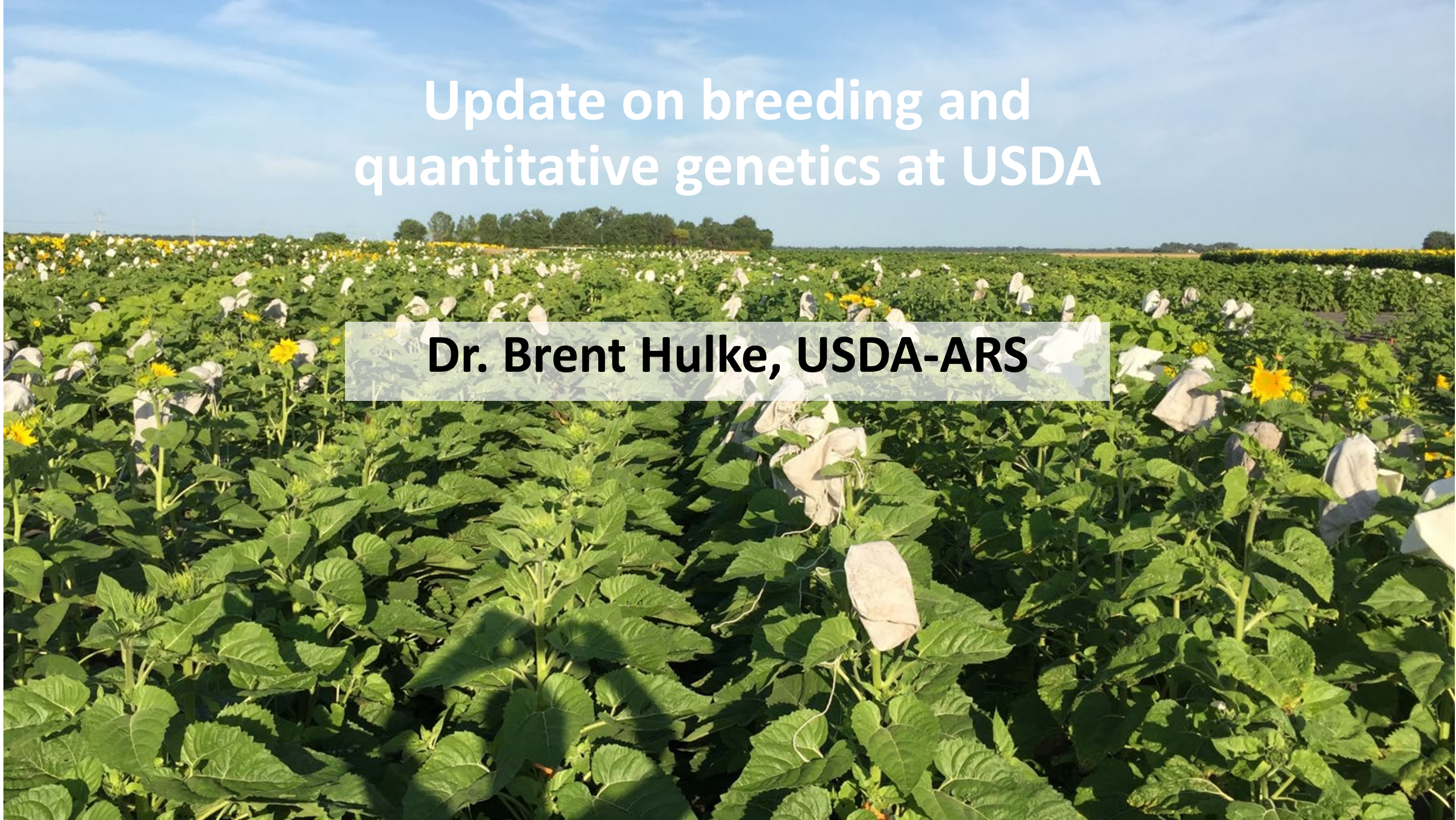


Update on breeding and quantitative genetics at USDA

Dr. Brent Hulke, USDA-ARS

Thanks!

Hulke Lab Staff

- Brady Koehler, Technician
- Zach Tarble, Technician
- Brian Smart, NDSU bioinformatician
- Emily DeValk, Grad. Student (NDSU)
- Ashley Barstow, Grad. Student (NDSU)
- Joe Barham, Grad. Student (NDSU)
- Numerous undergrad interns!
- Collaborators in many states!

