		✓			✓	✓
Deeper cut												✓				✓
Second-growth cutting in pastures	✓						✓	✓							✓	✓

Source: Josef Galler, Grünlandnachsatz, LWK Österreich



2.3 Goals for successful grassland

You should aim to achieve the following:

- » High dry mass yields
- » High energy and protein content
- » Stable, drought-resistant grassland

In order to achieve these goals, the grassland must be maintained permanently and consistently!

Yield and forage quality per year			
	Tons DM / ha	MJ NEL / kg	MJ NEL / ha
Meadows cut once	2 - 4	4.0 - 5.0	8 000 - 20 000
Meadows cut twice	4.5 - 7	4.5 - 5.5	20 000 - 40 000
Meadows cut three times	6.5 - 8.5	4.5 - 6.5	35 000 - 50 000
Meadows cut four times	8 - 11	5.7 - 6.5	45 000 - 70 000
Meadows cut five times	9 - 13	5.8 - 6.7	55 000 - 80 000
Field forage	10 - 13.5	6.0 - 6.7	60 000 - 90 000
Silage maize dough-ready	12 - 18	6.5 - 7.0	80 000 - 125 000

2.4 Tailored grassland management

In order to achieve the goals listed above, the entire grassland management for your farm must be adapted to your personal situation. As a general rule: High yields require high levels of fertiliser (particularly nitrogen). However, recommendations for this often lie above the legal limit of 210 kg/ha (in Austria - country specific differences).

Desired yield with the following fertilisation:

Grassland yield:

Target yield: 10 t DM/ha
 Energy density: 6.0-6.4 MJ NEL/kg DM
 Protein content: 14% - 18% = 140 - 180 g/kg DM

N-fertilisation in grassland:

220 kg N/ha for 10t DM
 70 kg through red clover and white clover in the plant population
 3-4.5 kg N per % share of clover
 150 kg N/ha (approx. 30 to 35 kg N per cut)



Successful dairy farms can significantly increase their milk yield by improving the quality of their forage each year.

3. RESEEDING AFTER PLOUGHING

If the unwanted species of grasses and herbs make up over 50 % of the plant population, they should be ploughed up with a plough or rotary hoe. The plants may also need to be ploughed up if they have been significantly damaged by white grubs. Even with root-propagated weeds, reseeding with ploughing up should be chosen as the weed removal method.

To note:

- » Ploughing can only be done in areas where this is possible.
Many surfaces cannot be ploughed because the soil conditions in the area make it impossible to do so.
- » Working depth up to 25 cm (if possible)
This means that the weeds are not only cut but are also buried.

The risk with ploughing up is that weeds may grow back again. For this reason, the ploughing should be followed by reseeding with a high seed rate of at least 30 kg/ha.



Reseeding



Weeding the new seed into the soil



Subsequent rolling is only required with reseeding.

4. GRASSLAND RESTORATION WITHOUT PLOUGHING

4.1 Restoration

If a rotary hoe or plough is not necessary, a thick tined weeder is the better option. With thick $\varnothing 8$ or $\varnothing 10$ mm tines, the ground can be ideally cleared of weeds to create good germination conditions for the seeds. This process is often referred to as grassland restoration.

Ideally, the restoration should be done with a thick tined weeder and with multiple passes over the ground. You should double- or triple-cross weed during the first weeding pass. High-quality grasses are deeper, better-rooted and withstand heavy loads better. Lower-quality grasses, particularly rough meadow-grass, can easily be removed from the plant population after cross-weeding several times because they are not as strongly rooted.



1. Multiple passes over the ground with the thick tined weeder to remove the unwanted species from the plant population

Practical example: Abundance of weeds in this area! After passing over the area three times, the majority of the unwanted grasses and herbs were removed.



2. Raking the material into windrows

Practical example: It is necessary to gather the grasses and herbs removed into windrows in order to create optimal germination conditions for the subsequent seeding.



3. Removal of the materials from the area

Practical example: The resulting large gaps are ideal as they create good germination conditions for the seeds that are planted afterwards. There should no longer be any moss or thatching. A lot of material is already removed after the first pass. The material removed comes to rest on the surface, is no longer pressed down and is subsequently transported away with the loader wagon.



4. Reseeding with thick tined weeder (between 20 and 35 kg/ha, depending on the plant population)

Practical example: The reseeding is then done during an additional seeding pass. In areas with low amounts of clover the reseeding should be done with 20/25 kg of seed. In areas with high amounts of clover, the reseeding should be done with 30-35 kg of seed.



4.2 Annual maintenance after restoration

After restoration, the newly sown plants should be left for a while. This gives the grasses time to establish themselves and develop a sufficient root system. In the second year after the reseeded, you should start to carry out an annual overseeding, also known as periodic overseeding, on your fields.

The purpose of this periodic overseeding is to immediately fill in any gaps in your grassland before weeds can start growing. This annual maintenance must be consistently carried out from the second year after the reseeded. If you fail to do so, you may eventually have to restore the plant population again after a few years.



Well-managed grassland with a low amount of rough meadow-grass. During a pass carried out as part of the spring maintenance, the sward is aerated, molehills are levelled off and seeds are oversown.



Restore before - maintain annually afterwards!

5. MAINTENANCE AND OVERSEEDING OF GRASSLAND

Overseeding with high-quality grasses is essential if you want to create and maintain high yield grassland. More and more desirable species of grass are lost through intensive use. For the most part, grasses no longer “seed” as they used to, but the desirable species of grass must be maintained. This can only be achieved through the proper overseeding of high-quality of grasses.

In practice, the classic overseeding method that uses a thick tined weeder, as opposed to ploughing the ground with a rotating hoe or plough, has proven to be the most effective - and rightly so because

- » this method largely preserves the high-quality grasses.
- » Grassland areas often cannot be ploughed because of their location.
- » Increased acreage performance (and therefore lower costs)
- » Areas remain stable
- » A cleaner plant population is created, as the weeds have no chance of growing through the old sward

Why maintain?

- » **Eliminating damage caused during winter**
Simple levelling is not enough to ensure a high grassland yield. Alongside the levelling off of mole and rodent hills and tackling of sward or trampling damage (e.g. through grazing) it is also important to get rid of dead, shallow-rooted grasses. Snow mould, which occurs in grass that has been left to grow too long during warm, rainy winters, must be got raked out.
- » **Encourage sward tillering**
The weeding tines cut the grass lightly, which encourages tillering. The grass grows back more thickly and produces more biomass.
- » **Close gaps in the sward**
Gaps in the sward must be oversown with valuable forage grasses, otherwise weeds, such as rough meadow-grass, can spread. You can carry out a preventative annual overseeding to avoid this. The risk of the ground surface becoming covered with molehills or other open gaps is very high.
- » **Incorporation of farmyard manure**
Farmyard manure and liquid manure must be reduced to small pieces and incorporated into the sward. If the manure remains on the plants, it can burn them and cause them to rot.
- » **Reduction of fodder contamination**
If molehills are not levelled off and distributed across the sward or if fertiliser is not incorporated correctly, during mowing or harvesting the grass it will end up in the fodder, increasing its potash content and making it indigestible.



