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Promilleafgiftsfonden for landbrug

X Longevity of seeds of Italian rye-grass following different stubble cultivation treatments

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Italian rye-grass (*Lolium multiflorum*) is in some areas considered a troublesome weed. The purpose of the present experiment was to test the influence of different stubble treatments on the longevity of newly shed seeds of Italian rye-grass. Two types of experiments were conducted, a field experiment using normal tillage implements and a small plot field experiment simulating the influence of various tillage treatments on placement of seeds in the soil profile. In the experiment simulating tillage treatments, samples of seeds were placed at distinct soil depths and the longevity of the seed samples following these treatments was assessed. In the field experiment using relevant tillage implements the working depth of the implement was controlled, but the influence on the placement of the seeds in the soil profile following the treatment was not assessed. However, assessing Italian rye-grass seedling emergence and longevity in the two types of studies gives an indication of how seed incorporation in the soil profile is influenced by the tillage implements. Both trials were repeated twice in 2015 and 2016. In both experiments newly harvested seeds of Italian rye-grass (cultivar Fox) were used.

The field experiment was in both years carried out in a stubble field after harvest of winter barley and removal of the straw. Treatments, assessments and applications are shown in Table 1.

Table 1. Treatments, assessments and applications in the field experiment.

Activity	2015	2016
Harvest of winter barley and removal of straw	3 August	18 July
Distribution of Italian rye-grass seeds on stubble	4 August	1 August
1st stubble treatment	4 August	1 August
2nd stubble treatment	24 August	23 August
1st count of germinated rye-grass seedlings	14 September	14 September
Control of germinated rye-grass seedlings with glyphosate before seedbed preparation	16 September	15 September
Seedbed preparation	30 September	27 September
2nd count of germinated Italian rye-grass	19 December	14 December

Italian rye-grass was sown in the stubble at a rate corresponding to 235 seeds per m2 in 2015 and 80 seeds per m^2 in 2016. The different stubble treatments included in the field trial are shown in Table 2. The implements used for stubble treatment and seedbed harrowing are shown in photos 1-3. The seedbed treatment in late September included driving with a seedbed harrow or a direct drilling machine but without sowing of a crop. Seedlings of Italian rye-grass were counted two times in the autumn (Tables 3 & 4). The first assessment shows the influence of the stubble cultivation treatments on the establishment of Italian rye-grass seedlings and the late assessment in December is taken as an indicator of the effect of the stubble cultivation treatments on longevity of rye-grass seeds. On the first assessment date in 2015 (Table 3) there was a reduced number of plants in treatments with stubble harrowing to 5 and 10 cm depth compared with treatments with no cultivation at all and the shallow treatments with the flex-tine weeder. The number of seedlings was lowest in treatments with stubble harrowing to 5 and 10 cm depth 3 weeks after harvest. This is probably due to a control of a proportion of the emerged seedlings

using this intensive treatment. Using the flex-tine weeder there was no difference in Italian rye-grass seedling density as affected by timing. This indicates that the second treatment with the flex-tine weeder did not control emerged seedlings. The results of the first assessments also show that emergence and establishment of Italian rye-grass seedlings in the stubble were unaffected of whether the stubble was left undisturbed or a shallow soil disturbance was made using the flex-tine weeder. The results of the early assessment in 2016 (Table 4) followed the same trend with a lower number of Italian rye-grass seedlings following the two stubble cultivation treatments to 5 or 10 cm depth. Following the first assessment emerged seedlings was controlled with a glyphosate application and later in the month a seedbed was prepared using the treatments described in Table 2. Seedlings of Italian rye-grass following the seedbed preparation were counted in December (Tables 3 and 4). The density of seedlings at this assessment date is taken as an indication of the longevity of seeds of Italian rye-grass following the different stubble treatments. The density was, however, generally very low in both years, and therefore no significant differences between stubble treatments were found. It cannot be precluded that some dormant seeds are remaining in the soil, and this would especially be expected following the two deeper stubble cultivations to 5 and 10 cm depth.

Flex-tine weeder.

Horsch direct drill.

Seedbed harrow.

Stubble harrow.

Table 2. Stubble treatment – timing, implement and tillage depth.

Treatment number	Immediately after harvest (4 August)	Approximately 3 weeks after harvest (24 August)	Seedbed late September (30 September)
1.	None	None	2 x seedbed harrowing 2-4 cm
2.	2 x flex-tine weeder 1-2 cm		2 x seedbed harrowing 2-4 cm
3.	2 x flex-tine weeder 2-4 cm		2 x seedbed harrowing 2-4 cm
4.	2 x stubble harrowing 5 cm		2 x seedbed harrowing 2-4 cm
5.	2 x stubble harrowing 10 cm		2 x seedbed harrowing 2-4 cm
6.		2 x flex-tine weeder 1-2 cm	2 x seedbed harrowing 2-4 cm
7.		2 x flex-tine weeder 2-4 cm	2 x seedbed harrowing 2-4 cm
8.		2 x stubble harrowing 5 cm	2 x seedbed harrowing 2-4 cm
9.		2 x stubble harrowing 10 cm	2 x seedbed harrowing 2-4 cm
10.	2 x flex-tine weeder 1-2 cm	2 x flex-tine weeder 1-2 cm	2 x seedbed harrowing 2-4 cm
11.	None	None	No-till drilling
12.	2 x flex-tine weeder 1-2 cm		No-till drilling
13.	2 x flex-tine weeder 2-4 cm		No-till drilling
14.	2 x stubble harrowing 5 cm		No-till drilling
15.	2 x stubble harrowing 10 cm		No-till drilling
16.	2 x flex-tine weeder 1-2 cm	2 x flex-tine weeder 1-2 cm	No-till drilling