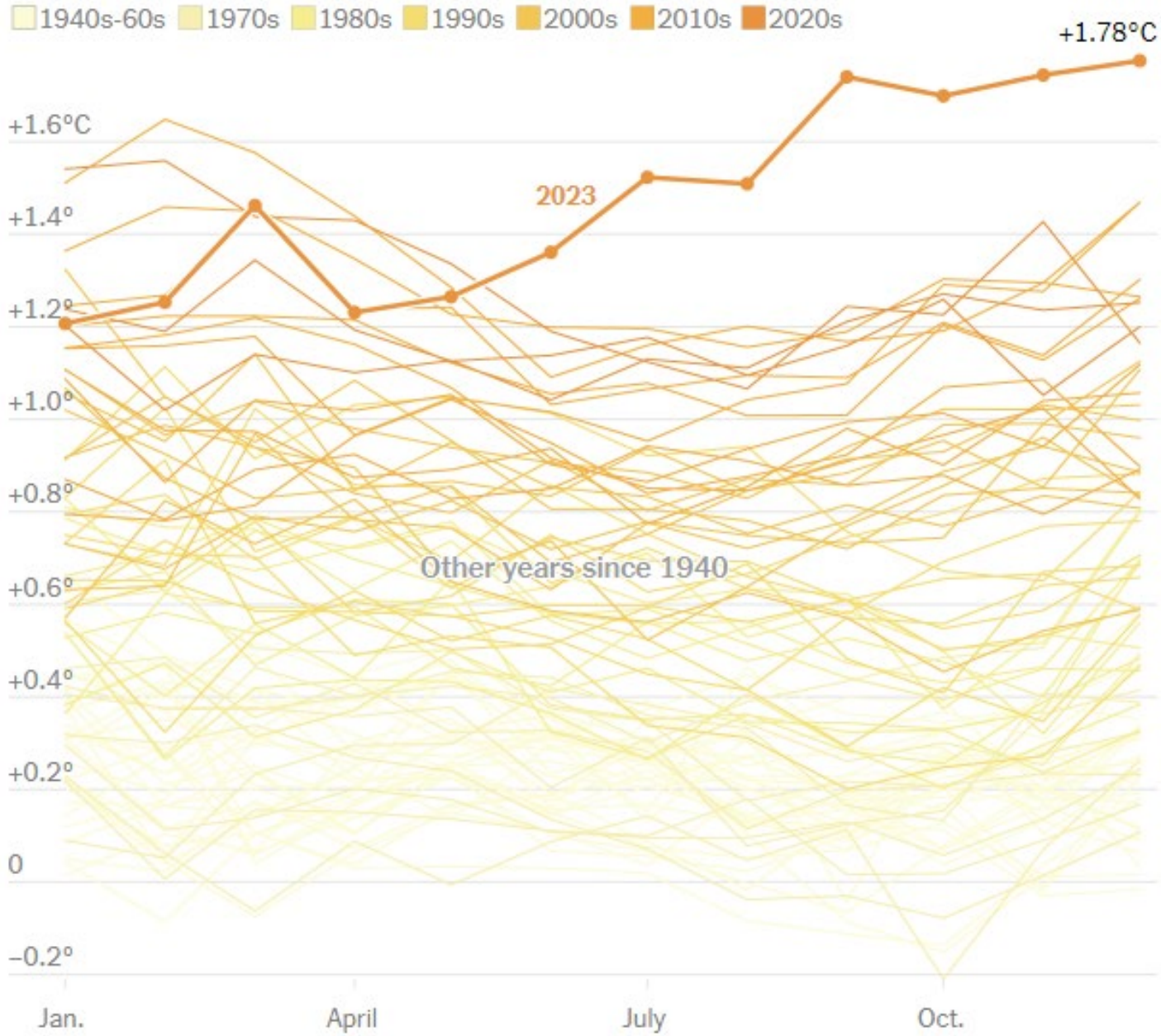
Funding sponsors

- National Sunflower Association
- National Science Foundation
- National Sclerotinia Initiative
- The Malone Family Foundation
- North Central Region SARE

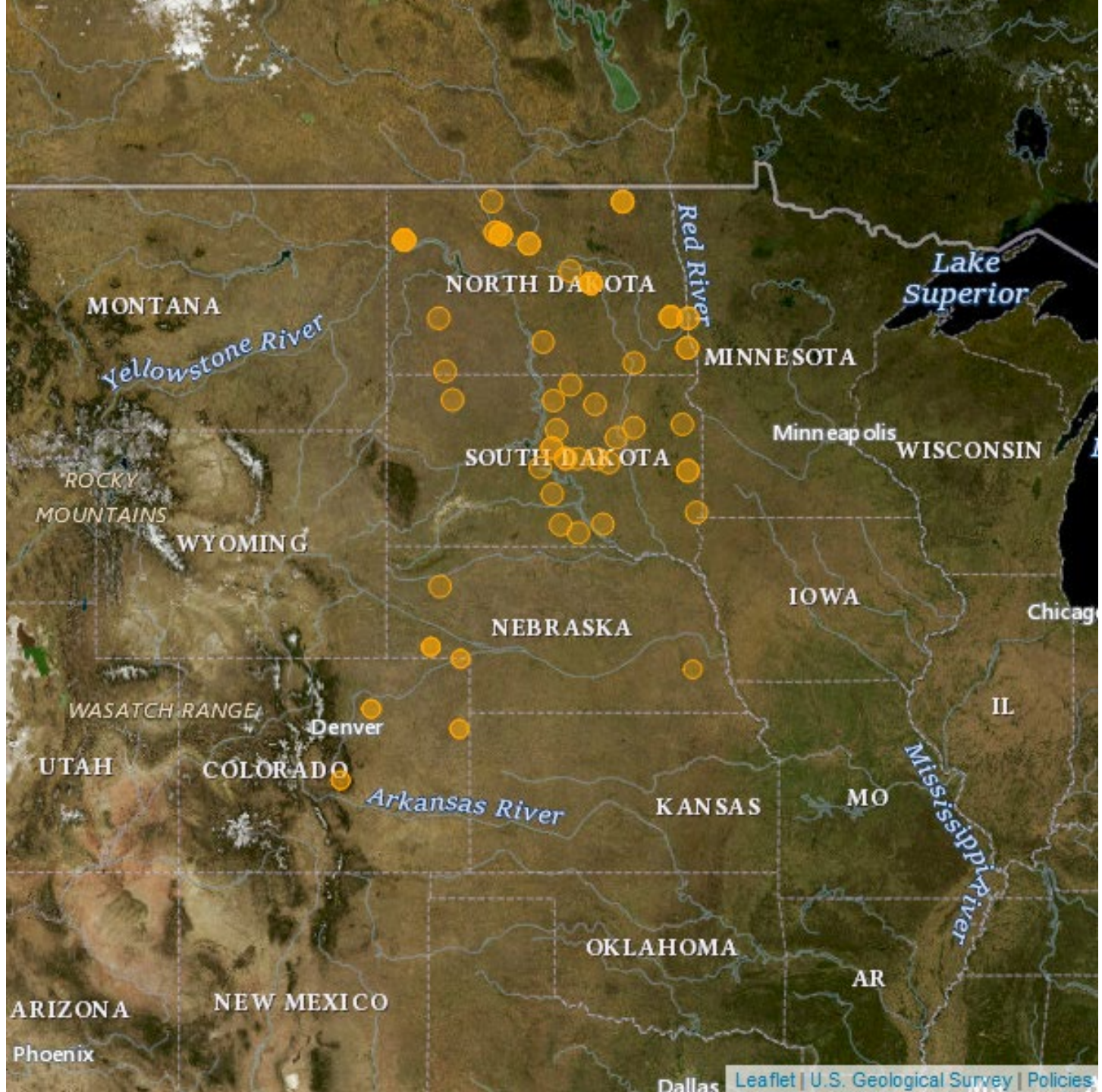
New NSF grant!

