NIBIO
NORSK INSTITUTT FOR BIOØKONOMI

Two years comparison of snow/ice removal vs. plastic sheets at NIBIO Apelsvoll

Wendy Waalen, Trygve S. Aamlid, Pia Heltoft & Jørgen Hornslien, NIBIO

Ice-Breaker Final Seminar, Nov. 3rd, 2023

Main research questions, WP2

1) How does ice cover affect the tolerance to low freezing temperature (LT_{50}) in various turfgrass species?
2) Can wireless sensor technology be used to monitor gas composition and thus the condition of the grass under the ice?
3) Will impermeable plastic covers between ice and grass result in better survival of various grass species?
4) Is it safer and overall more advantageous to diminish the duration of IE by removing snow and ice in early winter rather than late winter?

N

Field map

15m

16,5m

101 TR, 1	102 TR, 2	103 TR, 5	104 TR, 4	105 TR, 6	106 TR, 3
107 KK, 1	108 KK, 2	109 KK, 5	110 KK, 4	111 KK, 6	112 KK, 3
113 RS, 1	114 RS, 2	115 RS, 5	116 RS, 4	117 RS, 6	118 RS, 3
201 RS, 1	202 RS, 4	203 RS, 3	204 RS, 6	205 RS, 5	206 RS, 2
207 TR, 1	208 TR, 4	209 TR, 3	210 TR, 6	211 TR, 5	212 TR, 2
213 KK, 1	214 KK, 4	215 KK, 3	216 KK, 6	217 KK, 5	218 KK, 2
301 RS, 2	302 RS, 6	303 RS, 1	304 RS, 4	305 RS, 3	306 RS, 5
307 KK, 2	308 KK, 6	309 KK, 1	310 KK, 4	311 KK, 3	312 KK, 5
313 TR, 2	314 TR, 6	315 TR, 1	316 TR, 4	317 TR, 3	318 TR, 5

TR: Annual bluegrass

KK: Creeping bentgrass

RS: Red fescue

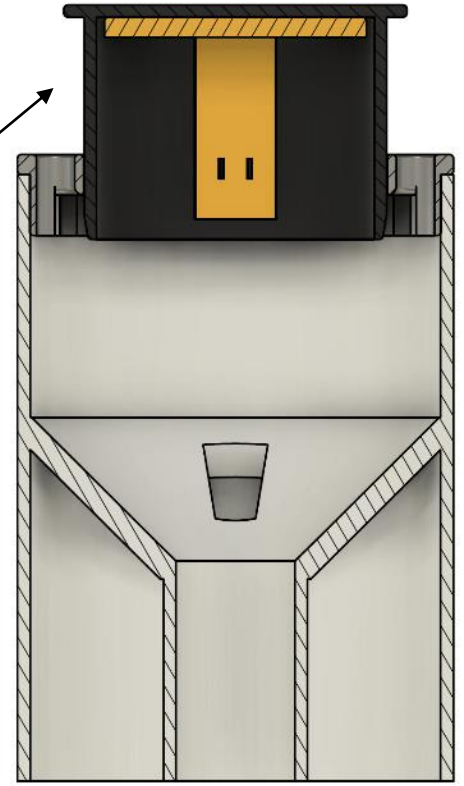
Treatments:

1) Control: no removal of snow and ice
2) Snow and ice removal the entire winter
3) Long term ice encasement (IE)
4) As treatment 3, but with a plastic cover between ice and grass.
5) As treatment 2 until mid January. IE from mid January.
6) As treatment 3, but with ice removal in early March.