Table 3. Density of Italian rye-grass seedlings following different stubble cultivations in 2015.

Immediately after harvest (4 August)	Approximately 3 weeks after harvest (24 August)	Seedbed late September (30 September)	No. of rye-grass seedlings per m^2 (14 September)	No. of rye-grass seedlings per m^2 (19 December)
None	None	Seedbed harrow 2-4 cm	52	0.25
Flex-tine weeder 1-2 cm		Seedbed harrow 2-4 cm	71	0
Flex-tine weeder 2-4 cm		Seedbed harrow 2-4 cm	73	0
Stubble harrow 5 cm		Seedbed harrow 2-4 cm	38	0.25
Stubble harrow 10 cm		Seedbed harrow 2-4 cm	28	0.5
	Flex-tine weeder 1-2 cm	Seedbed harrow 2-4 cm	55	0.5
	Flex-tine weeder 2-4 cm	Seedbed harrow 2-4 cm	46	0
	Stubble harrow 5 cm	Seedbed harrow 2-4 cm	16	0.75
	Stubble harrow 10 cm	Seedbed harrow 2-4 cm	9	0.25
Flex-tine weeder 1-2 cm	Flex-tine weeder 1-2 cm	Seedbed harrow 2-4 cm	71	0
None	None	No-till drilling	72	0
Flex-tine weeder 1-2 cm		No-till drilling	73	0
Flex-tine weeder 2-4 cm		No-till drilling	79	0.25
Stubble harrow 5 cm		No-till drilling	36	0.5
Stubble harrow 10 cm		No-till drilling	27	0
Flex-tine weeder 1-2 cm	Flex-tine weeder 1-2 cm	No-till drilling	60	0.25
LSD (p=0.05)			17	NS

Table 4. Density of Italian rye-grass seedlings following different stubble cultivations in 2016.

Immediately after harvest (4 August)	Approximately 3 weeks after harvest (24 August)	Seedbed late September (30 September)	No. of rye-grass seedlings per m^2 (14 September)	No. of rye-grass seedlings per m^2 (14 December)
None	None	Seedbed harrow 2-4 cm	6	0.75
Flex-tine weeder 1-2 cm		Seedbed harrow 2-4 cm	8	0.75
Flex-tine weeder 2-4 cm		Seedbed harrow 2-4 cm	7	0.5
Stubble harrow 5 cm		Seedbed harrow 2-4 cm	6	1.5
Stubble harrow 10 cm		Seedbed harrow 2-4 cm	6	0.75
	Flex-tine weeder 1-2 cm	Seedbed harrow 2-4 cm	5	0.5
	Flex-tine weeder 2-4 cm	Seedbed harrow 2-4 cm	5	0.75
	Stubble harrow 5 cm	Seedbed harrow 2-4 cm	2	0.0
	Stubble harrow 10 cm	Seedbed harrow 2-4 cm	3	0.25
Flex-tine weeder 1-2 cm	Flex-tine weeder 1-2 cm	Seedbed harrow 2-4 cm	9	0.25
None	None	No-till drilling	8	0.5
Flex-tine weeder 1-2 cm		No-till drilling	9	0.75
Flex-tine weeder 2-4 cm		No-till drilling	9	0.5
Stubble harrow 5 cm		No-till drilling	4	0.25
Stubble harrow 10 cm		No-till drilling	4	0.25
Flex-tine weeder 1-2 cm	Flex-tine weeder 1-2 cm	No-till drilling	7	0.25
LSD (p=0.05)			3	NS
* NS = not significant				

The small plot field experiment was carried out using seeds from the same seed lot. Samples of 400 seeds were counted and placed either at the soil surface or buried at different depths in the first week of August. Two treatments included placement of the seeds at the soil surface. In the first treatment seeds were left directly at the soil surface, whereas in the second treatment a shallow harrowing was carried out with the fingers to mimic shallow soil tillage. The treatments with placement of seeds at the soil surface was carried out in small pots, whereas the treatments including burial at different depths were carried out using samples with seeds mixed with soil and placed in fabric mesh bags. By the end of September all samples were collected from the field and a germination test was carried out in the laboratory. During the germination test soil samples were kept moist to ensure optimal conditions for germination. The number of germinated seedlings was counted when emergence ceased, and this figure (Figures 1 and 2) is taken as an indication of the influence of the various field treatments on the longevity of Italian rye-grass seeds. The result varied between the two years. In 2015 (Figure 1) the lowest viability was found in seeds left at the surface, and there was no influence of finger harrowing. With increasing depth increasing viability was generally found this year. Obviously it seems that the “finger harrowing” had a limited influence on seed placement and hence longevity. In 2016 there was no significant difference between seeds left at the surface and seeds incorporated to 5 cm depth. A larger viability was, however, also seen in 2016 for seed samples incorporated to 10 and 25 cm depth.