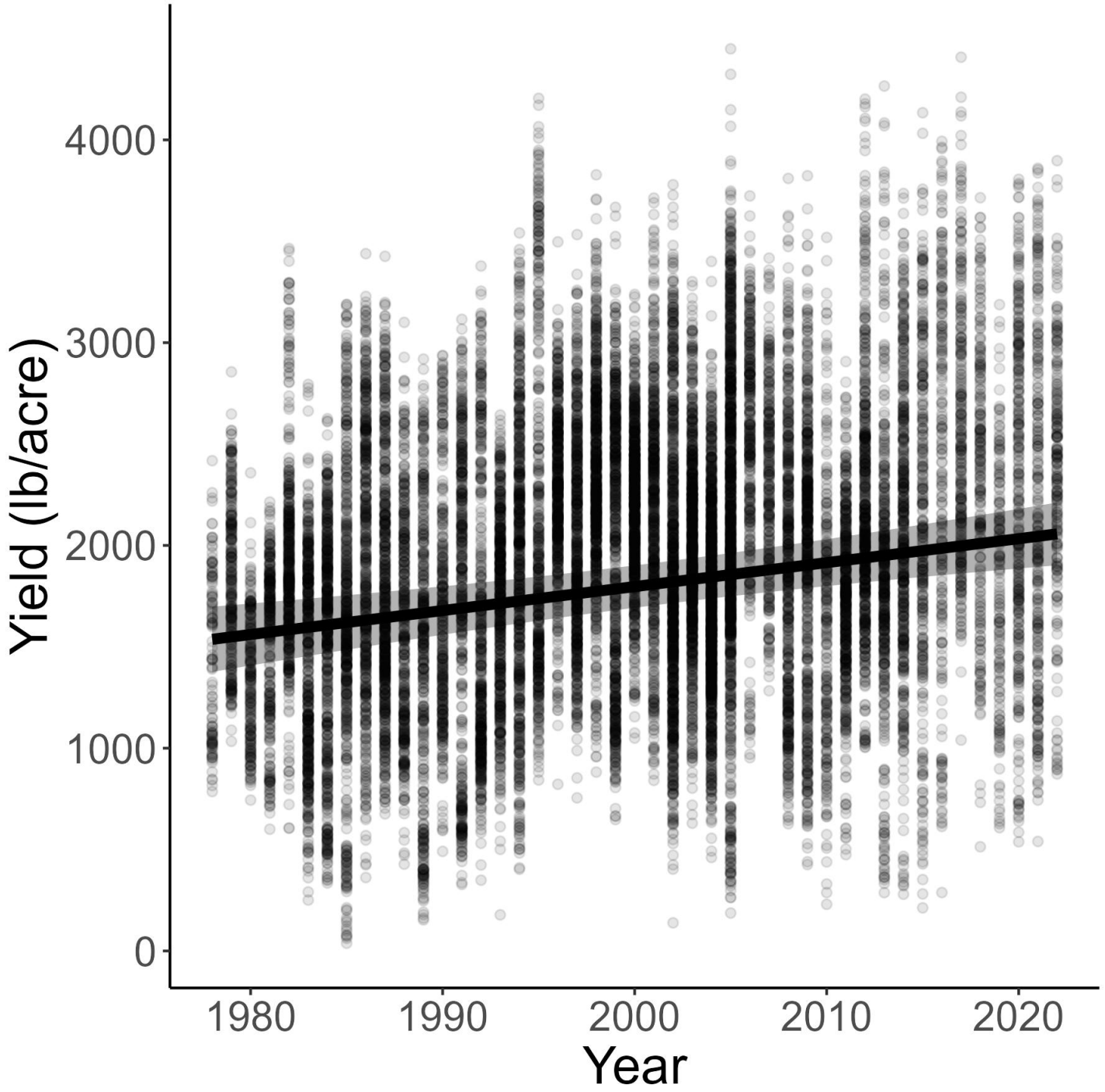
- “Uniting long-term field experiments and modern genomics to prepare sustainable crops for the future”
  - Nolan Kane – Genomics, University of Colorado – Boulder
  - Sarah Elmendorf – Ecological Modeler, INSTAAR University of Colorado-Boulder
  - Brent Hulke – Sunflower Genetics, USDA-ARS
- An ORCC project
  - Organismal Response to Climate Change
- Goal: Use historical climate, genomics, and sunflower hybrid trial data to understand how sunflower has adapted to changing climate

Monthly global temperature compared with preindustrial levels

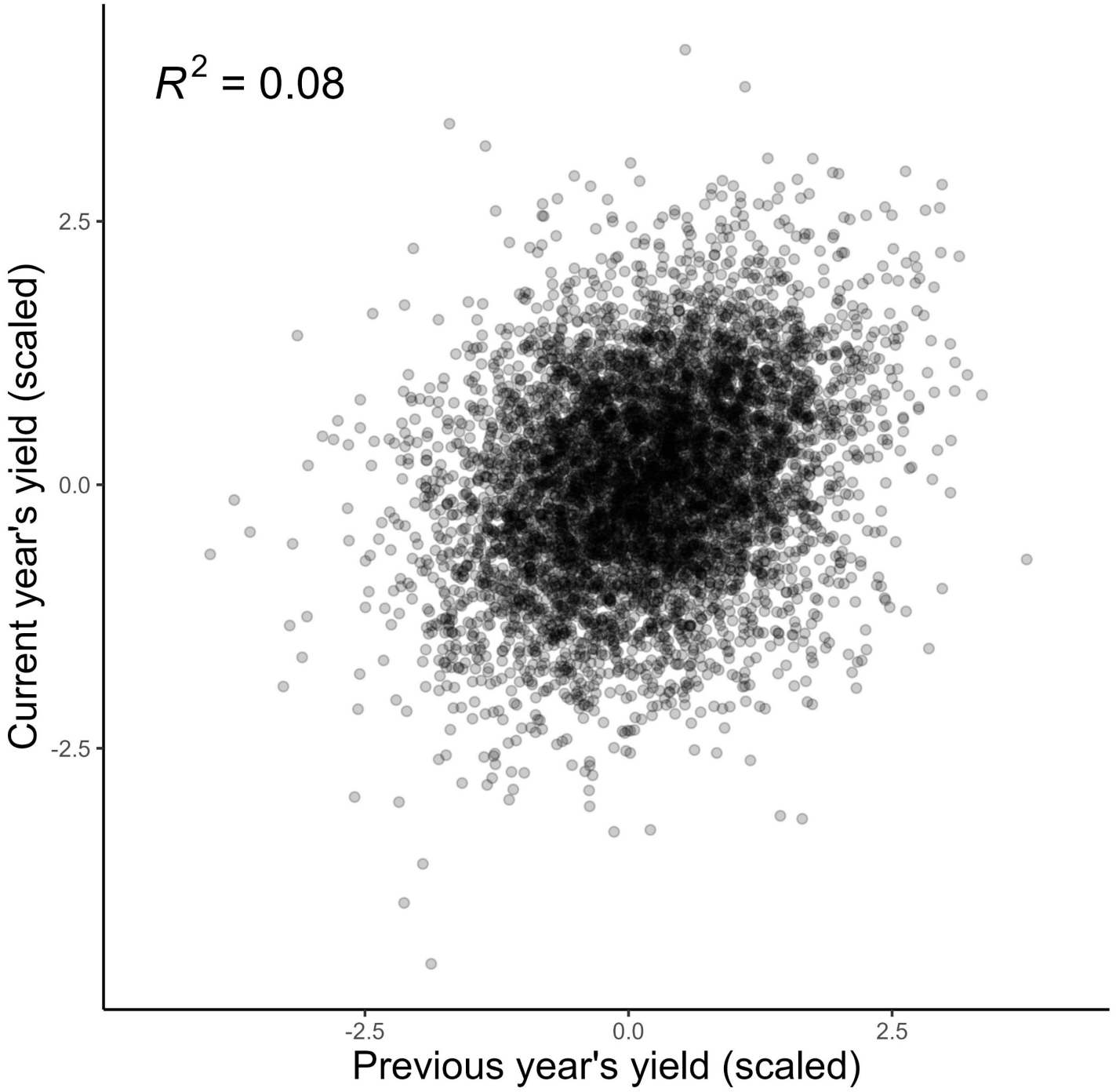


Source: Copernicus/ECMWF


MONTANA
Yellowstone River
NORTH DAKOTA
Red River
Lake Superior
MINNESOTA
Minneapolis
WISCONSIN
SOUTH DAKOTA
ROCKY MOUNTAINS
WYOMING
IOWA
NEBRASKA
Chicago
WASATCH RANGE
Denver
IL
UTAH
COLORADO
Arkansas River
KANSAS
MO
Mississippi River
OKLAHOMA
AR
ARIZONA
NEW MEXICO
Phoenix
Dallas
Leaflet | U.S. Geological Survey | Policies



