



**Robotic mowing on fairway and semi-rough:
Less diseases
but more white clover**

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Photo 1: Daily dew removal can explain the lower disease incidence due to robotic mowing. Photo: Karin J. Hesselsøe.

Since 2020, the NIBIO Turfgrass Research Group has been studying agronomic, environmental, and economic consequences of switching to robotic mowing on golf course fairways and semi-roughs.

Preliminary results from the 2021 field trials at Landvik Research Station (Norway) showed the same high turfgrass quality with robotic and manual mowing. On semi-rough, robotic mowing showed a tendency to less disease but more white clover than with manual mowing.

ROBO-GOLF field trials

The ROBO-GOLF project includes three WPs (work packages), in which

two mowing systems are compared:

Robotic mowing with small light-weight robotic mowers (Husqvarna 550) and traditional mowing with reel mowers on fairway and rotary mowers on semi-rough. A trial area was established at the NIBIO Research Station in Landvik, south Norway, for WP1 and WP2 in 2020. WP3 takes place on one golf course in each of the Nordic countries: Norway, Sweden, Finland, Denmark, and Iceland. Turfgrass quality, fertilizer requirement, weed encroachment and susceptibility to various diseases are studied.

This article presents some of the main results from WP1 and WP2 in 2021. More detailed information can be found in Hesselsøe et al. (2022).

High turfgrass quality on fairway – more variation on semi-rough

In the WP1 field trials with robotic and manual mowing of pure stands of colonial bentgrass (*Agrostis capillaris*), red fescue (*Festuca rubra*) and Kentucky bluegrass (*Poa pratensis*) were compared on fairway (mowing height 15 mm). In the beginning of the season, no differences in turfgrass visual quality were found between robotic and manual mowing in the three species (Figure 1).

However, from late June Kentucky bluegrass and colonial bentgrass had a higher turfgrass quality when mown by the robots.

On the semi-rough (mowing height 35 mm) perennial ryegrass (*Lolium perenne*), red fescue (*Festuca rubra*), and Kentucky bluegrass (*Poa pratensis*) were studied. No differences between robotic and manual mowing could be found in any of the three species in April and May. In June the quality was better with robotic than with manual mowing due to a new rotary mower being introduced on manually mown plots; this must be regarded as an artefact due to change of equipment. However, in August and September, the turfgrass visual quality of perennial ryegrass and red fescue was significantly better with manual than with robotic mowing.

Differences in disease incidence

The higher turfgrass visual quality in the robotic-mown colonial bentgrass on fairway in autumn (Figure 1), can be explained by healthier plants compared to the manually mown plots. The tendency to lower disease incidence due to robotic mowing was seen in all species on the fairway, and on semi-rough the disease incidence was significantly lower in all species. The difference between robotic and manual mowing may be explained by the daily dew removal by the robotic mowers (Photo 1).

Differences in coverage of white clover

A sub study on the encroachment of broadleaved weeds was established in May 2021, planting in plugs of dandelion (*Taraxacum officinale*), white clover (*Trifolium repens*), and broadleaved plantain (*Plantago major*) in both fairway and semi-rough. The white clover developed in both areas (Figure 3) – especially in perennial ryegrass which had a lower density than red fescue and Kentucky bluegrass in the semi-rough trial. The lower density of perennial ryegrass can partly be explained by a tough winter in 2020-21, and partly by the fact that the species received the same amount of fertilizer, 60 kg N/ha/year, despite perennial ryegrass usually having higher nutritional requirements.

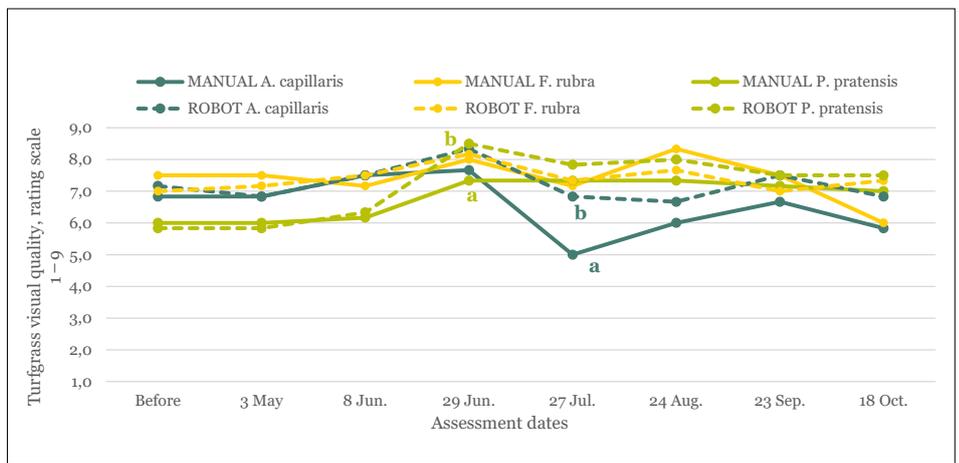


Figure 1: Turfgrass visual quality on fairway as affected by robotic (ROBOT) vs. manual mowing (MANUAL) from April to October 2021 in *Agrostis capillaris*, *Festuca rubra*, and *Poa pratensis*. A rating value of 5 or above is acceptable. Before = Beginning of April before mowing started. Different letters (a and b) indicate significant differences between the two mowing systems for the individual observation dates.