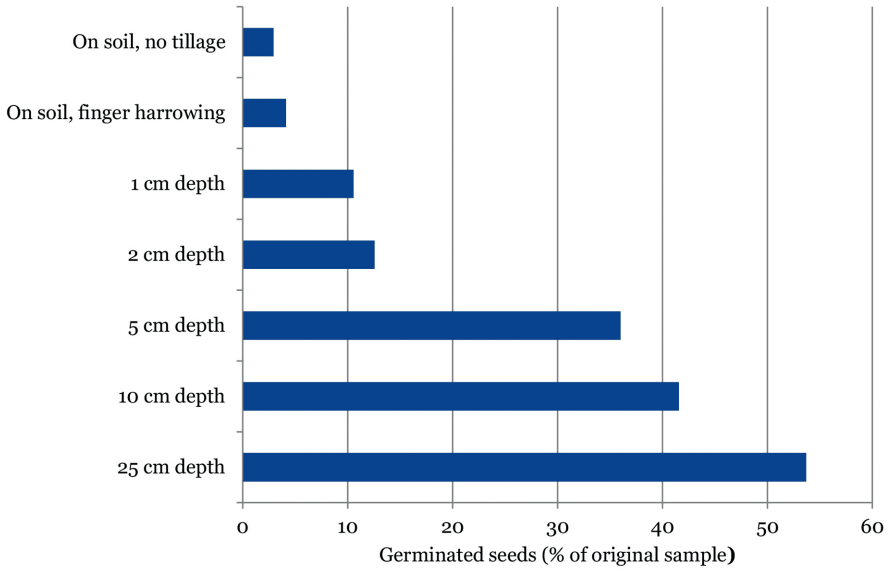

Figure 1. Germination of seeds of Italian rye-grass from samples kept at different soil depths in the field from beginning of August to the end of September 2015. The figures show the number of plants in the germination test as a percentage of the original seed sample. LSD =4.75.

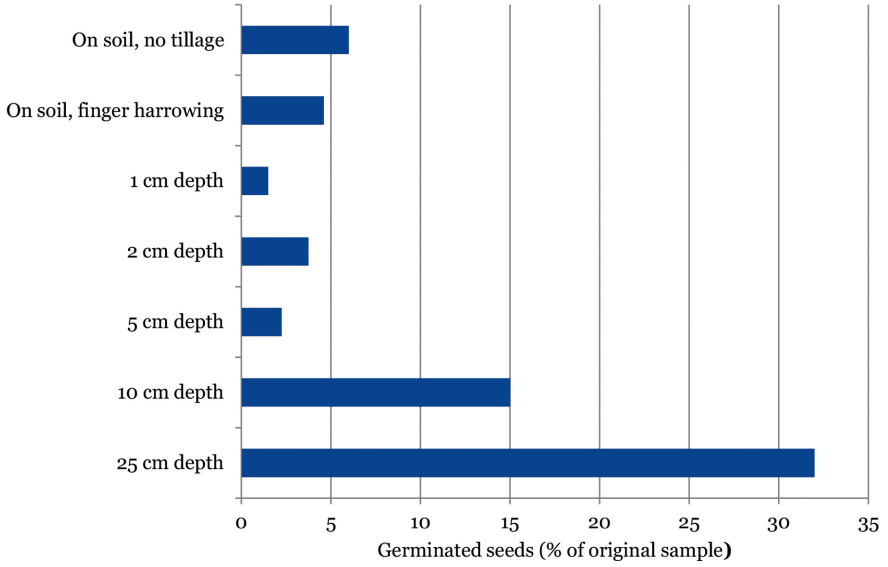

Figure 2. Germination of seeds of Italian rye-grass from samples kept at different soil depths in the field from beginning of August to the end of September 2016. The figure shows the number of plants in the germination test as a percentage of the original seed sample. LSD=5.6.

Conclusion

The results of the two experiments are parallel and support the general conclusion that stubble treatment strategy can have a large influence on the persistence of newly shed seeds. The longevity of Italian rye-grass seeds was very limited at the soil surface. When seeds were incorporated, a much higher percentage of the seeds survived, and this percentage increased with increasing burial depth. An important question is how superficial stubble treatments influence incorporation of seeds and hence longevity. The experiment with full-scale tillage implements as well as the experiment with simulated "finger harrowing" showed that there was no negative influence of a shallow tillage probably because neither the "finger harrowing" nor the flex-tine weeder incorporates the seeds.