11.8 lb/A per year improvement



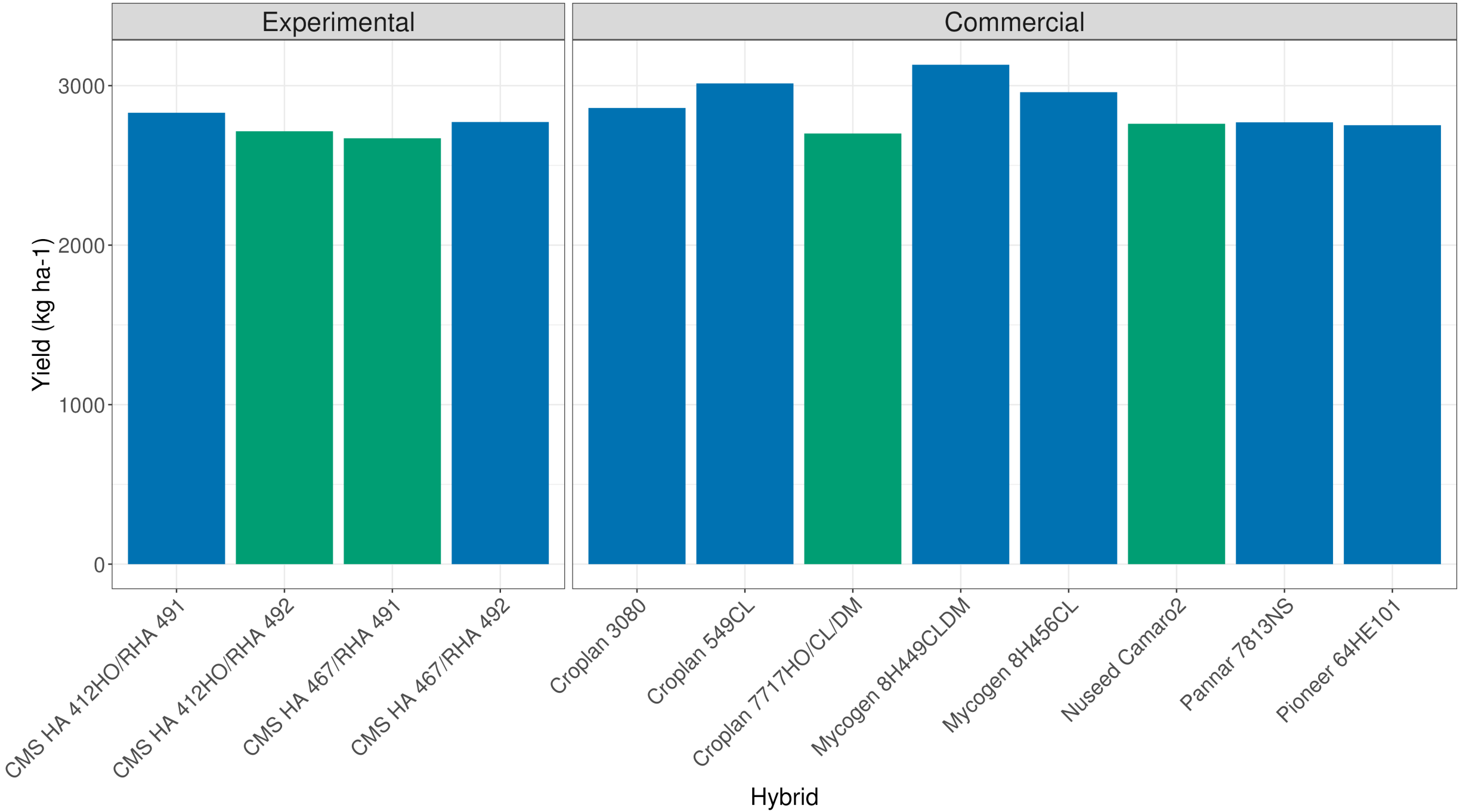
784 hybrids
442 site-years

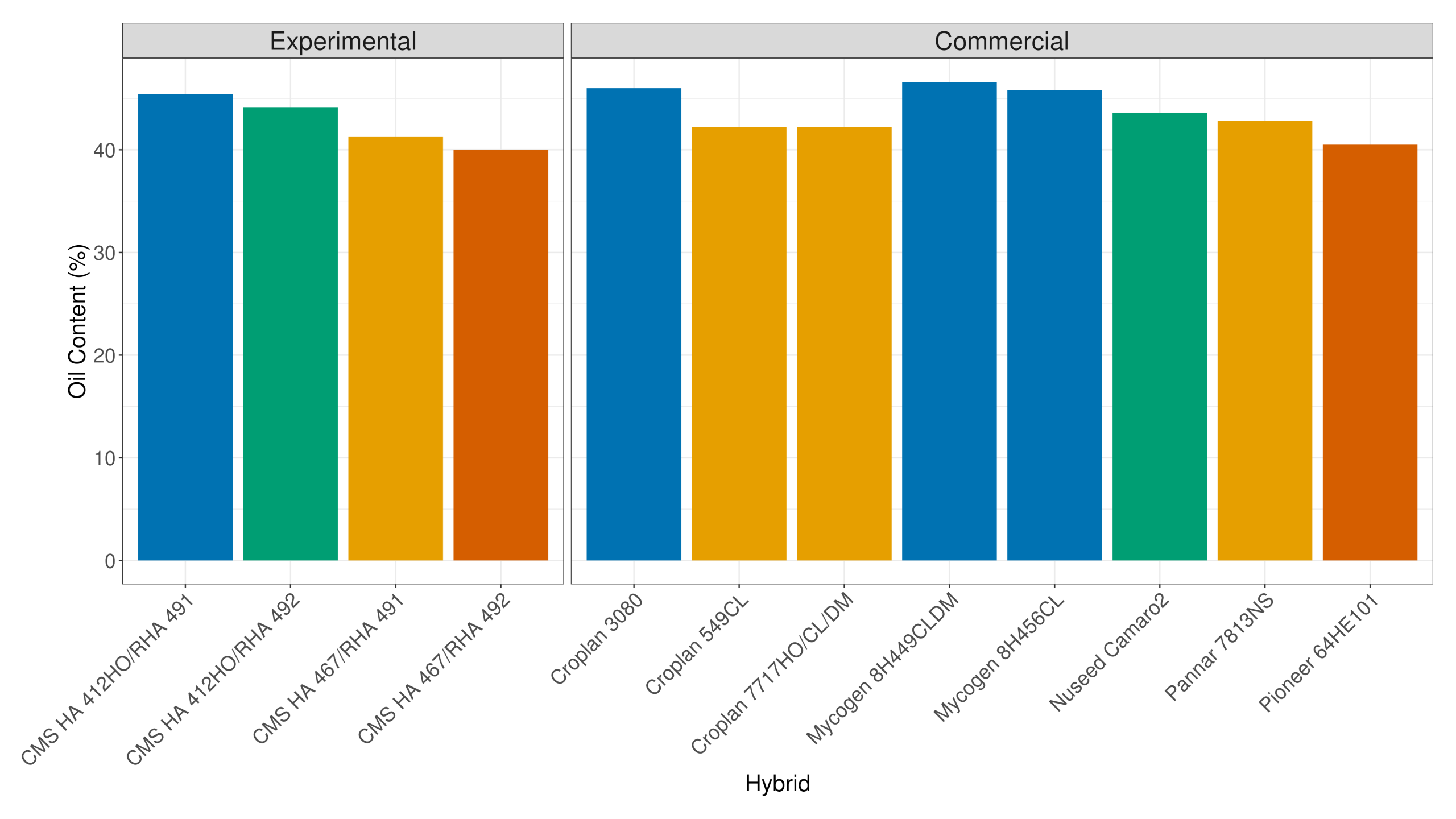
Colorado
Nebraska
North Dakota
South Dakota