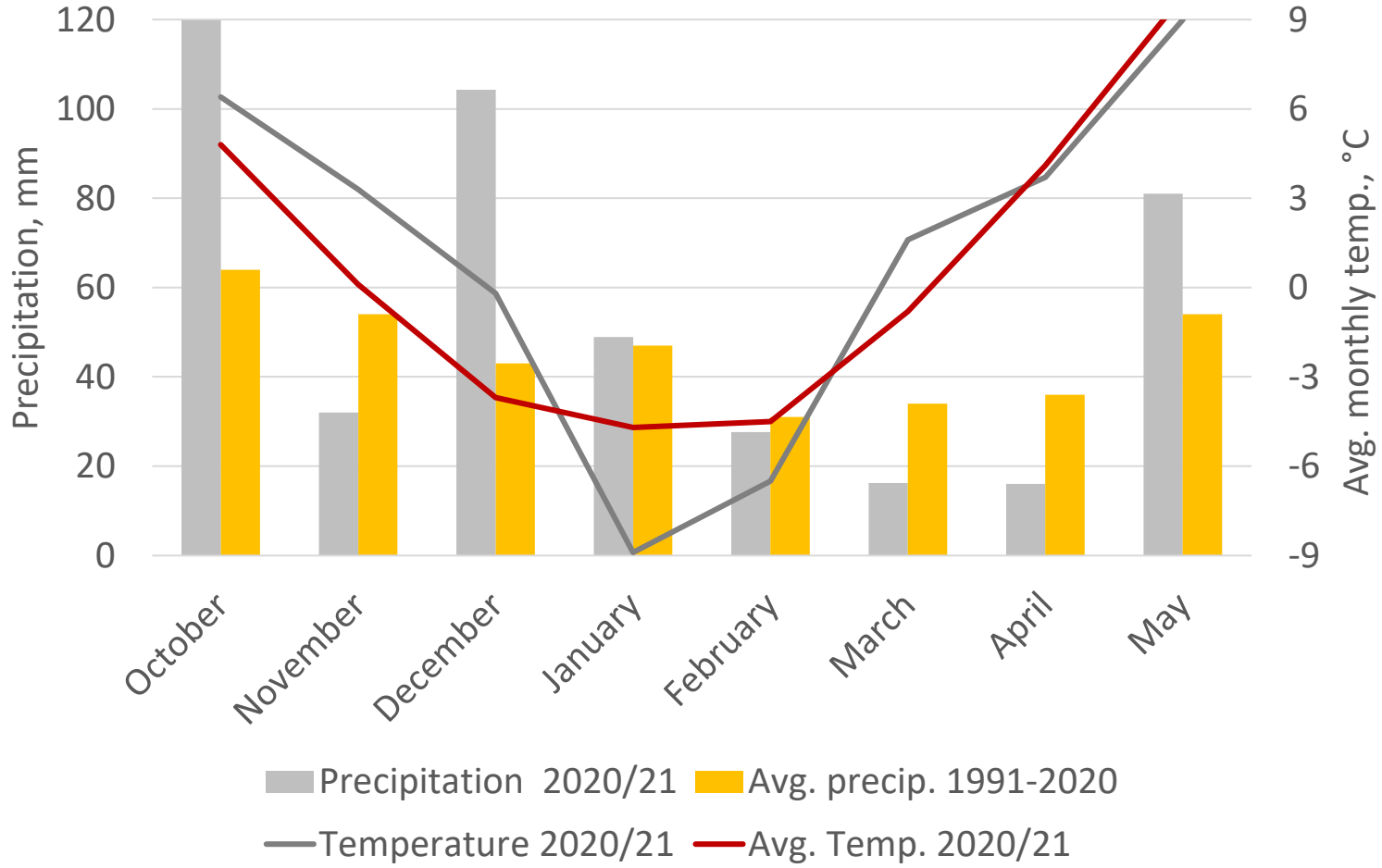
NIBIO

Sensors

- Placed in treatment 1 (control), 3 (IE) og 4 (IE with plastic) in each species
- Two types of placement were tested: flush with the green surface and in putting cups
- Measurement of temperature, O_2 and CO_2 every third hour throughout the winter