One of the most important factors when it comes to increasing milk yield is increasing the fodder quality!

5.1 Levelling during spring

Levelling in spring with a simple pasture harrow has one major disadvantage: it does not have a disruptive effect on the already abraded harrowed fields. While this method does level off molehills, it does not remove any thatching or unwanted species of grass, such as rough meadow-grass.



5.2 Maintenance with a thick tined weeder

Only a thick tined weeder can level off the ground and remove any unwanted grass species at the same time. The ground can be worked very aggressively with the thick weeding tines. Rough meadow-grass, with its shoots above ground, can be effectively removed with an aggressively set grassland weeder. In addition, thatching plants, such as moss, or other unwanted species can also be removed by this method. Common grasses, such as ryegrass and cocksfoot, are able to better withstand the weeder and are not removed. Levelling with a grassland weeder only levels out the ground, it does not remove any plants.

A thick tined weeder in combination with a strong triangular front levelling plate and a drill acts as a maintenance, overseeding and under-seeding device all in one.

Maintenance in spring ("levelling"):

- » Molehills and organic fertiliser are incorporated
- » Unevenness and weeds are removed in one work process
- » Levelling off of the grassland after the winter
- » Tillering is encouraged
- » Dry conditions are required

Maintenance in late summer:

- » More common for pastures
- » Cleaning cut necessary



Meadow weeding has no weed regulating effect!

5.3 Combination of maintenance and overseeding

In practice it is recommended that you combine the maintenance and overseeding into one work process as this can save time and money. Therefore, we recommend combining both measures.

Overseeding in spring

Advantages of overseeding in spring before the first cut

- » Annual overseeding is ideal for maintaining a well-managed plant population
- » Closes gaps created by molehills and winter damage
- » Levelling off, removal of weeds and reseeding are combined in one work process
- » There is usually enough moisture to do this in early spring

Disadvantages

- » The first cut must be done in good time so that the sown grasses have enough light and air
- » An opening for the first cut cannot be guaranteed in areas with a high risk of late frost
- » Areas with droughts in spring can also pose a problem

Overseeding in late summer

Advantages of overseeding after the penultimate cut (mid-August to mid-September)

- » The ideal time for restoring grassland and getting rid of the removed material
- » Good time for carrying out maintenance for plant populations that have been less well managed
- » Mostly dry conditions are best for removing rough meadow-grass and other unwanted species from the plant population
- » As the days are getting shorter and there is often a lot of dew formation, there is usually sufficient moisture
- » There is less competition from the old sward due to the slowing vegetation growth

Disadvantages

- » Bi-annual pass required (once in spring to "level off" the ground and then once in late summer)
- » In particularly dry years, an opening cannot be definitely guaranteed
- » Subsequent maintenance in the following spring should therefore be done very carefully, since otherwise the young plants may be pulled out or damaged



Sufficient soil moisture or subsequent precipitation is important for successful overseeding.

5.4 Grassland maintenance timetable

GRASSLAND MAINTENANCE TIMETABLE					
January	February	March	April	May	June
No work		Aerate, level off	cut		
		Overseeding		Reseeding/ploughing	
Liming, fertilisation					
July	August	September	October	November	December
cut					No work
	Overseeding tackling rough meadow-grass				
Liming, fertilisation					



6. GRASSLAND MAINTENANCE TECHNOLOGY

The PNEUMATICSTAR range is a reflection of our many years of experience and development in grassland maintenance.

6.1 PNEUMATICSTAR-PRO: "The professional machine for professionals"

1. A heavy **triangular front levelling plate** to level off heaps of earth
Not sloping, but triangular
The flow of soil is channelled upwards and not spread across the ground
2. Stable, **movable frames** for optimal adjustment to the ground
Upwards and downwards movement of the folding joints– ideal adjustment to the ground
3. Parallelogram-guided, hydraulically-regulated and **fixed tine sections**
The tine pressure on the ground can be easily adjusted with the hydraulic cylinders. By connecting all cylinders to one another, the uneven ground is distributed over the entire working width. This means that the same tine pressure is applied across the entire working width.
4. **P-BOX** for optimal sowing, with option of computer-control.
5. **Distribution plate** with spray guard in the middle for ideal seed distribution
The first three tines open the sward and the last three distribute the seeds, guaranteeing ground contact.
6. **8 or 10 mm** (0.31" or 0.39") directly spring loaded **tines** with 2.5 cm (1") true line distance = 40 tines per metre of working distance and a 6-row tine section for the best possible pass!
7. **Filling step** for a simple and secure filling of the seed box.
8. **No trailing rollers** (see Chapter "Rolling in grassland")