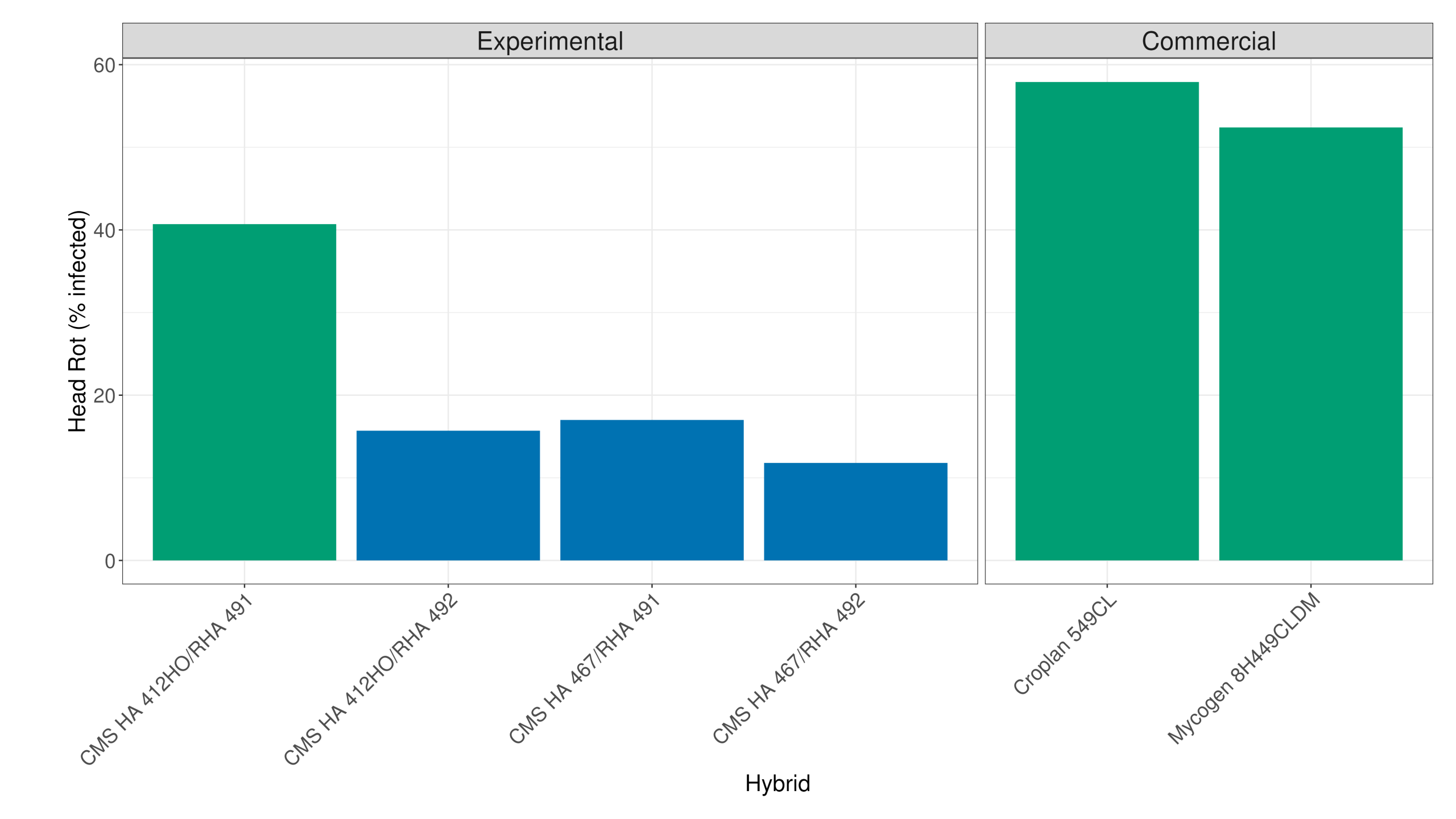
Mid-maturity parent line releases

HA 490, RHA 491, RHA 492

- HA 490 – better source of Pl17 and Clearfield/HO than HA 458
- RHA 491 – Pl15 source
- RHA 492 – Pl15 source with Clearfield resistance