Weather conditions 2020-21

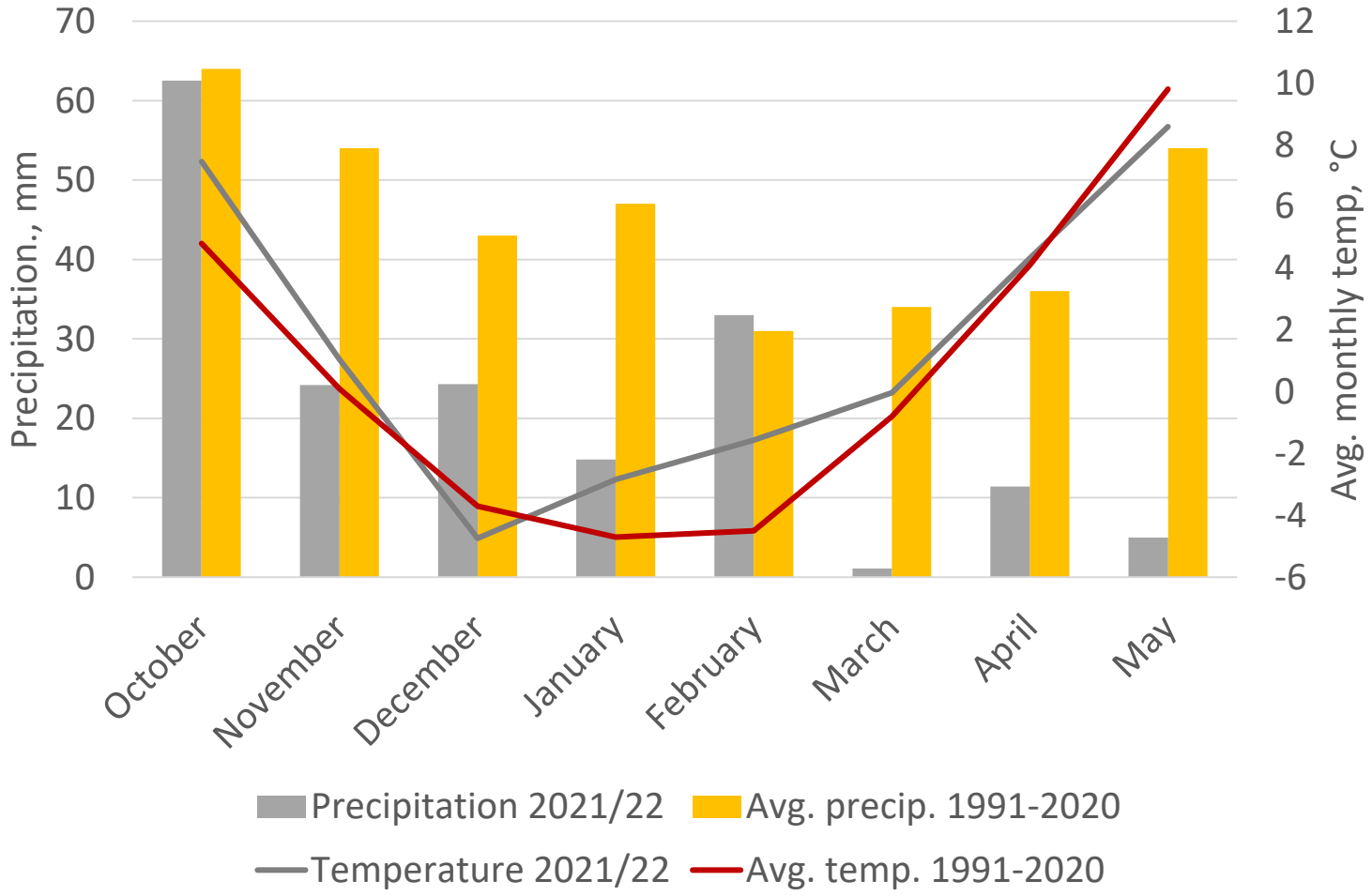


Ice encasement period:
Jan. 11 – Apr. 5 =
ca. 3 mo

Plastic cover period:
Nov. 30 – Apr. 9 =
ca. 4,3 mo

January 2021

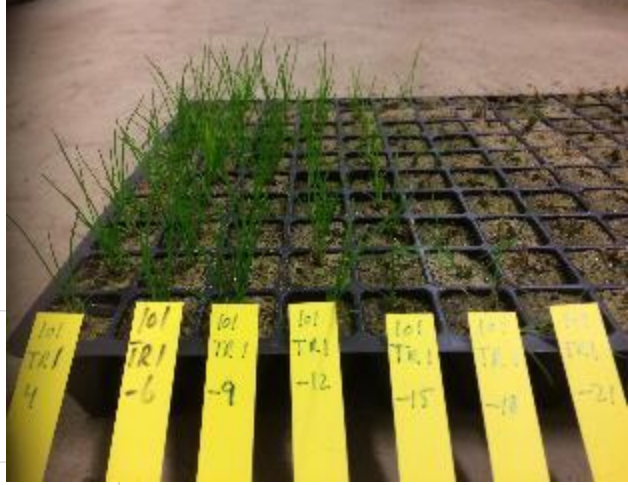
Weather conditions 2021-22

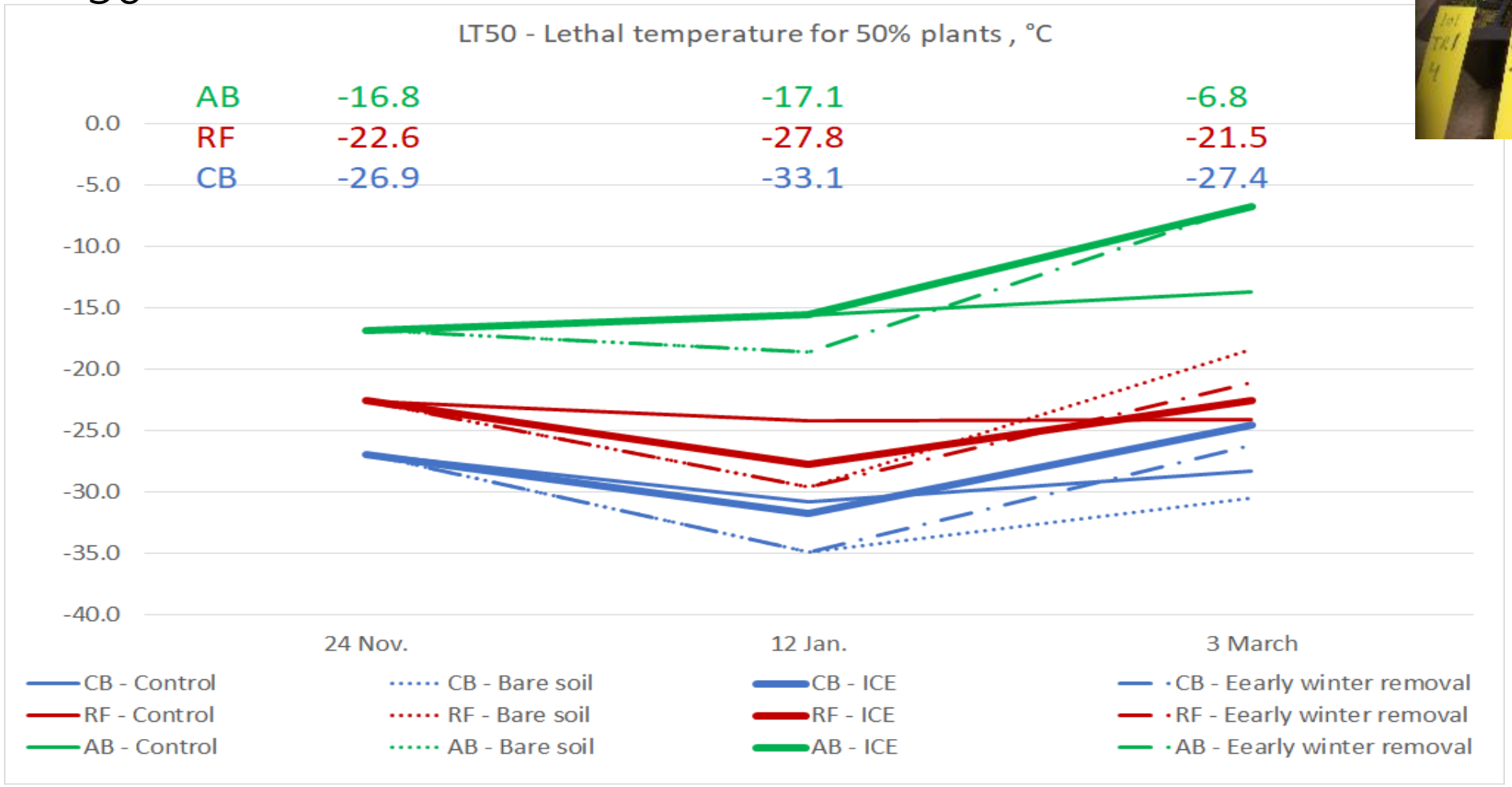


Ice encasement period:
Dec. 2 – Apr. 15 =
4.5 mo

Plastic cover period:
Nov.29 – Apr. 21 =
ca. 5 mo

Q1: How does ice cover affect the LT_{50} in various turfgrass species?