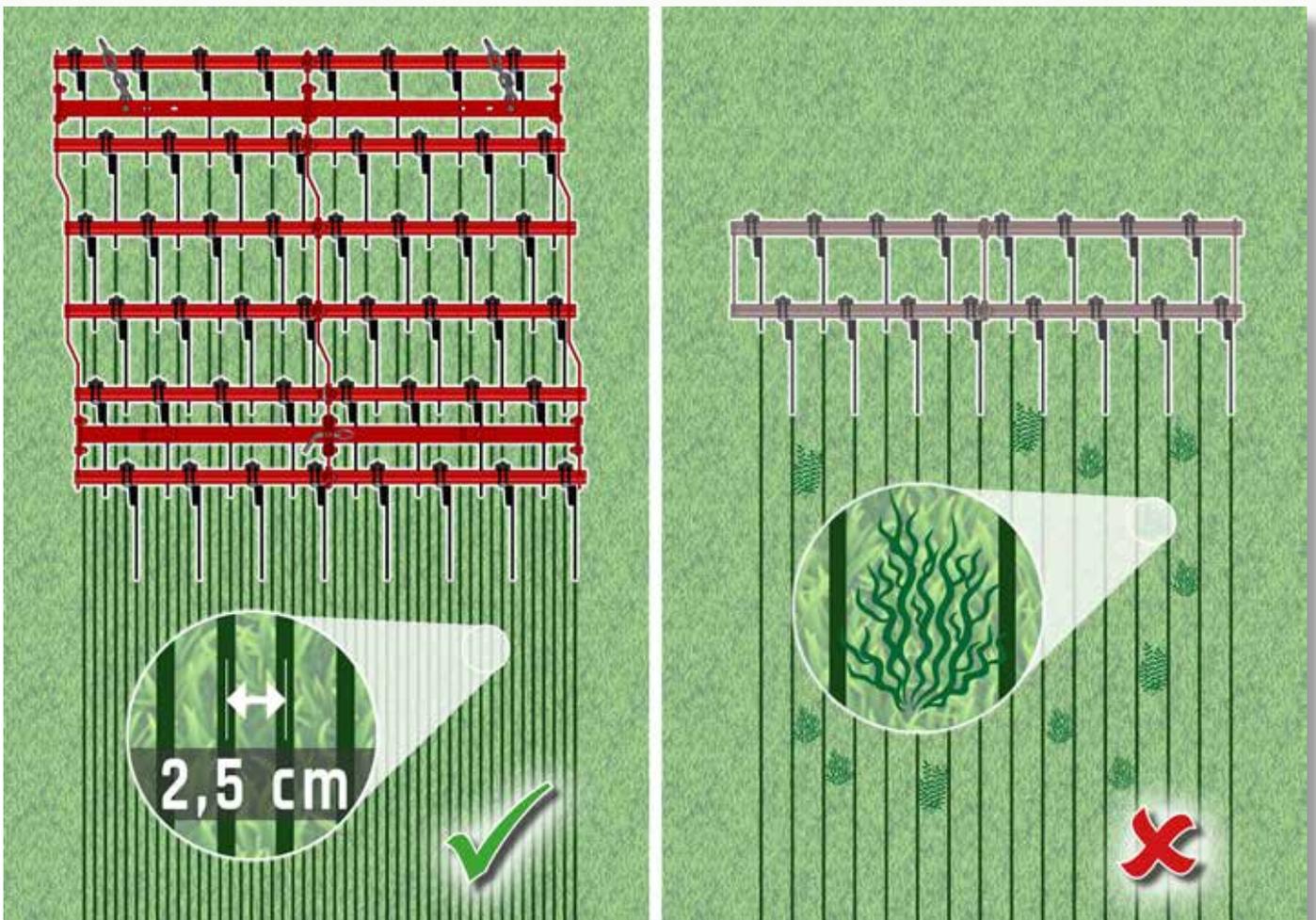




6.2 Line distance for grassland weeding

The line distance combined with aggressively adjustable tines is the main reason behind successful grassland overseeding.

In order to remove unwanted herbs and grasses successfully, the line distance between the tines needs to be narrow. This is the only way to work over the entire area and free the soil of rough meadow-grass.



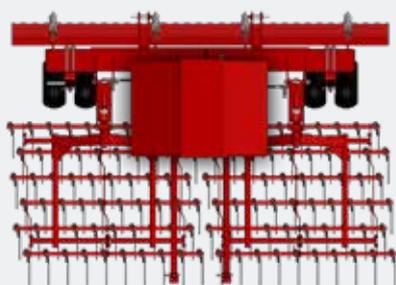
8-10 mm (0.31-0.39") thick tines with a line distance of 2.5 cm (1") get the best results.

7. ROLLING IN GRASSLAND

7.1 Why you should not combine weeding and rolling

- » The ideal working speed of weeding tines is **8-10 km/h (5-6 mph)**
- » The ideal working speed of rollers is max. **4-5 km/h (2.5-3 mph)**
- » Rollers cannot work effectively at high speeds
- » The rollers cannot press down across the entire working width due to the natural unevenness in the ground
- » The sward is hard anyway due to the heavy harvesting equipment used; pressing it down does not bring any further advantages
- » In wet conditions there is a risk of the rollers becoming bogged down or stuck
- » Pressing down on the soil makes it easier for weeds that have been previously uprooted to grow again
- » The rollers are only required for a reseeding (and NOT for maintenance)

7.2 Different requirements for weeding with or without rollers



3 m



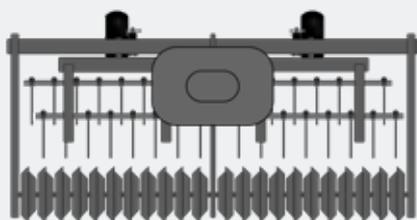
max. 8 - 10 km/h



60 PS = 20 PS/m



< 3 ha/h



3 m



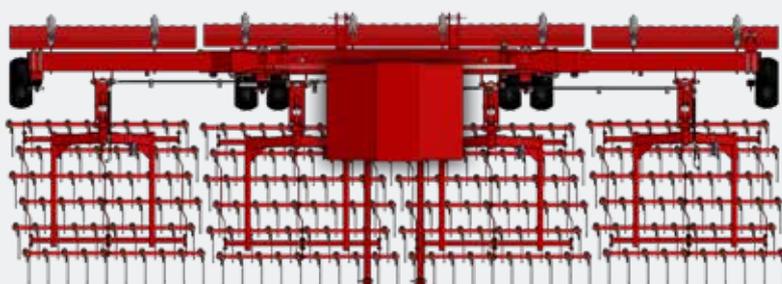
max. 4 - 5 km/h



90 PS = 30 PS/m



< 1.5 ha/h



6 m



max. 8 - 10 km/h



80 PS = 13.3 PS/m



< 6 ha/h

The roller is ideal for use in grassland restorations where there is a lot of loose soil (partly with ploughing up and reseeding). However, if the work is done properly, the rollers do not add any particular benefits. With most activities it is actually counter-productive, e.g. when weeding out rough meadow-grass, since we want to get rid of this plant and not press it back into the ground with a roller.



No roller can press in the seed across an entire area!

Rollers can only put individual "lines" into the ground on ground capable of bearing a load. The seeds are not pressed into the soil. The best option here would be to use the weeder tines to sow the seeds. The best consolidation is subsequent rainfall, as this allows the seeds to germinate safely.



Example: Farm with 30 ha of grassland

Measures	Machine	Area	Roller
Spring maintenance without overseeding	PNEUMATICSTAR or PNEUMATICSTAR-PRO	15 ha	
Spring maintenance with overseeding	PNEUMATICSTAR or PNEUMATICSTAR-PRO	15 ha	
Overseeding in summer	PNEUMATICSTAR or PNEUMATICSTAR-PRO	10 ha	
Restoration in summer with multiple passes	PNEUMATICSTAR or PNEUMATICSTAR-PRO	5 ha	No Under certain circumstances: Yes
Total		55 ha	5 ha

With 90% of passes, maintenance with the thick tined weeder without trailing rollers is recommended.
With 10% of passes, a subsequent rolling may be required.



No rolling is required with grassland maintenance!

8. TOP 10 FEATURES OF GRASSLAND WEEDERS

1. React to the identified problems with the **right solutions**
2. **Restore first then follow up with annual maintenance**
3. **Maintenance in spring and restoration in late summer**
4. Conventional levelling is **not useful here**
5. If the **weeder becomes clogged**, it must be cleaned and then **passed through the field again**
6. **No rollers for grassland maintenance**
7. Keep the **roller and weeder separate** when restoring the grassland.
8. **Do not spread/compress** piles of earth and molehills
9. Use a **mixture of grasses** that is suitable for the region
10. Do not forget the **liming**

9. EXAMPLE FROM PRACTICE

Practical example of the effect that weeds can have on your yield

Grassland target yield

- » Target yield: 10000 kg DM/ha
- » Energy density: 6.0 MJ NEL/kg DM
- » Protein content: 160 g/kg DM

DM = dry mass yield

Actual situation

- » 15 % gaps, docks (1 plant/m²) or other useless species of plant
- » Without calculating any additional damage, there is a "deficit" of:
 - 9000 MJ NEL per ha
 - 240 kg protein per ha

Loss of protein – replaced with soya

- » 240 kg: 40 x 100 = 600 kg soya (per ha GL)
- » 600 kg soya x € 0.39 = **€ 234.00** (per ha GL)