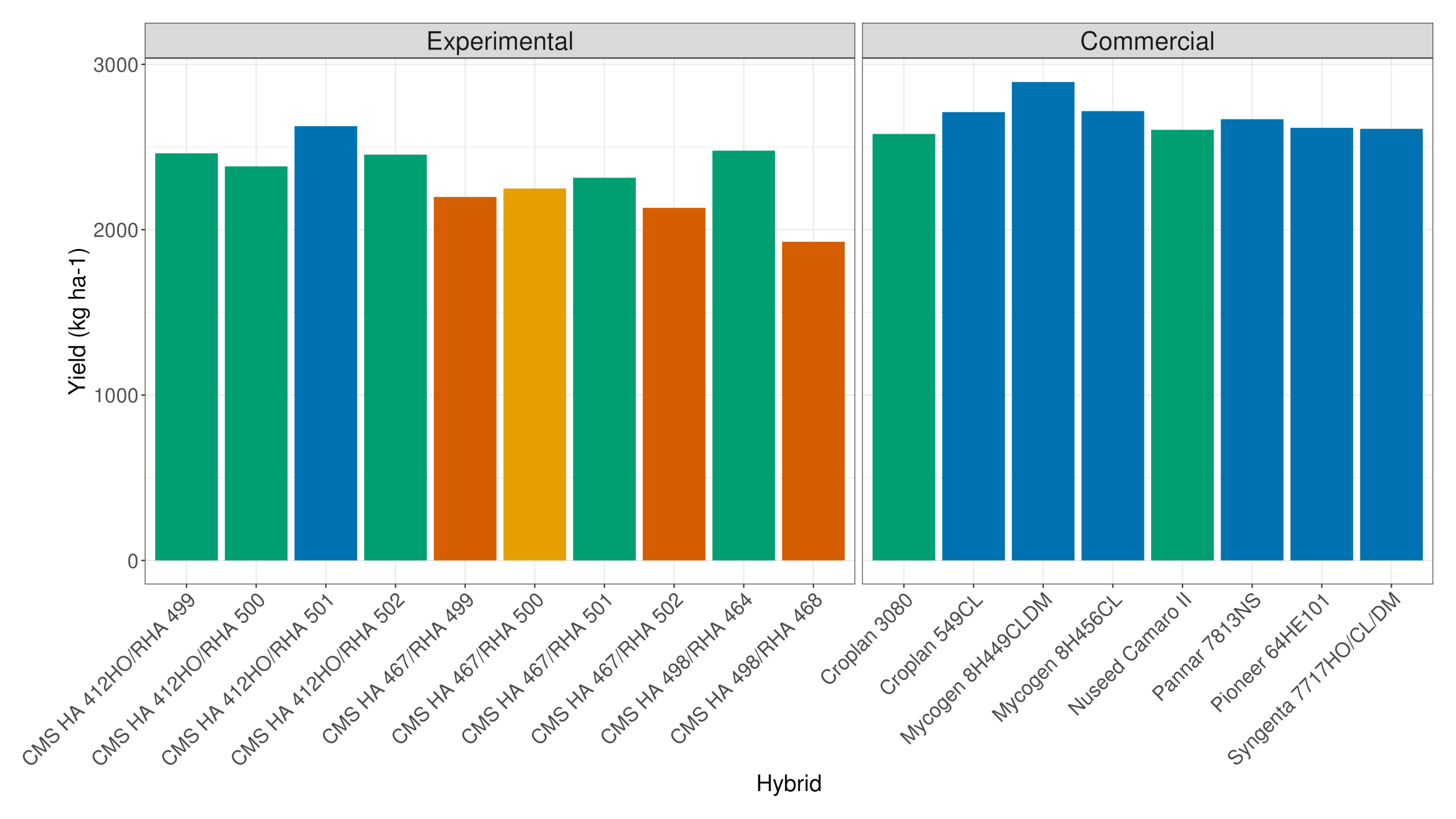

Experimental
Commercial
Yield (kg ha-1)
3000
2000
1000
0
CMS HA 412HO/RHA 491
CMS HA 412HO/RHA 492
CMS HA 467/RHA 491
CMS HA 467/RHA 492
Croplan 3080
Croplan 549CL
Croplan 7717HO/CL/DM
Mycogen 8H449CLDM
Mycogen 8H456CL
Nuseed Camaro2
Pannar 7813NS
Pioneer 64HE101
Hybrid

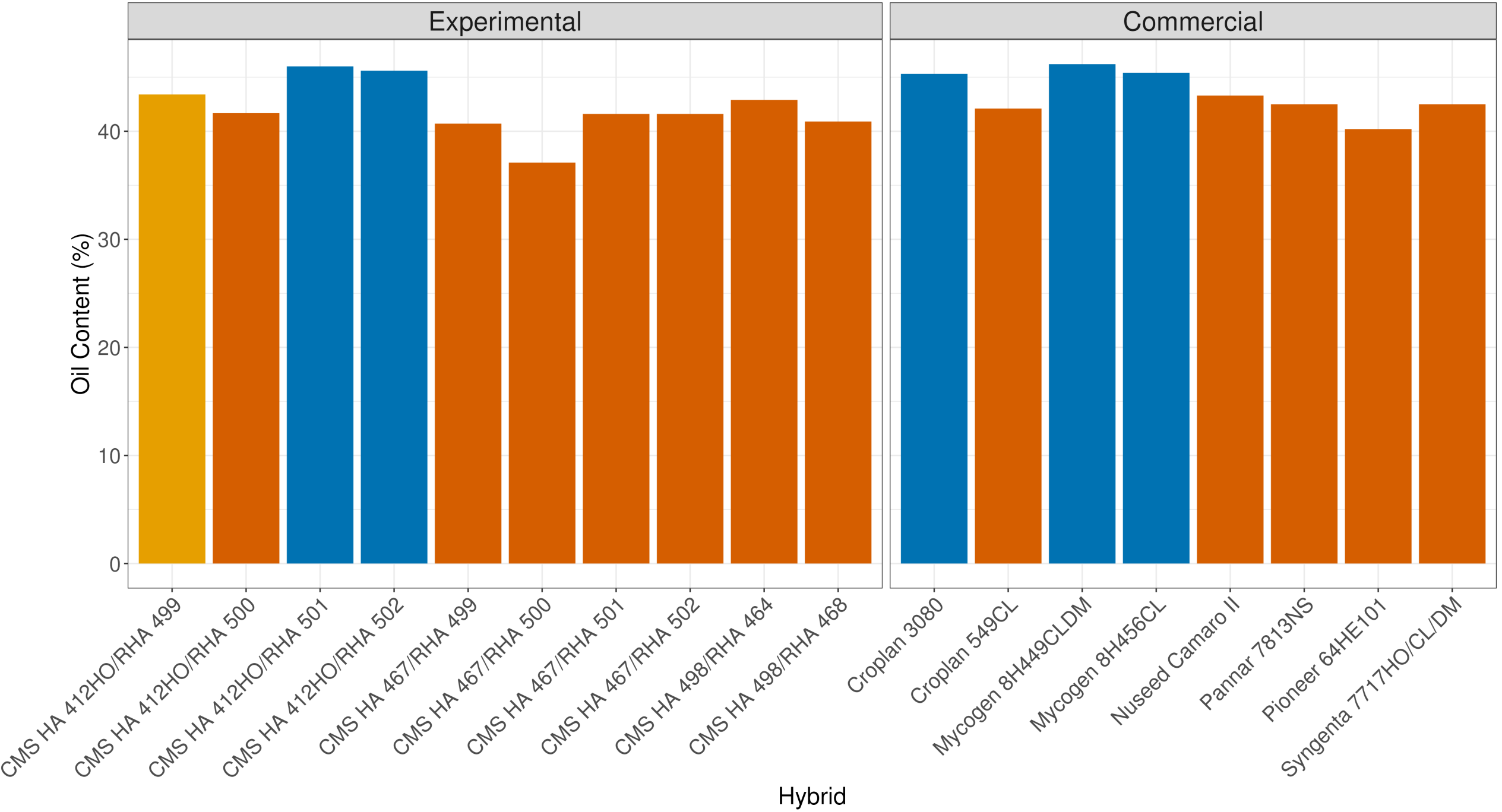

Experimental
Commercial
Oil Content (%)
0
10
20
30
40
CMS HA 412HO/RHA 491
CMS HA 412HO/RHA 492
CMS HA 467/RHA 491
CMS HA 467/RHA 492
Croplan 3080
Croplan 549CL
Croplan 7717HO/CL/DM
Mycogen 8H449CLDM
Mycogen 8H456CL
Nuseed Camaro2
Pannar 7813NS
Pioneer 64HE101
Hybrid