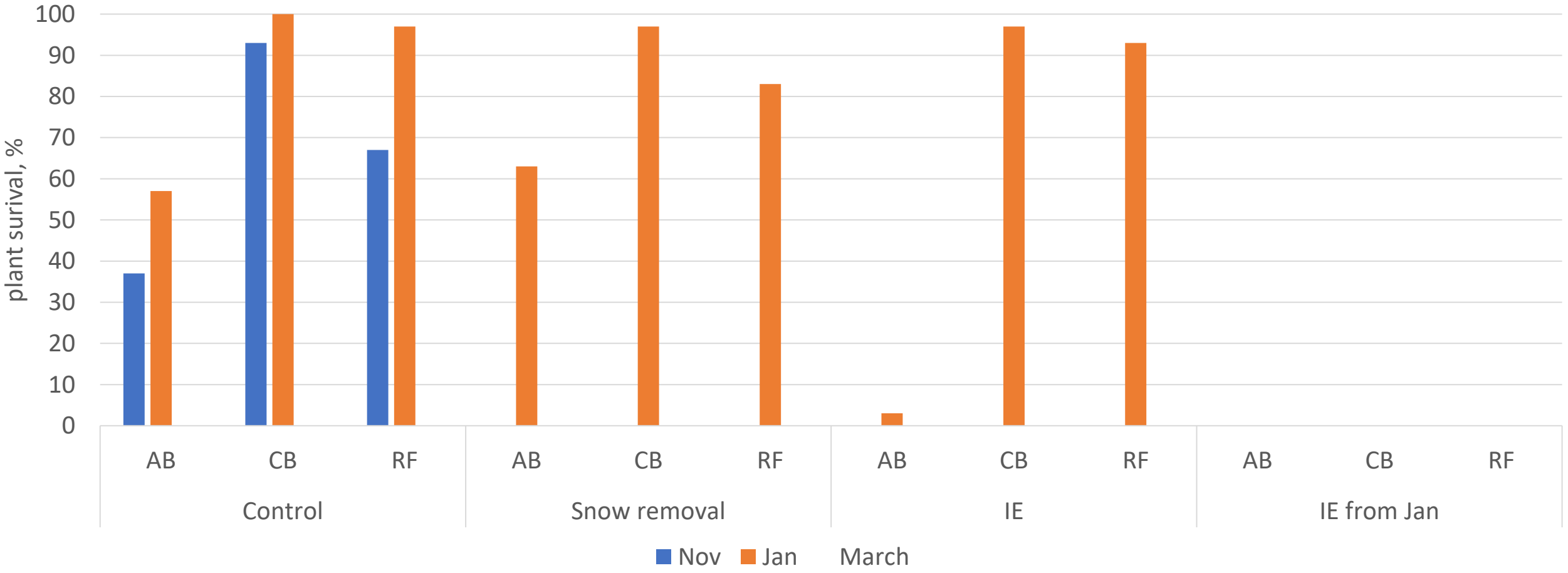


LT_{50} 2020/21

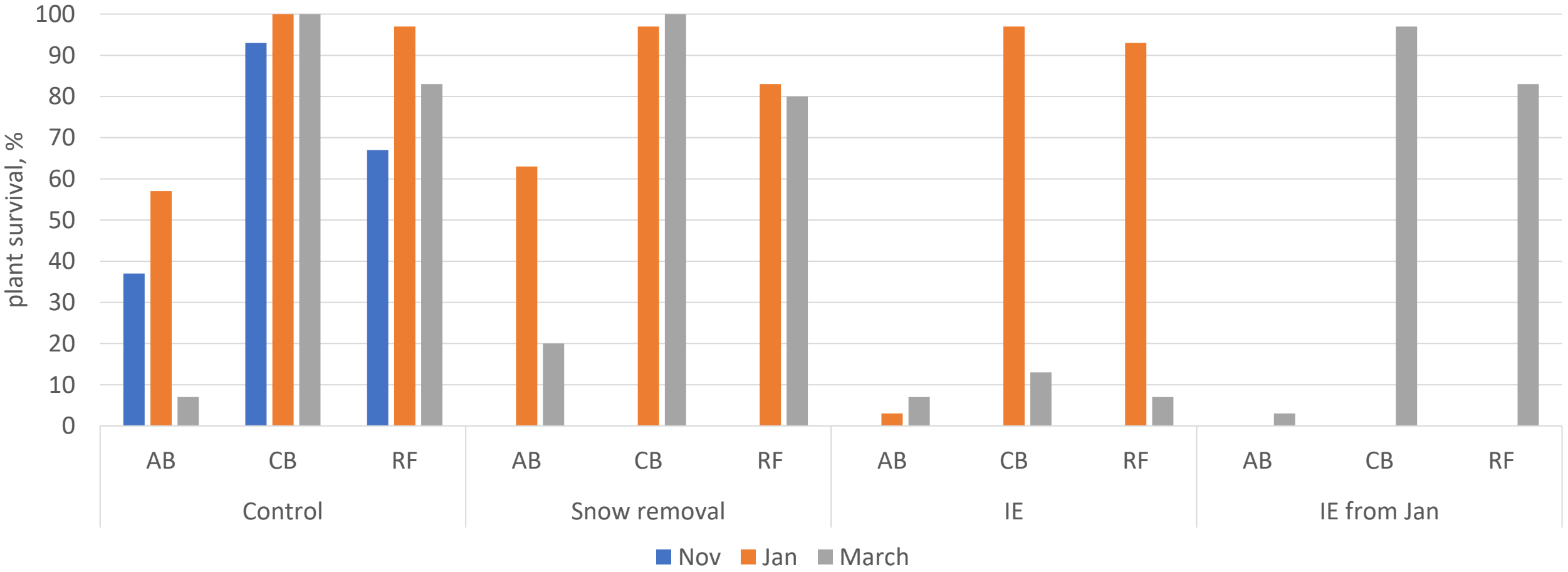
AB = annual bluegrass RF = red fescue CB = creeping bent