Energy loss - replaced with wheat

- » 9000 MJ/ha - 4400 MJ/ha (from soya) = 4600 MJ/ha
- » 4600 MJ: 7 MJ/1 kg wheat = approx. 600 kg wheat
- » 650 kg wheat x € 0.185 = **€ 120.00** (per ha GL)

Total energy and protein loss with 1 dock/m² (or 15% gaps)

- » 600 kg soya x € 0.39 = € 234.00
- » 650 kg wheat x € 0.185 = € 120.00
- » per ha of grassland **€ 354.00**

On average, meadows have at least 30% gaps or other lower-quality grasses:

Approx. € 700.00 loss per ha of grassland

With 0.5 docks/m² (damage threshold) =
€ 177.00 loss per ha of grassland

Meadow maintenance with the Einböck PNEUMATICSTAR

- | | | |
|--|---|-------------------|
| » Working speed 8-10 km/h | = | up to 6 ha/h |
| » Minus turning, filling and start-up time | = | 4 ha/h |
| » PNEUMATICSTAR grassland seeder | = | € 15.00/ha |
| » Tractor and driver | = | € 15.00/ha |
| » Seeds 8 kg - 10 kg per year | = | € 50.00/ha |
| » Maintenance costs per year | = | € 80.00/ha |

10. LIMING / FERTILISATION

10.1 Liming

To ensure that the overseeding is successful, we recommended liming shortly before or after the overseeding. For grassland, carbonic lime is the product of choice.

Weakens the docks - strengthens the grasses:

The advantage of lime is that it also suppresses unwanted plants such as docks. Since docks need acidic soil to germinate, by adding lime you're taking away their first chance to germinate.

Therefore, the lime supports the growth of the oversown grasses and herbs and fights against unwanted species. Many high-quality grasses, such as English ryegrass, timothy, Kentucky bluegrass, etc., require higher pH levels in order to establish themselves well.

If the overseeding includes a lot of legumes, liming is mandatory. Lucerne in particular requires a pH level of over 6.5.

However, the pH level is not the only decisive factor when overseeding, the calcium levels in the soil are also important.

If your soil has lower pH values, it is a good idea to over-seed with lucerne or red clover after liming. Liming can also be useful in soils with higher pH values in order to increase the "free calcium" in the soil.

It is best to do the liming just before or after the overseeding. Finely ground limestone is preferred as it more effective due to its larger surface area. Spreading with an auger spreader is usually the method of choice.

Maintenance or initial liming:

If the soil has not been limed for many years, starting by using a larger amount of lime than usual is recommended. However, with grassland it is recommended that you spread an average amount of lime every two years instead of large amounts of lime every 3-4 years.

Since the lime can be easily washed out, particularly during periods of high rainfall, spreading a large amount of lime every few years has a significantly lower success rate.

Maintenance liming: approx. 1000-1500 kg/ha of carbonic lime every 2 years at the time of the overseeding
Initial liming: approx. 1500-2500 kg/ha of carbonic lime for the first spreading, afterwards only maintenance spreading

Types of lime:

There are various different types of lime. Limestone powder, primarily consisting of calcium carbonate (CaCO_3), is mostly used for periodic liming to maintain or increase the pH level in the ground.

Dolomite powder is mainly made up of magnesium carbonate (MgCO_3). This lime is recommended if there is a lack of magnesium in the soil.

Natural gypsum powder on the other hand is mainly used to fertilise calcium (Ca) and sulphur (S). There is no alkaline lime in natural gypsum, which means that it does not affect the pH level of the soil. The calcium is present in the form of CaSO_4 and it helps mainly to build up the soil structure. More detailed information about this can be found under 10.4 Sulphur fertilisation.



Recommendation: Approx. 1000-2000 kg/ha of carbonic lime

10.2 Soil studies can help to find remedies

So that you do not carry out any unnecessary liming and fertilising, a soil study can help you to find suitable remedies. It should be noted that vital basic nutrients such as calcium, phosphorous, nitrogen, potassium and magnesium, as well as the pH level of the soil, should be studied.

The findings of these studies provide information about which nutrients you should fertilise with.

Only the correct balance of basic nutrients and trace elements can guarantee a successful overseeding.

10.3 Fertilisation

The grassland must be fertilised with the necessary basic nutrients and trace elements. You can use the previously performed soil study to see which nutrients and elements your soil needs.

Overseeding is only successful if the soil has no major nutrient deficiency.

Withdrawal-oriented (nitrogen) fertilisation

The Fertilising Ordinance provides for a maximum of 170 kg/ha of nitrogen on grassland (Fertilising Ordinance AT & DE).

These limits are sometimes reached after the withdrawal-oriented fertilisation of just 5-6 cut meadows. Therefore, the nitrogen available must be spread in a targeted and efficient way.

The amount of nitrogen required for 10t DM/ha is around 220 kg. Each % of clover can provide approx. 3-4.5 kg of nitrogen. Therefore, for a plant population with 15% clover you would need approx. 160 kg N/ha. However the withdrawal can vary wildly according to location, the mixture composition and intensity of use.

Mineral fertilisation:

It may be particularly useful to fertilise with mineral fertiliser when the plants are beginning to grow.

The quickly available nitrogen can be easily absorbed by the grassland.

When using mineral fertiliser, you must also remember to take the trace element levels of the soil into account. If you use mineral fertiliser, you may need to also use sulphur fertiliser in spring.

Organic fertiliser is recommended for permanent grassland in particular.



Organic fertilisation:

Organic fertilisation can help you to balance out any imbalances in the basic nutrients. Not only are nutrients such as nitrogen (N), phosphorous (P) and potassium (K) present in liquid and solid manure, but so are many other vital nutrients that play a key role in plant nutrition.

Fertiliser in the form of farmyard manure is particularly recommended for use in autumn after the last cut or in early spring. It is important to use well rotted manure so that you do not subsequently end up with organic material in the animal's fodder.

It is vitally important to apply liquid manure after each cut so that the grassland has enough nitrogen available quickly after growing. Care must be taken to ensure that you use thin liquid manure. Manure that is too thick does not wash into the soil as well and can damage the sward if there is hot weather afterwards.

Combination of organic fertiliser and lime:

In order to save passes over the meadows, you could spread lime in the barn instead.

These so-called "lime-straw mattresses" have two main benefits. First, they improve the air quality in the stall, and second, they allow the lime to spread along with the liquid or solid manure.

Manure lime, which is blown directly into the slurry pit, is also a great option.



Overseeding is only successful if there is the right balance of basic nutrients and trace elements in the soil and if they, together with the pH level, create a favourable soil structure.

10.4 Sulphur – an important nutrient

Calcium and sulphur are often forgotten in grassland management. What many people do not know is that their effect as a mineral in fodder is of great importance because calcium deficit, or milk fever, is one of the most common metabolic illnesses in cows during the calving period. In addition, high calcium content in the soil helps to ensure that your animals do not ingest too much potassium. An excessive amount of potassium could result in unfavourable DCAB values or fertility problems.

Most soils also have insufficient sulphur levels.