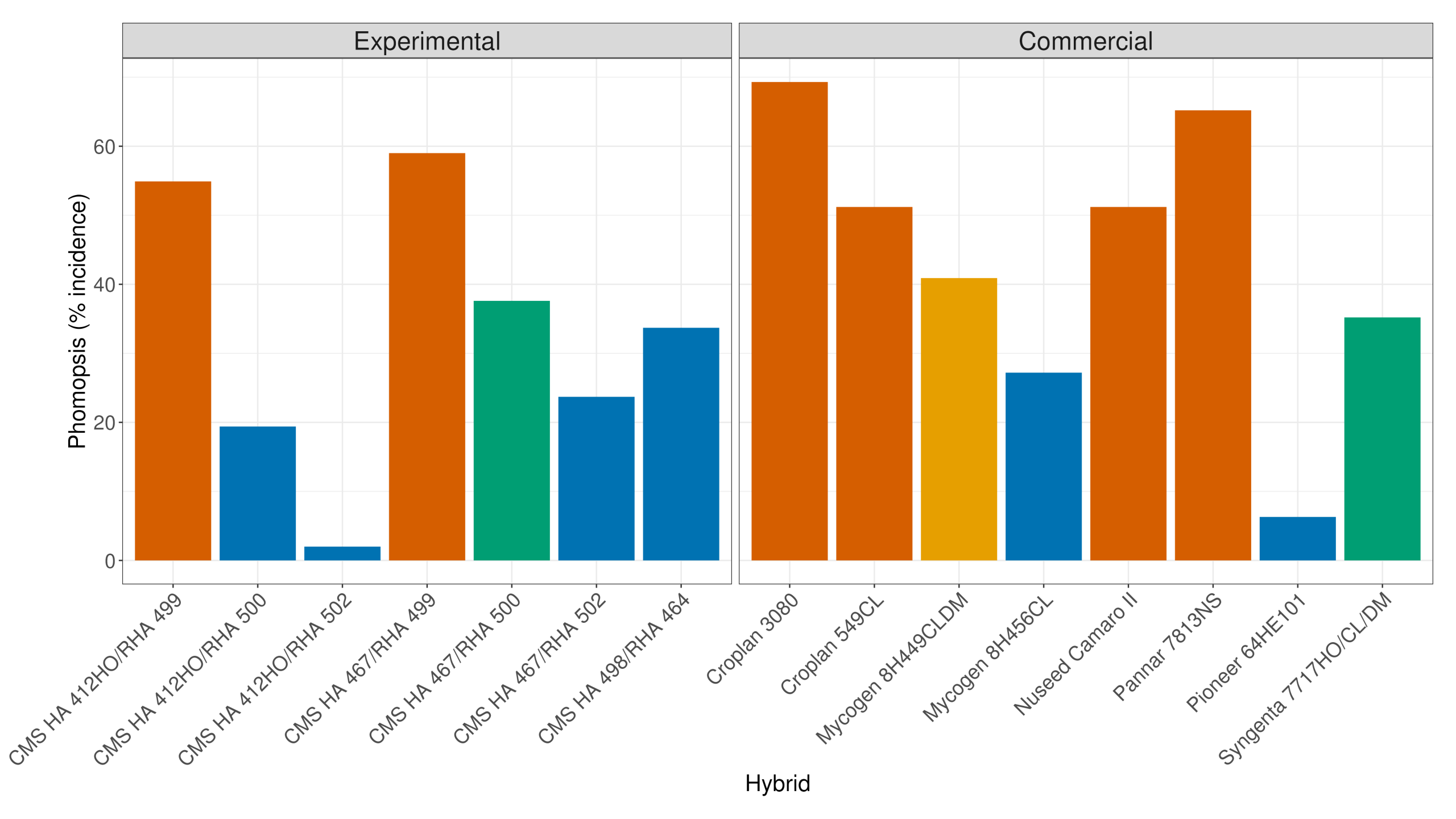

Experimental
Commercial
Head Rot (% infected)
60
40
20
0
CMS HA 412HO/RHA 491
CMS HA 412HO/RHA 492
CMS HA 467/RHA 491
CMS HA 467/RHA 492
Croplan 549CL
Mycogen 8H449CLDM
Hybrid

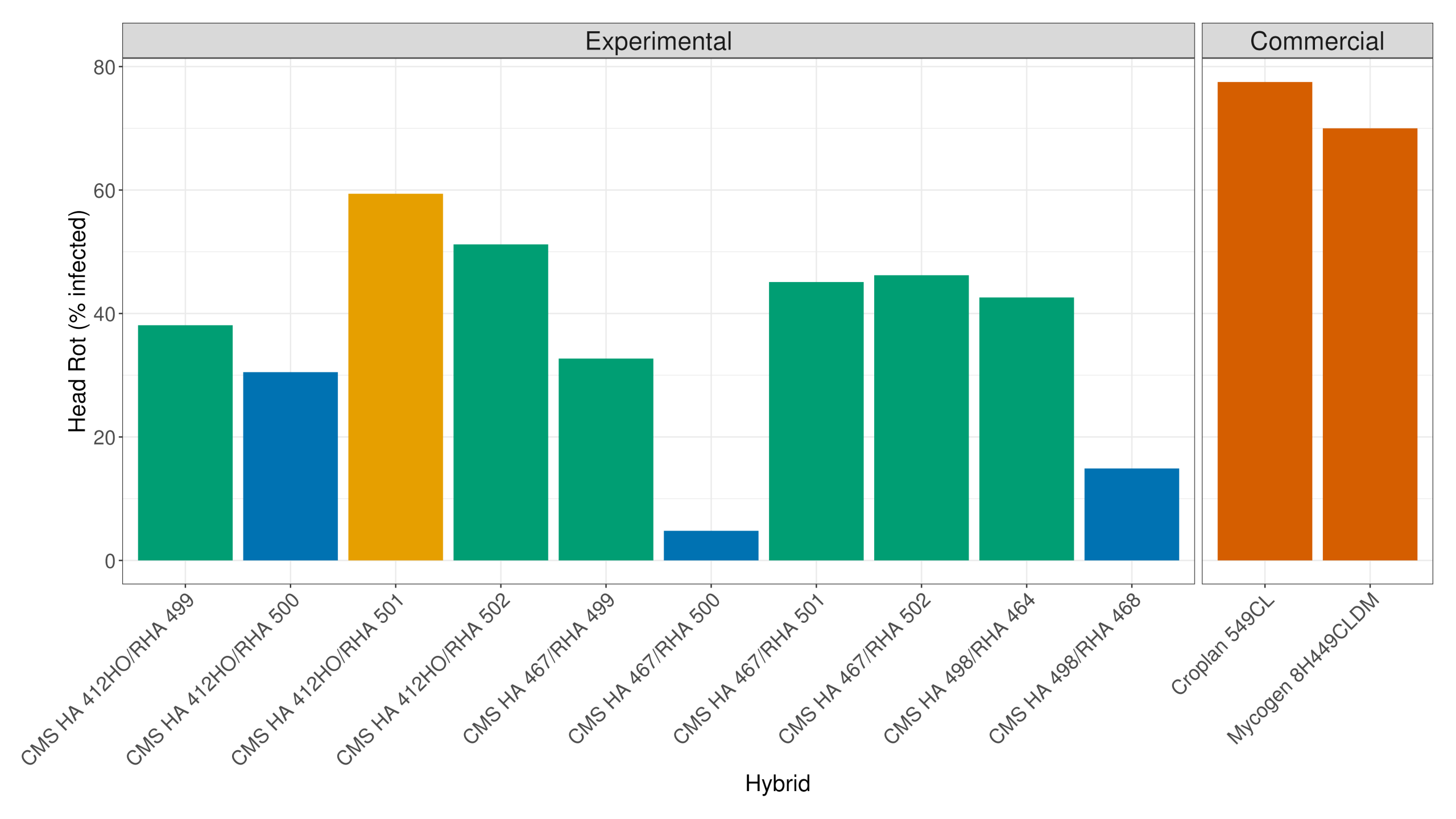
HA 498, RHA 499, RHA 500, RHA 501, RHA 502