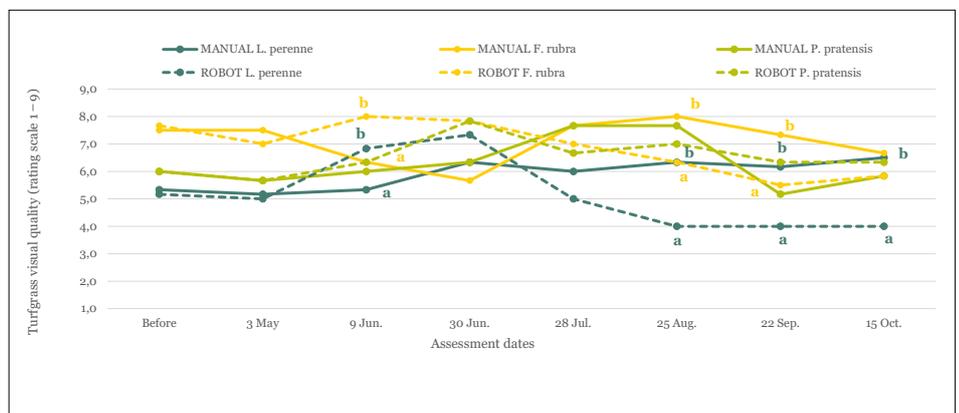


Figure 2: Turfgrass visual quality on semi-rough as affected by robotic (ROBOT) vs. manual mowing (MANUAL) from April to October 2021 in *Lolium perenne*, *Festuca rubra* and *Poa pratensis*. A rating value of 5 or above is acceptable. Before = Beginning of April- before mowing started. Different letters (a and b) indicate significant differences between the two mowing systems for each of the observation dates.

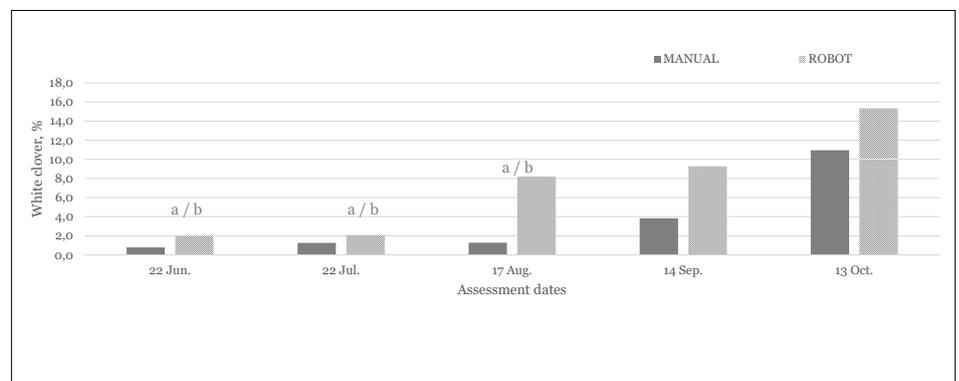


Figure 3: Coverage of white clover in semi-rough (subplots with transplanted white clover) mown by robotic and manual mowers. Different letters (a and b) indicate significant differences between the two mowing systems. Mean of three grass species.



Photo 2: Clippings in the WP2 subplots were collected with a John Deere walk-behind mower. The samples were analyzed for dry matter weight and N concentration. Photos: Trygve S. Aamlid.

More white clover on the robotic-mown plots of perennial ryegrass resulted in a lower turfgrass visual quality (Figure 2).

Likewise, in the Kentucky bluegrass and red fescue semi-roughs, transplanted and spontaneous white clover increased significantly on robotic mown vs. manually mown plots. Further research is needed to clarify how and why white clover is spreading in plots with robotic mowing. Our hypothesis so far is, that robotic mowing compared to manual mowing can favor creeping weeds, such as white clover, especially in a thin and weak lawn.

All results from WP1 were collected from plots established with pure turfgrass species, and not mixtures which is commonly used on golf course fairways and semi-roughs. A fairway mixture of Kentucky bluegrass, colonial bentgrass and red fescue was established for WP2. Here the overall trend was a higher turfgrass visual quality in the robotic mown plots, but the difference was not significant.

Differences in fertilizer demand due to robotic mowing?

In terms of fertilizer demand, our hypothesis was that the return of small clippings from the robotic mowers would lead to greater fertilizer savings than the return of longer clippings using conventional (reel) mowers.

In WP2, the nitrogen (N) fertilizer effect of return of clippings with robotic vs. manual mowing was studied on fairway. Annual N rates of 0, 30, 60, 90, and 120 kg/ha/year, each split into 6 equal inputs, were applied over the season. Collection of clippings once per month (Photo 2) showed that a return of clippings both for manual and robotic mowing increased clipping yields compared to when clippings were removed which was no surprise. When clippings were returned – both for robotic and manual mowing - yields differed through the season. At some times robotic mowing had higher yields and at other times manual mowing had higher yields.

So far we haven't found significant differences between robotic and manual mowing when it comes to fertilizer demands, but the trials continues in 2022, and hopefully we will be able to answer this question.

Conclusion

Turfgrass visual quality assessments revealed comparably high ratings for robotic and manual mowing, with a trend to higher quality for robotic mowing in the fairway. Disease incidence and weed encroachment revealed some differences between robotic and manual mowing that has to be investigated further.

In the final year of the project, thatch accumulation, root development and divot recovery will be studied in addition to turfgrass quality, weed encroachment, disease occurrence and fertilizer requirements after three years of robotic mowing. A survey on the five golf courses in WP3 investigating players and greenkeepers satisfaction on the robotic mowers will also be completed.

References

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