The most important thing here is the way in which the sulphur is introduced into the soil. One of the best ways of doing this is by using calcium sulphate (CaSO₄). In addition, clover and lucerne are known for their high annual sulphur requirements.

What are the signs of sulphur deficiency?

1. Low yields of leguminous fodder crops
2. Lightening of the plant population (low levels of chlorophyll)

The right answer in practice

One of the best sulphur fertilisation methods for grassland is fertilisation with natural gypsum. This method ensures that there are sufficient levels of sulphur throughout the entire season. (Tip: Make sure that the sulphur is magnesium-free!) Natural gypsum rock is also particularly suitable for this, since it has a high calcium sulphate (CaSO₄) content.

With gypsum, you can apply both the desired amount of calcium and sulphate at the same time. Natural gypsum contains sulphur in the form of sulphate. The sulphate is water-soluble and so it dissolves continuously throughout the entire season and guarantees regular fertilisation.

Sulphur liming is best done before the plants start to grow. As the conversion of sulphur in the soil progresses faster at higher temperatures, we recommend fertilising with sulphur in early spring.

Example:

Grassland that is used intensively has an annual sulphur requirement of 40-60 kg/ha. The soil often does not get enough sulphur through organic fertilisation alone. The conversion takes too long if the weather is too cold which is why it is best to carry out the sulphur fertilisation in spring.

Sulphur balance	
	Sulphur requirement in S kg/ha/year
Crude protein formation	approx. 22 kg
Plant growth	approx. 13 kg
Leaching	approx. 10 kg
Total requirement	approx. 45 kg

11. GRASS MIXTURES

Article by Michael Traxl, Head of Grassland & Field Forage Product Management, Saatbau Linz

In recent years, cattle and milk production have become much more intensive in many regions.

Progressive global warming, increasing numbers of animals on farms, as well as the demand for better fodder quality, are all factors which have caused the cut frequency of grassland areas to increase in the last few years. In many areas where it used to be normal to do 3 cuts a year, the new average is 4 or 5 cuts, and in meadows that were only cut 4 times a year before, it is now normal to do 5 or 6.

Due to the early cutting times, the concentration of the ingredients has increased, largely at the expense of the structure, which is particularly important for ruminants in order to maintain a stable environment in the rumen. This lost structure is often not sufficiently balanced or is balanced incorrectly, sometimes with fatal consequences for the animals.

11.1 Good basic forage saves concentrate

In order to produce more milk from basic forage, you need a high fodder quality. In practice, milk yield from basic forage varies and it is not the same from every cut. The only way to save concentrate is to have the best basic forage possible.

A milk yield of up to 6000 kg of milk/cow can be obtained from good basic forage with around 16-17% crude protein, 6.3 – 6.6 MJ NEL, 3.5 g P/kg dry mass (DM). This can even rise to 8000 kg of milk, if portions of arable basic forage (trefoil-grass, maize) are added. Short-grass pastures show the highest basic forage efficiency in grassland.

The better the quality of the basic forage, the greater the forage intake and the higher the yields. In order to achieve this, the grassland and forage must be optimally managed and maintained. One of the most important factors for the success of the basic forage is the plant population and its composition.

11.2 The meadow – a symphony of many different plants

Permanent grassland is a plant community. This community only works when all individual plants and all other factors (fertilisation, overseeding, harvesting, etc.) are in harmony with each other. If one thing is done incorrectly, it can have a negative effect on the entire plant community and this will be reflected in the yields and their quality.

A cut that is too deep delays the growth of the plants and therefore also the next cut. Unwanted plant species can establish themselves in any gaps that develop and they then have to be regulated later. With every measure they take, farmers intervene in plant communities and therefore, it is important to be aware of what effects each measure can have.

The basic forage quality really depends on the plant population, its time of use and its fertilisation.



Optimal grassland plant population: 60-80% high-quality grasses, 10-20% clover, 10-20% herbs

There is a range of high-quality seed mixtures available for different location and weather conditions, usage types and intensities, which can be used for the reseeding or overseeding of forage areas. Different mixture compositions are required depending on the intended use, whether for permanent pastures, permanent meadows, temporary pasture or for field forage cultivation.

If you want to protect the permanent grassland more effectively against drought stress, a mixture with a high percentage of cocksfoot or red clover is recommended. If leguminous plants and herbs get out of hand quickly, then grass-based mixtures are the right choice.



The most successful method is population management with regular/periodic overseeding. Restoring grassland after white grub damage, drought stress or due to high levels of weeds (rough meadow-grass) is significantly more costly and time-consuming. Periodic overseeding or restoration is best done after the third or fourth cut around the middle or end of August. If there are large gaps in the ground coverage or lots of molehills, this can also be done in conjunction with the meadow maintenance in spring before the first cut.

11.3 Grasses provide the yield

Grasses make up the largest part of the plant communities in meadows. Above all, they are the largest bulk producers on permanent grassland and thus guarantee the yield, provided that they are managed optimally. In any case, a grassland mixture should always contain English ryegrass (also known as perennial ryegrass). As a real all-round talent, it can withstand frequent cuts, is firm, grows back very quickly, covers the ground well, has high carbohydrate and crude protein values when used in good time, responds very well to fertilisation, and much more.

Meadow fescue and timothy are top grasses, which give a mixture more winter hardiness, which is often needed in cooler or harsher locations. In addition, they are very suitable for fodder as they have a nutritive value of 8 (the highest possible value).

Most of the floor is covered by Kentucky bluegrass. As a bottom grass, it covers the free soil surface early and prevents unwanted species from germinating. Its good sward-formation properties and ability to re-grow well makes it essential for pastures, and a great partner for permanent meadows. Kentucky bluegrass is very difficult to establish as it has a very slow early growth and is competitively weak. Therefore, mixtures usually contain high amounts of this particular grass.

Droughts in permanent grassland often have serious consequences as grasses need large quantities of water. Cocksfoot works a little differently but still achieves fairly good yields. This grass needs less water and is therefore better suited to drier locations and longer periods of drought. There are other grasses (red fescue, golden oatgrass, oatgrass, etc.), which should not be missing from a mixture, particularly if the grassland is used intensively.

11.4 Leguminous plants are key suppliers of crude protein

Leguminous plants should be the second most common plant in the meadow. They are an important source of crude protein and animals love eating them. One of the most important leguminous plants is white clover. It has the highest nutritive value of all leguminous plants, binds a lot of nitrogen, tolerates a lot of cuts (unavoidable in pastures), is very difficult to oust from the ground since, among its other qualities, it is very robust .

Red clover and lucerne are typical arable plants that have found their way into permanent grassland in dry years. With a strong root system, they can root themselves in deeper soil layers and so better withstand periods of drought. The disadvantage of these plants is that they are very hard to control and can spread a lot in very dry years (this is particularly the case with lucerne).

Alsike clover and bird's-foot trefoil are not a top priority for fodder as they have a low nutritive value. They are undemanding and can be found mainly in extremely dry and barren locations or on slopes, for example.



11.5 Herbs make the fodder tasty

Herbs increase the elasticity of forage utilisation and the mineral content of the growth. Due to their contents they significantly contribute to the palatability of the fodder and therefore increase the intake.