2021/22
Frost tolerance testing, -21°C

2021/22
Frost tolerance testing, -21°C



2021/22
Frost tolerance testing, -21°C



Q2:Can wireless sensor technology be used to monitor gas composition and thus the condition of the grass under the ice?

Treatment - Data from both winters

	mid Temp	Temp_min	Temp_max	mid O2	O2_min	midCO2
1 (control)	-0,7	-4,6 b	8,6 a	17,1 a	10,3 a	12970 b
3 (IE)	-0,6	-3,9 ab	4,9 ab	11,8 b	5,9 b	30754 a
4 (IE + plastic)	-0,6	-2,6 a	3,9 b	13,7 b	6,5 ab	28640 a
	ns	0,011	0,017	0,000	0,028	0,000

NIBIO

Q3: Will impermeable plastic covers between ice and grass result in better survival of various grass species?

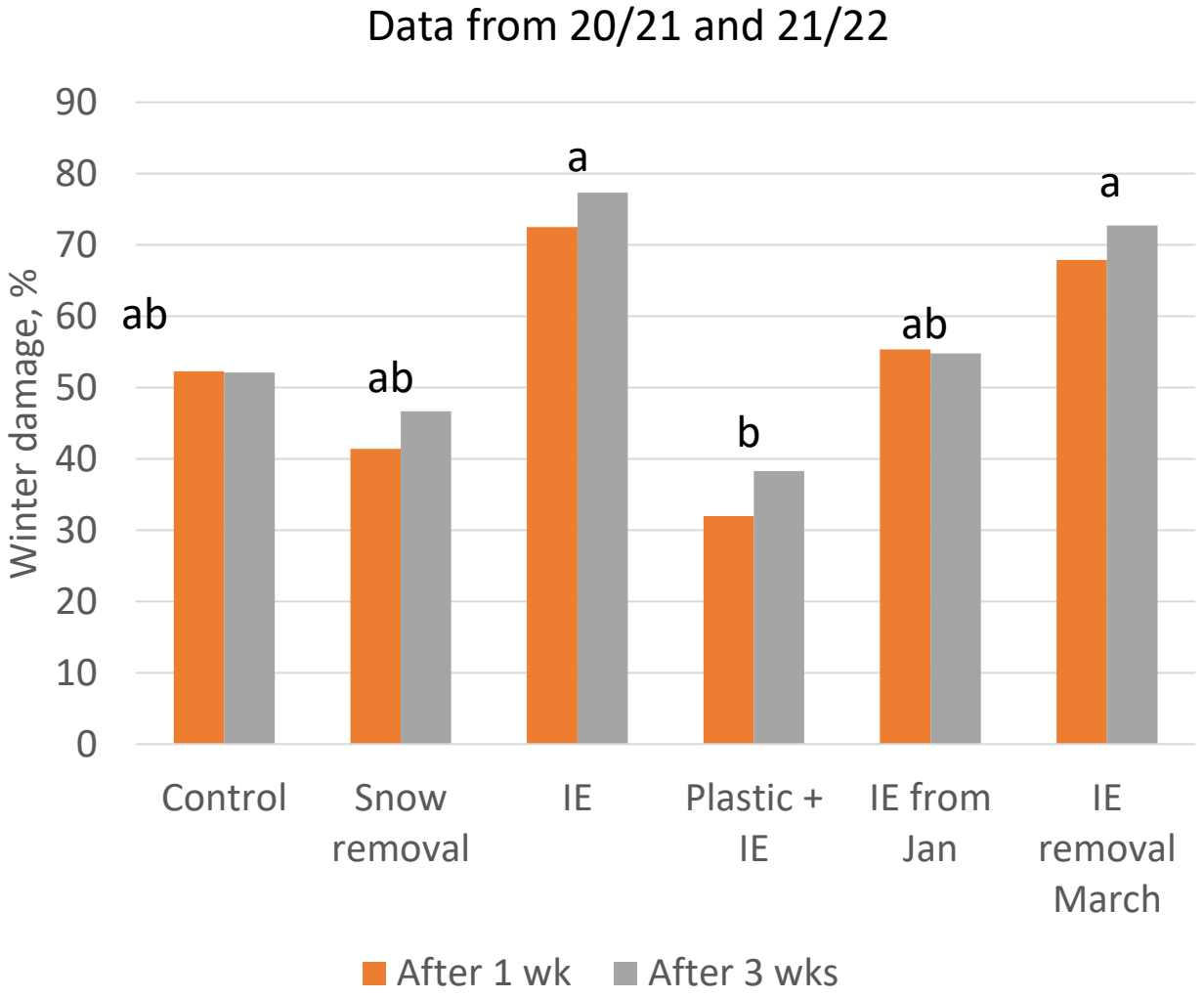
Winter damage, %

1 week after cover removal:

- Year: No significant difference (NSD)
- Species (Treatment): NSD (0,076)
- Treatment: 0,012

3 weeks after cover removal:

- Year: NSD (0,076)
- Species (Treatment): NSD (0,146)
- Treatment: 0,02



Q4: Is it safer and overall more advantageous to diminish the duration of IE by removing snow and ice in early winter rather than late winter?

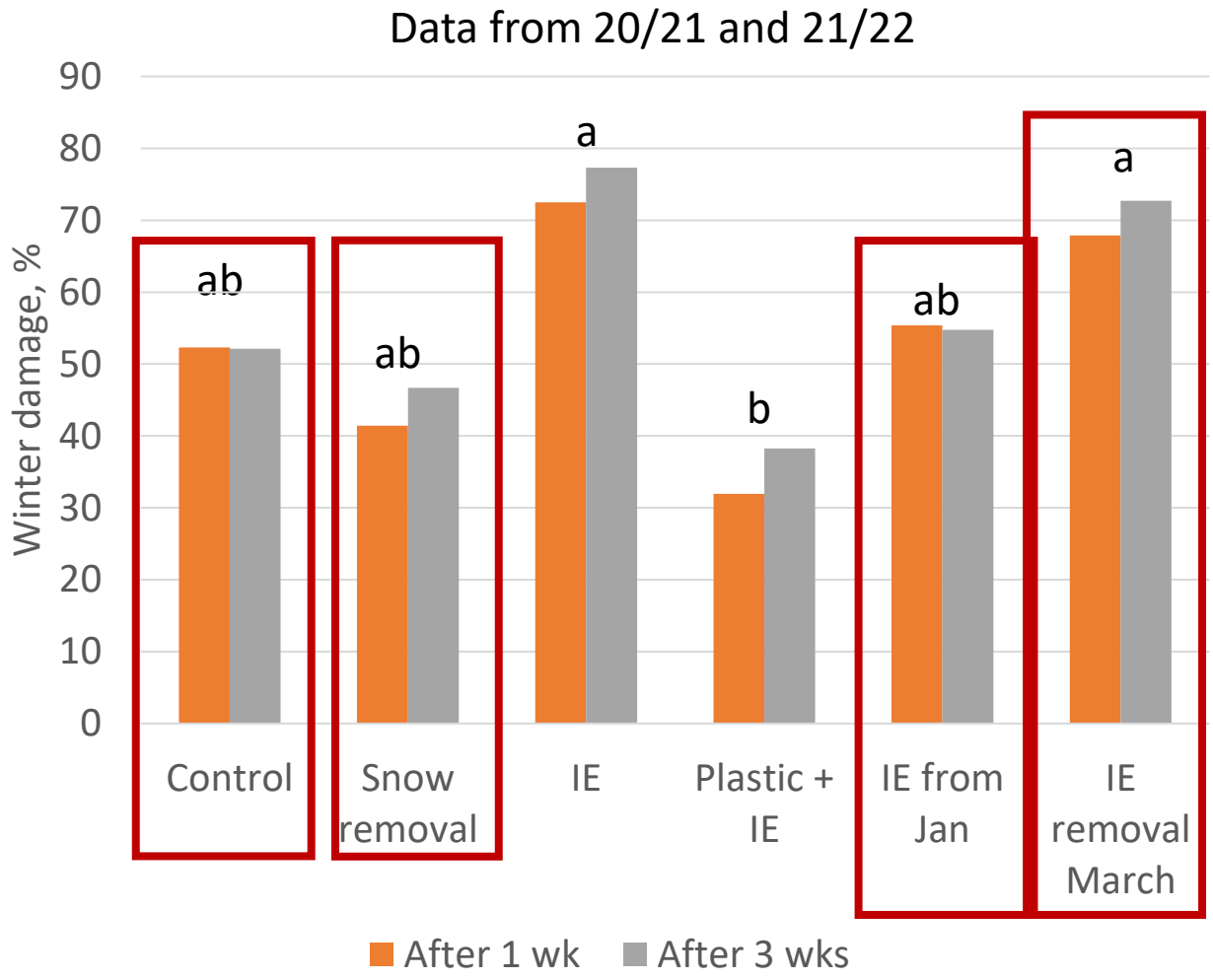
Winter damage, %

1 week after cover removal:

- Year: NSD
- Species (Treatment): NSD (0,076)
- Treatment: 0,012

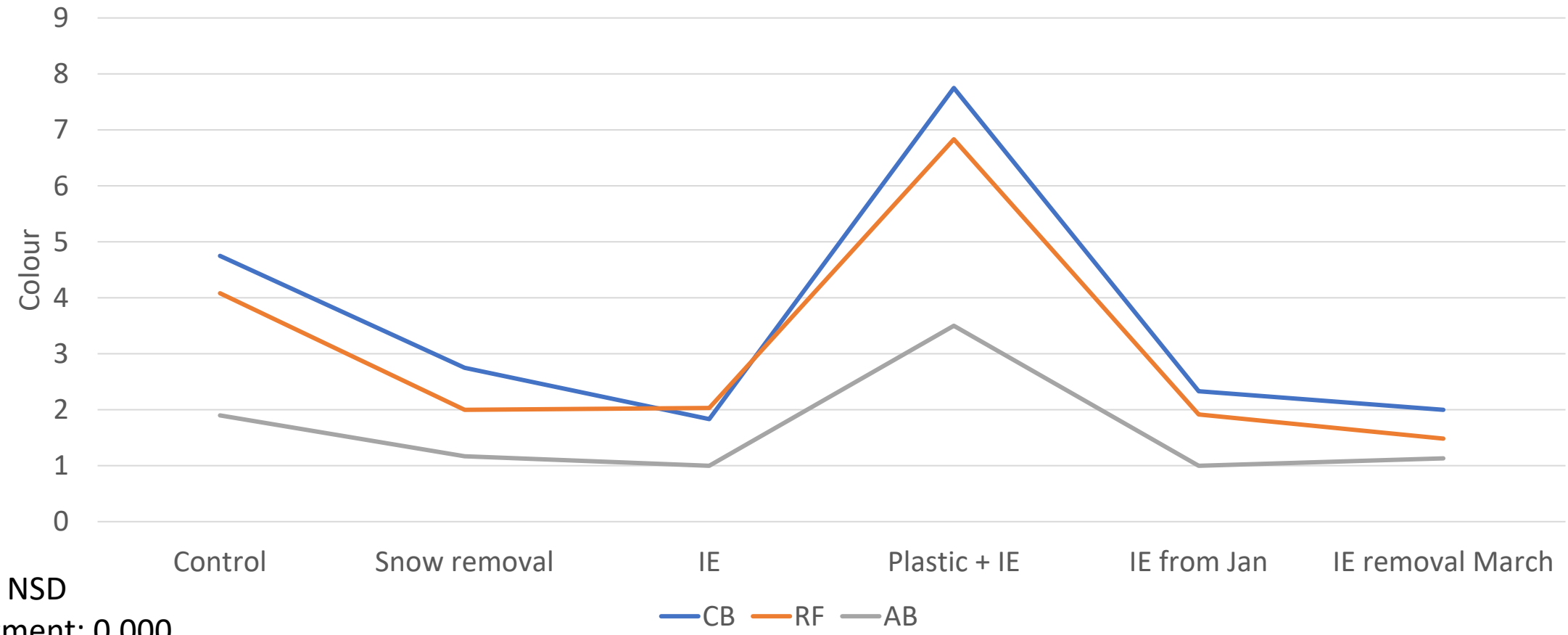
3 weeks after cover removal:

- Year: NSD (0,076)
- Species (Treatment): NSD (0,146)
- Treatment: 0,02



Colour one week after cover removal

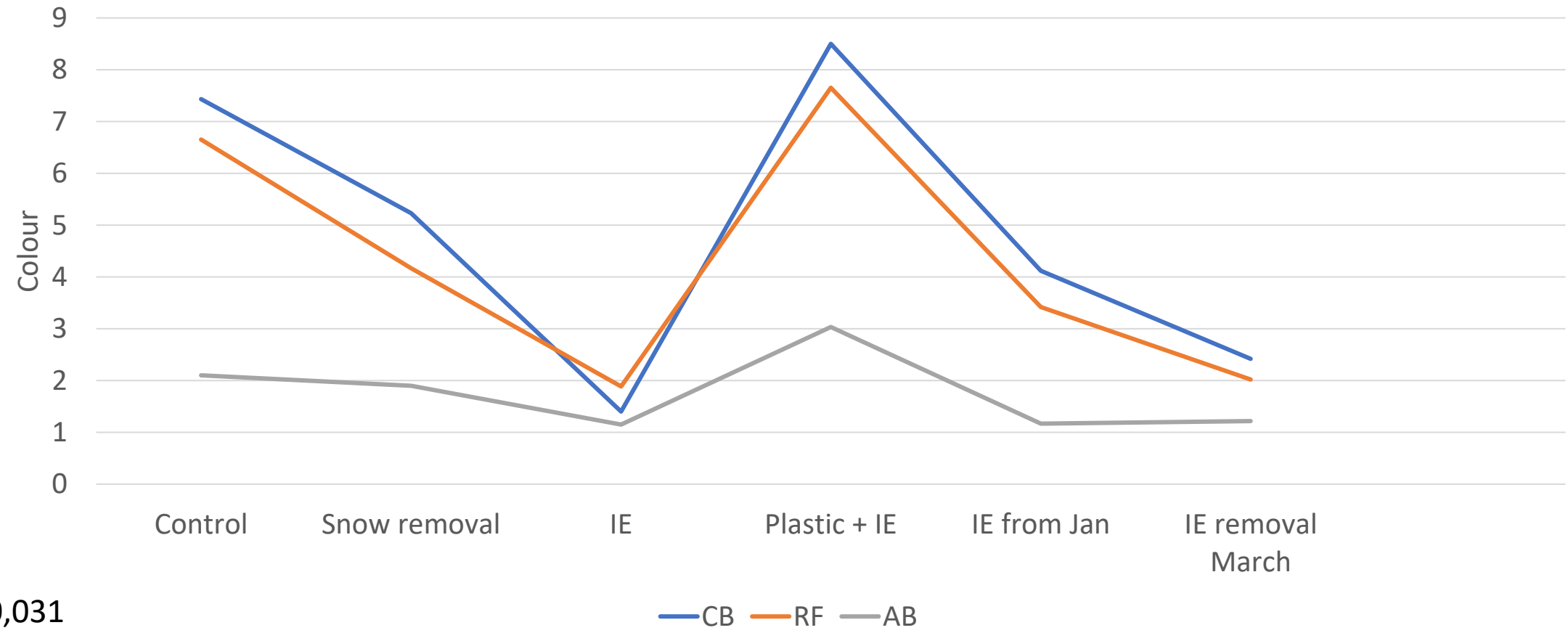
Data from 20/21 and 21/22



Year: NSD
Treatment: 0,000
Species (Treatment): 0,000

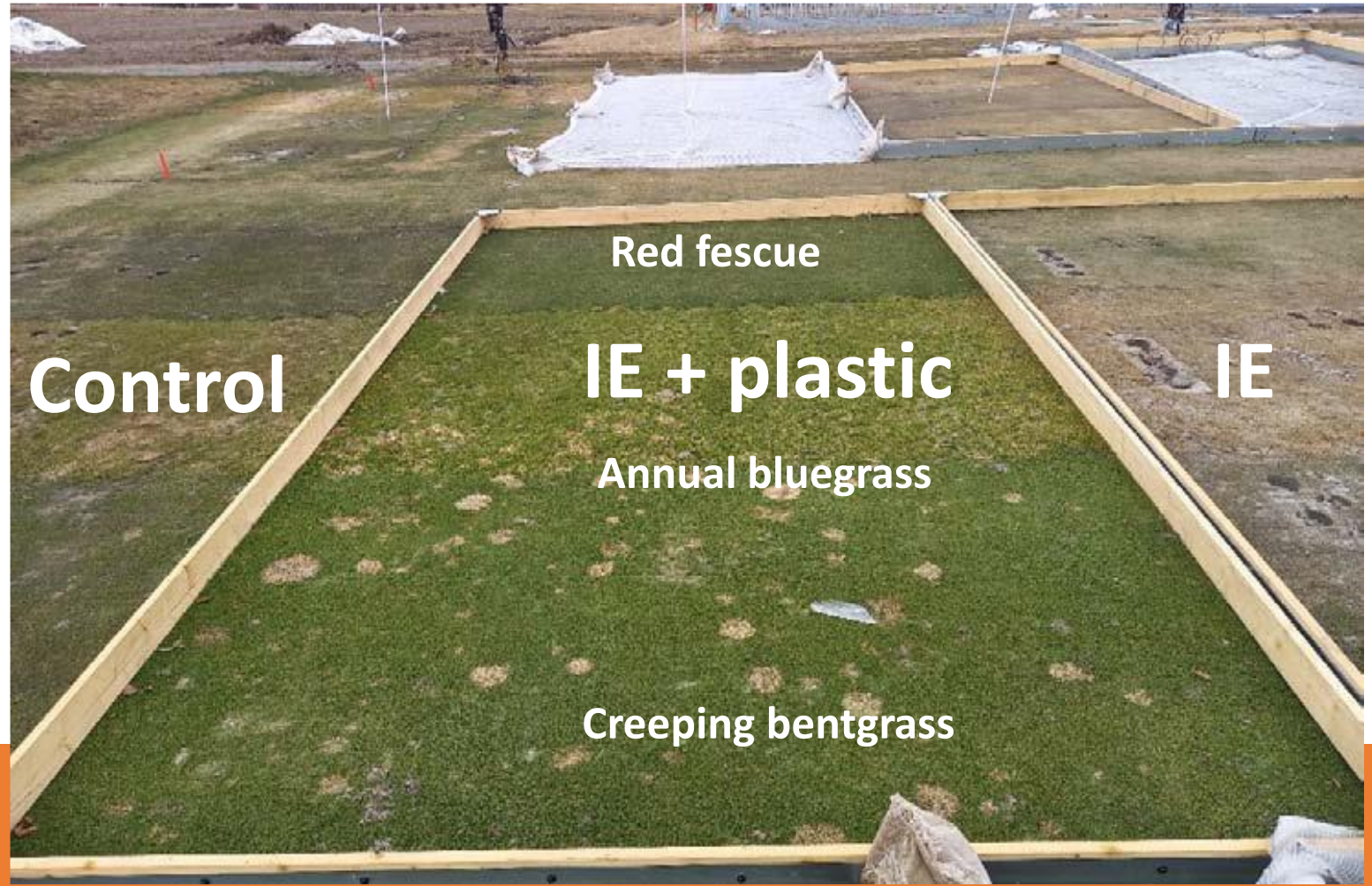
Colour three weeks after cover removal

Data from 20/21 and 21/22



Year: 0,031
Treatment: 0,000
Species (Treatment): 0,000

20/21: Plastic cover under IE: Superior spring results in all three species



NIBIO

Areal picture,20/21

- Treatment 4 (plastic between IE and grass) is very visible!

Conclusions

1. Can wireless sensor technology be used to monitor gas composition and thus the condition of the grass under the ice?
   - No differences in gas measurements between IE and IE + plastic were detected
   - Other factors than gas compositon was responsible for winter damage following IE in these experiments.

2. How does ice cover affect the LT50 in various turfgrass species?
   - Frost tolerance was severly reduced following IE established in early winter
   - Annual bluegrass was completely dead already in January.
   - Creeping bentgrass and red fescue were alive in January, but survival was only approx. 10 % in March
   - IE established in January was also very damaging for AB. By March all plants were dead.

Conclusions

3) Will impermeable plastic covers between ice and grass result in better survival of various grass species?

- Results are very clear – YES, all three species benefit!!

4) Is it safer and overall more advantageous to diminish the duration of IE by removing snow and ice in early winter rather than late winter?

- Delaying IE until January was beneficial for spring colour of CB and RF, compared to IE from December. Ice removal in March, on the other hand, gave no improvements
- Early stress avoidance is a better strategy than trying to reduce stress in late winter

Thank you!