The most important species of herbs are:

- » Ribwort plantain
- » Yarrow
- » Dandelion
- » Caraway
- » Hogweed

Poisonous and potentially poisonous plants must be avoided and destroyed if necessary. They can have a negative effect on animal health.



11.6 Variety choice means elasticity

In addition to all the plants that are needed, the choice of variety is also crucial. Varieties with different maturity times have a greater elasticity in use and therefore allow for a larger harvest window. With intensively managed meadows with multiple cuts, the use of fast-growing, early to medium maturing varieties is recommended. With typical 3-cut meadows, it is better to use medium to late maturing varieties.

Mixtures that are commercially available are usually optimally matched to requirements with regard to the variety choice. However, attention should be paid to the exact composition of the mixture because one thing is clear, the varieties in an intensive reseeding mixture for favourable locations are definitely not suitable for use on a farm at 800 m above sea level with 3 cuts.

Recommended grasses and habit								
Species	Habit	Pure stands quantity	Permanent pastures				Permanent meadows (for mowing)	
			dry	fresh	humid	rough	mild/medium	rough
Intensive								
White clover	S	20	●	✓	✓	✓	✓	✓
Cocksfoot	TF	20	✓	✓	●	✓	✓	✓
Meadow foxtail	S	30	–	●	✓	–	–	–
Timothy	TF	20	●	✓	✓	✓	✓	✓
Engl. ryegrass	TF(S)	25	–	✓	–	–	✓	–
Kentucky bluegrass	S	30	✓	✓	✓	✓	✓	✓
Medium								
Alsike clover	T	20	–	●	✓	●	–	●
Oatgrass	TF	40	✓	✓	●	●	●	●
Golden oatgrass	TF	20	✓	✓	●	✓	●	●
Meadow fescue	TF	30	●	✓	✓	✓	✓	✓
Extensive								
Bird's-foot trefoil	T	30	✓	✓	●	✓	●	●
Black medic	T	30	●	–	–	–	●	–
Smooth bromegrass	S	–	✓	–	–	–	–	–
Red fescue	S, TF	30	✓	✓	●	✓	✓	✓
Black bent	S	20	–	–	✓	●	●	●
Common bent	S	20	–	–	–	●	–	●
Crested dog's tail	TF	30	–	–	–	●	–	●

✓ = well suited

● = suitable only to a limited extent

– = not suitable

S = Sward-forming

TF = Tuft-forming

T = Taproot

Source:
cf. "Grünlandnachsaat"
(2nd edition 2010)
Publisher:

Provincial Chamber of Agriculture of Austria



Grass mixtures should be adapted to the climate, region and intensity of use



12. IMPROVING THE PLANT POPULATION

12.1 Problems

- » Pronounced summer droughts - less high-quality grasses
- » Precipitation is decreasing all year round
- » Temperatures are increasing – +2°C in the last two years
- » White grubs – mostly a consequence of grassland damaged by drought



White grubs



Drought damage

12.2 Solutions for tackling white grubs

- » Balanced plant population
- » Extensive ground cover results in lower soil temperatures and therefore a lower risk of white grubs.
- » High-quality grasses with better root growth can better withstand extreme situations.



Ideal plant populations are less susceptible to white grubs or droughts.

12.3 Create drought-tolerant grassland

- » Adapt the range of varieties
- » Ensure a sufficient cutting height
- » Overseeding and maintenance is becoming increasingly important.

Cocksfoot - the drought-tolerant stem grass

Cocksfoot should have a fixed place in drought-tolerant mixtures, since it is one of the few grasses that can withstand droughts well.

Its nutritive value is not as high as that of perennial ryegrass, so the composition of the grasses in the mixture is particularly important.

Around 20% of the plant population in dry locations should be cocksfoot.



Red clover - drought-tolerant leguminous plant

In general, the best leguminous plant for grassland is white clover. However, when it comes to choosing a drought-tolerant variety, red clover is the best option. You should try to establish this in your grassland plant population to a certain extent. The main problem with red clover is that it usually does not tolerate being cut and therefore must be oversown each year. Furthermore, red clover is a vital supplier of crude protein and should account for 10-15% of the plant population in grassland.



12.4 Further findings

The future of drought tolerant grassland will be a middle ground in terms of yields. The aim in the future will be to ensure fewer variations in yields; maximum yields will no longer be controlled. The aim of drought tolerance is to generate yield reliability. In addition, in the past 10 years we have seen that cocksfoot and red clover have developed comparatively well during the dry period.



Optimal plant population = consistently high yields

13. AREA-SPECIFIC SEEDING

13.1 Reasons for using the ISARIA sensor system in grassland

N fertilisation

The main argument for the use of the ISARIA sensor system is to guarantee the efficient use of fertilisers. With the help of the "sensor analysis", the plant population can be evaluated and you can determine exactly how much N should be applied. Grassland needs different quantities of N at different cutting times, from the first cut in spring, to the last cut in autumn. The reason for this is that the yield continuously decreases from the first to the last cut and so the fertiliser quantity must be adapted to the cut.

- » Supply yield zones with N in a targeted way
- » Targeted use of mineral fertilisers
- » Precise analysis of the liquid manure utilisation and exact measurement of the mineral fertiliser application.
- » Restriction of the N fertilisation through the Fertilisation Ordinance through the targeted distribution of N to increase yield and higher N efficiency

Grassland overseeding

Thanks to the sensor-supported evaluation of biomasses, it is possible to determine spectrally the degree of ground coverage. Due to the recommended increases, areas with low ground coverage are oversewn with higher quantities of seed. At the same time, the sensors detect areas with higher floor coverage and over-seed them with lower quantities of seed.

- » Optimised seed quantities -> lower levels of weed pressure
- » No waste of seeds (savings potential)
- » Higher basic fodder yield (literature and opinions of grassland experts)



13.2 How the ISARIA plant sensor works

The Isaria plant sensor from Fritzmeier measures the intensity of the light reflected off the ground and plants after illuminating them with red and near-infrared light. In addition, four LEDs in each sensor head send light with four different wavelengths in short intervals. Different plants and the soil reflect this light to different degrees. A light detector measures the intensity of the reflection in the four relevant wavelengths.

Fritzmeier uses the reflection values collected to calculate its own two indexes, the Isaria Reflectance Measurement Index (IRMI) for the nitrogen supply to the plant, and the Isaria Biomass Index (IBI) which measures floor coverage and crop growth. The exact wavelengths used by Fritzmeier to calculate the indexes are a company secret.

Good to know...

- » The plant sensor identifies good and poorly developed areas.
- » The "smart4grass" sensor function allows for an automatic adjustment of the seed rate for the grass overseeding.
- » The Isaria sensor transfers the target values to the computer of the seeding device.
- » The computer then adjusts the speed of the sowing shaft.



14. TEST REPORT

Summary of the test report: "Improvement of the drought-tolerance and range of species in high-yield grassland"
Report 2018-2020 by Dipl. Eng. Peter Frühwirth | Provincial Chamber of Agriculture of Upper Austria

14.1 Facts & figures about the test

Pilot farm: Upper Austria, 4572 St. Pankraz

Test duration: 2018-2021

Overseeding technology: Grassland seeder PNEUMATICSTAR-PRO, 6 m working width, Ø 10 mm tines

Plant population:

The plant growth of the test area was characterised by a very high percentage of English ryegrass, with a good dockage of white clover and a low, but well-distributed, percentage of golden oatgrass. The dockage of cocksfoot was low and was a result of the overseeding in 2016. In addition, there was a high percentage of rough meadow-grass.

Mowed: 5X per year

Nutrient supply:

Excluding liquid manure (around 20 m³/ha, 6x per year). Maximum 25% thinning from the second liquid manure spreading.

Overseeding mixtures:

Three different overseeding mixtures were spread. These mixtures contained the following components:

Mixture 1: 50% cocksfoot, 21% timothy, 29% red clover

Mixture 2: 44% cocksfoot, 12% timothy, 44% red clover

Mixture 3: 50% cocksfoot, 50% red clover

Overseeding variants

The entire test area was split into "restorative overseeding" and "periodic overseeding".

Amount spread during restorative overseeding (abbreviated as RO hereinafter): 30 kg/ha

Amount spread during periodic overseeding (abbreviated as PO hereinafter): 15 kg/ha

Aims of "restorative overseeding"

The aims of "restorative overseeding" are significantly different to that of "periodic overseeding". The main aim of restoration is to remove the rough meadow-grass and transform the plant population quickly. The restorative overseeding is a one-off measure and should prepare the ground for later subsequent periodic overseeding.

Aims of "periodic overseeding"

"Periodic overseeding" is particularly useful in areas where there is not a lot of rough meadow-grass and where there are gaps or uncovered ground. This is a prerequisite to allow new grasses to germinate without any major problems. However, consistent and, above all, long-term implementation is decisive for success. With a 4-cut use, the ground should ideally be oversown every 2 years. If the grassland is cut 5 times a year, periodic overseeding must be integrated into the grassland management as a standard measure.



Remove lower-quality grasses - let higher-quality grasses become established

14.2 Restorative overseeding

Raking

The PNEUMATICSTAR-PRO grassland seeder (working width of 6 metres) removed as much of the thatched rough meadow-grass as possible through double-cross weeding. The tines were set as aggressively (vertically) as possible. Between the first and second cross-weeding, and after the second weeding passage, the material removed was swathed and transported away from the area by loader wagon. At the end, the seeds were sown with the tines flattened.

Over-seed quantity: 30 kg/ha

Optimal time: In August

Result

The plant population was very dry due to the weather at the time. The rough meadow-grass could be almost 100% removed from the plant population by “weeding”. Do not let the appearance after a successful restoration worry you. The open spaces and brown ground simply indicate how much the rough meadow-grass has already affected the grassland population.

Unfortunately, due to the aggressive way of working with the vertical tines, a lot of English ryegrass and white clover was also removed. However, as there were high amounts of English ryegrass and because white clover usually grows and spreads well, this did not pose a problem. After all, the main goal of a restoration is to completely remove all rough meadow-grass from the plant population. There was then enough space left to establish the overseeding mixture and the ground provided an ideal foundation for a successful plant population conversion with high-quality fodder grass species. There was no rolling.



Before

After



After 2 weeks



After 6 weeks

14.3 Periodic overseeding

Raking

Thick tined grassland weeders, like the PNEUMATICSTAR-PRO, have also proved to be effective when used for periodic overseeding. The tines are set aggressively (slightly sloping) or nor (flat) according to the plant population, depending on whether there is a large or a small amount of rough meadow-grass. On the "periodic overseeding" test area, test mixtures were applied by the seeder passing over with flat set tines (penultimate hole).

Over-seed quantity: 10- 15 kg/ha

Optimal time: In August

Result

The red clover and cocksfoot included in the overseeding mixture have clearly established themselves from the second year of the overseeding. Fortunately, generally the English ryegrass also remained intact and was able to reach its full yield potential in 2020 thanks to the optimal weather conditions. Therefore, the dry matter yields were only slightly lower than those of the restoration (see Yields - Tests Results).



14.4 Yields - Tests Results

The following yields come from the cut in the second year following the restoration (in 2020). Harvest and preservation losses are not taken into account. The tests were done with three different overseeding mixtures and then compared with the zero variant, where no overseeding was done.

Dry mass yield (Abbr. DM) second year after the restoration

Restorative overseeding yields:

Mixture 1: 11.08 t DM/ha

Mixture 2: 12.09 t DM/ha

Mixture 3: 12.69 t DM/ha

Zero variant: 10.99 t DM/ha

Periodic overseeding yields:

Mixture 1: 11.95 t DM/ha

Mixture 2: 10.82 t DM/ha

Mixture 3: 12.35 t DM/ha

Zero variant: 10.42 t DM/ha

Crude protein yields (Abbr. XP)

Restorative overseeding yields:

Mixture 1: 1,70 t XP/ha

Mixture 2: 1,98 t XP/ha

Mixture 3: 2,11 t XP/ha

Zero variant: 1,64 t XP/ha

Periodic overseeding yields:

Mixture 1: 1,81 t XP/ha

Mixture 2: 1,71 t XP/ha

Mixture 3: 1,87 t XP/ha

Zero variant: 1,64 t XP/ha

Protein contents (Abbr. XP)

Restorative overseeding protein contents:

Mixture 1: 15.6% XP

Mixture 2: 16.6% XP

Mixture 3: 16.9% XP

Zero variant: 15.4% XP

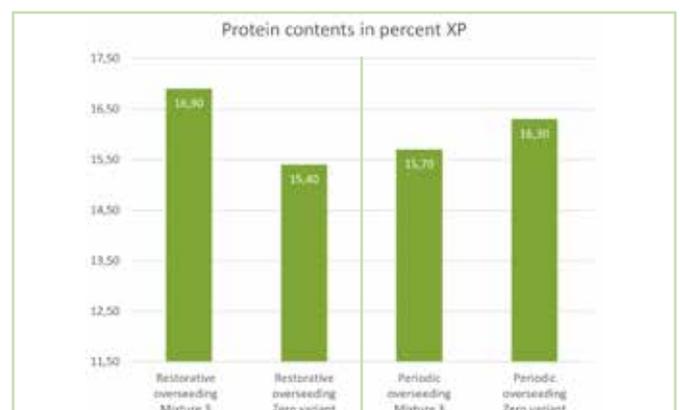
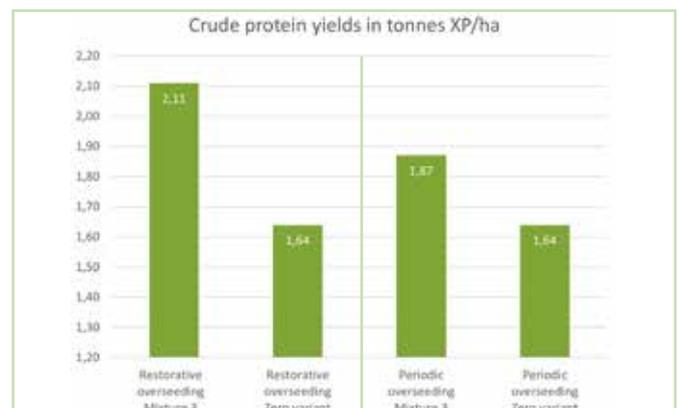
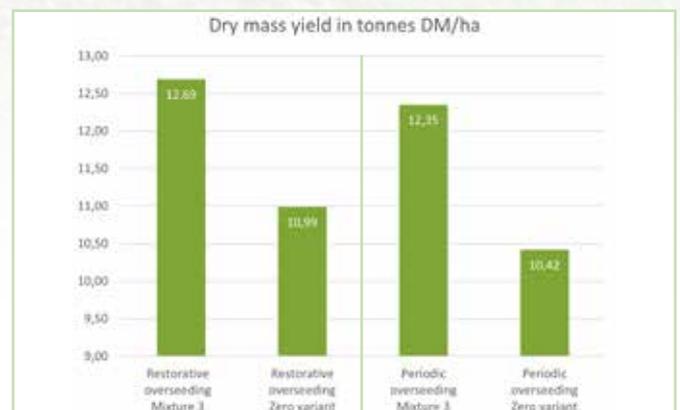
Periodic overseeding protein contents:

Mixture 1: 15.9% XP

Mixture 2: 16.5% XP

Mixture 3: 15.7% XP

Zero variant: 16.3% XP



Results of the test report:

The restoration carried out with Mixture 3 had the highest XP and DM yields. In the periodic seeding, the XP% contents were on average better with the zero variant. Despite this, the overall XP contents were significantly higher with an overseeding.

14.5 2019: A year of drought

Due to the extreme dryness in 2019, no fodder analyses and no yield surveys were carried out during this year. Above all, however, because the restoration overseeding had to build up a yield-generating stock in the first growth. The oversown grasses and red clover were already fully developed by the second growth.

There were drastic differences between restorative overseeding, periodic overseeding and the respective zero variant in terms of the visual appearance and the measured plant population height. From the first to the fourth growth, the restorative overseeding stood out clearly and positively compared to all other variants. In particular, cocksfoot and red clover dominated the plant population after the restorative overseeding. The English ryegrass was still yield-generating up to the second growth, although clearly declining. In the summer months, it was then only involved in the formation of mass to a very minor extent.



Starting population (zero variant) in the second growth on 17th June 2019. Approx. 20 cm growth height. Here the lack of precipitation is already having a major impact.



Restorative overseeding second growth on 17th June 2019. Approx. 45 cm growth height. Cocksfoot, timothy and red clover have all developed very well. Engl. as a bottom grass, ryegrass makes the plant population dense (ears in the foreground).



Restorative overseeding third growth on 23rd July 2019. The red clover formed a very good mass during the persistent drought. Plant population height approx. 40 cm.



Periodic overseeding in third growth on the 23rd of July 2019. Plant population height approx. 25 cm. Significantly less mass formation than with restorative reseeded due to the dryness.

14.6 Calculation of costs

Restoration costs	Duration per ha (hours)	Costs in € per ha
Cross-weeding (2 passes)	1.50	108.00
Raking		22.00
Transporting away	0.75	75.00
Cross-weeding (2 passes)	1.50	108.00
Raking		22.00
Transporting away	0.75	75.00
Seeding with seeder (5th pass)	0.75	54.00
Total for restoration		464.00
Cost of seeds (Mixture 3 ÖAG quality seeds)	5.73 €/kg, 30 kg/ha	172.00
Total costs for the restoration measure		€ 636.00

"Periodic overseeding" costs	Duration per ha (hours)	Costs in € per ha
Seeding with seeder	0.75	54.00
Total for "periodic overseeding" (terminated system)		54.00
Cost of seeds (Mixture 3 of ÖAG quality seeds)	5.73 €/kg, 15 kg/ha	86.00
Total costs for the periodic overseeding measure		140.00

	Fodder range for cows in %	Milk proceeds per ha (based on NEL) up to in €	Milk proceeds per ha (based on nXP) up to in €
Restoration Mixture 3	115%	€ 5491.00	€ 6400.00
Zero variant	100%	€ 4842.00	€ 5450.00
Additional proceeds compared to the zero variant		€ 650.00	€ 951.00

	Fodder range for cows in %	Milk proceeds per ha (based on NEL) up to in €	Milk proceeds per ha (based on nXP) up to in €
Periodic overseeding Mixture 3	121%	€ 5313.00	€ 6076.00
Zero variant	100%	€ 4447.00	€ 5166.00
Additional proceeds compared to the zero variant		€ 866.00	€ 910.00

14.7 Summary of costs and proceeds

As this practical test shows, periodic overseeding is a more financially useful "investment" than restoration. The costs of the overseeding variant can be covered quickly, sometimes in less than a year, thanks to the increased yields and resulting higher milk proceeds. In addition, this test has shown that there is also a very high potential for protein yield in grassland.

15. SUMMARY

In order to create and maintain successful grassland, there are several important steps that must be taken:

1. Identify causes
2. Determine suitable measures
3. Counteract early with the right meadow maintenance and overseeding
4. With major damage, renew the grassland with a reseeding
5. Harvest success

Why choose the PNEUMATICSTAR-PRO?

1. Ideal maintenance device for meadow maintenance in spring
2. Ideal overseeding device for the reseeding or overseeding of grassland plant populations
3. Meadows are aired and planting is encouraged
4. Weeds rooted on the surface are regulated
5. Gaps are filled in with annual overseeding
6. High acreage performance with lower costs



Additional brochures on "GRASSLAND MAINTENANCE & ORGANIC FARMING":

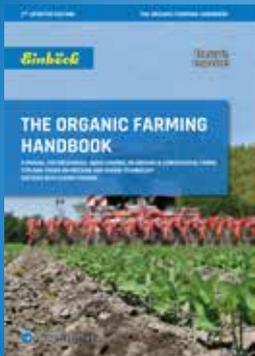


GRASSLAND CARE

- » Grassland weeder
GRASS-MANAGER(-PRO)
- » Grassland seeder
PNEUMATICSTAR(-PRO)
- » Sports field weeder
SPORTSTAR

SEEDING & FERTILISING

- » Pneumatic seeding box
P-BOX-STI | P-BOX-MD
- » Pneumatic front tank
JUMBO-SEED
- » Mechanical seeding box
DRILLBOX | MECHANICBOX
- » Row crop drill
CHOPSTAR-SEEDER

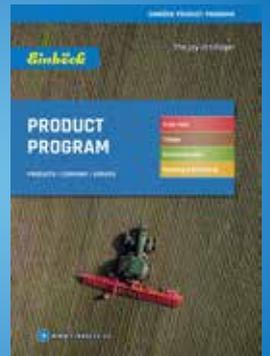


ORGANIC FARMING

- » Guide to mechanical weed control
- » Tips and interesting facts about weeding and hoeing technology
- » With FUSION FARMING to success

PRODUCT RANGE

- » Crop care
- » Tillage
- » Grassland care
- » Seeding & fertilising



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