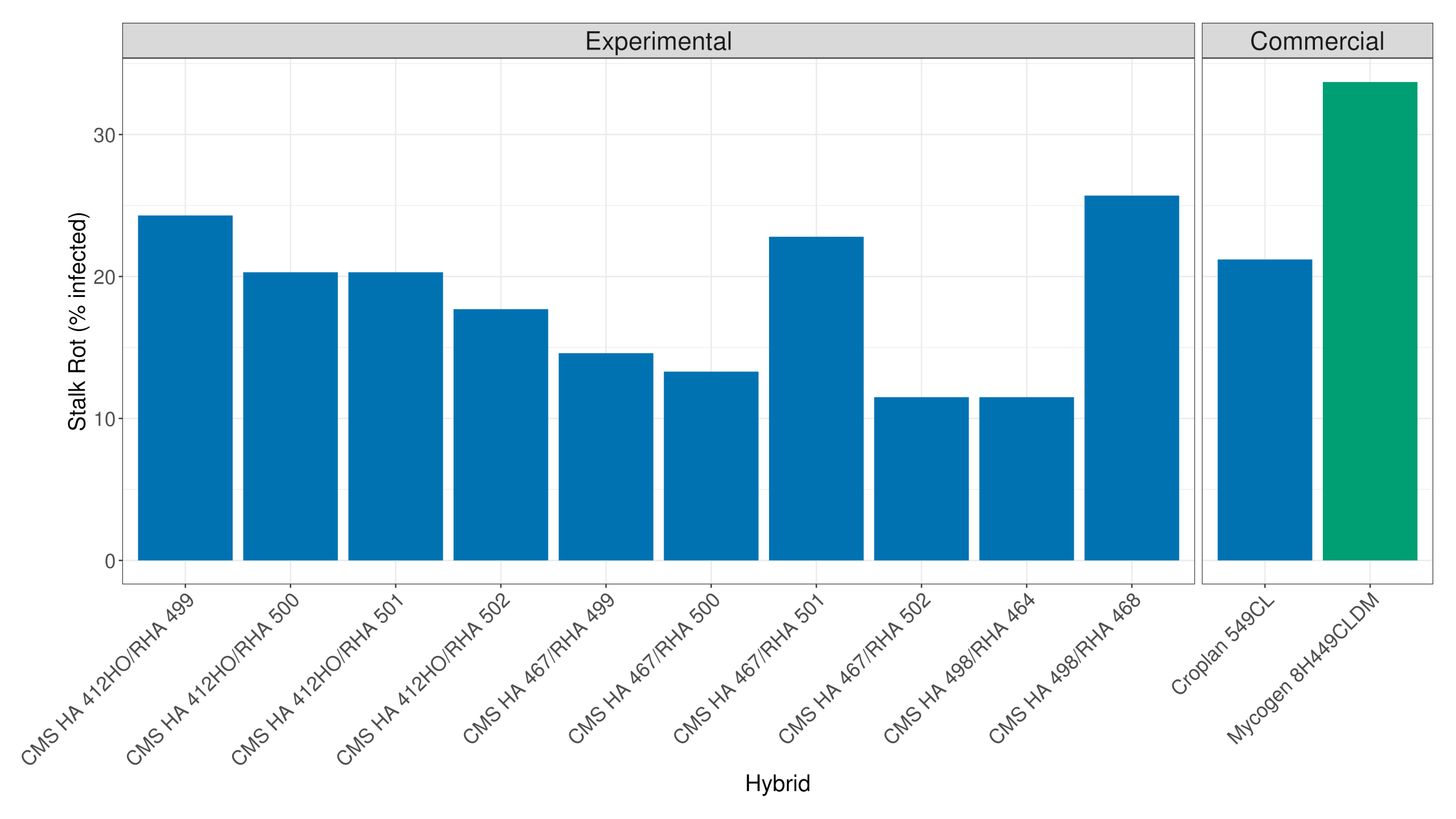
- HA 498 – short stature, late maturing Clearfield/HO, Sclerotinia/Phomopsis res.
- RHA 499 – Clearfield, PlArg DM resistance
- RHA 500 – Clearfield, Sclerotinia/Phomopsis res.
- RHA 501 -- diversity – Orobanche res?
- RHA 502 – HO, Phomopsis res.


Experimental
Commercial
Yield (kg ha-1)
3000
2000
1000
0
CMS HA 412HO/RHA 499
CMS HA 412HO/RHA 500
CMS HA 412HO/RHA 501
CMS HA 412HO/RHA 502
CMS HA 467/RHA 499
CMS HA 467/RHA 500
CMS HA 467/RHA 501
CMS HA 467/RHA 502
CMS HA 498/RHA 464
CMS HA 498/RHA 468
Croplan 3080
Croplan 549CL
Mycogen 8H449CLDM
Mycogen 8H456CL
Nuseed Camaro II
Pannar 7813NS
Pioneer 64HE101
Syngenta 7717HO/CL/DM
Hybrid


Experimental
Commercial
Oil Content (%)
0
10
20
30
40
CMS HA 412HO/RHA 499
CMS HA 412HO/RHA 500
CMS HA 412HO/RHA 501
CMS HA 412HO/RHA 502
CMS HA 467/RHA 499
CMS HA 467/RHA 500
CMS HA 467/RHA 501
CMS HA 467/RHA 502
CMS HA 498/RHA 464
CMS HA 498/RHA 468
Croplan 3080
Croplan 549CL
Mycogen 8H449CLDM
Mycogen 8H456CL
Nuseed Camaro II
Pannar 7813NS
Pioneer 64HE101
Syngenta 7717HO/CL/DM
Hybrid


Experimental
Commercial
Phomopsis (% incidence)
0
20
40
60
CMS HA 412HO/RHA 499
CMS HA 412HO/RHA 500
CMS HA 412HO/RHA 502
CMS HA 467/RHA 499
CMS HA 467/RHA 500
CMS HA 467/RHA 502
CMS HA 498/RHA 464
Croplan 3080
Croplan 549CL
Mycogen 8H449CLDM
Mycogen 8H456CL
Nuseed Camaro II
Pannar 7813NS
Pioneer 64HE101
Syngenta 7717HO/CL/DM
Hybrid


Experimental
Commercial
Head Rot (% infected)
0
20
40
60
80
CMS HA 412HO/RHA 499
CMS HA 412HO/RHA 500
CMS HA 412HO/RHA 501
CMS HA 412HO/RHA 502
CMS HA 467/RHA 499
CMS HA 467/RHA 500
CMS HA 467/RHA 501
CMS HA 467/RHA 502
CMS HA 498/RHA 464
CMS HA 498/RHA 468
Croplan 549CL
Mycogen 8H449CLDM
Hybrid

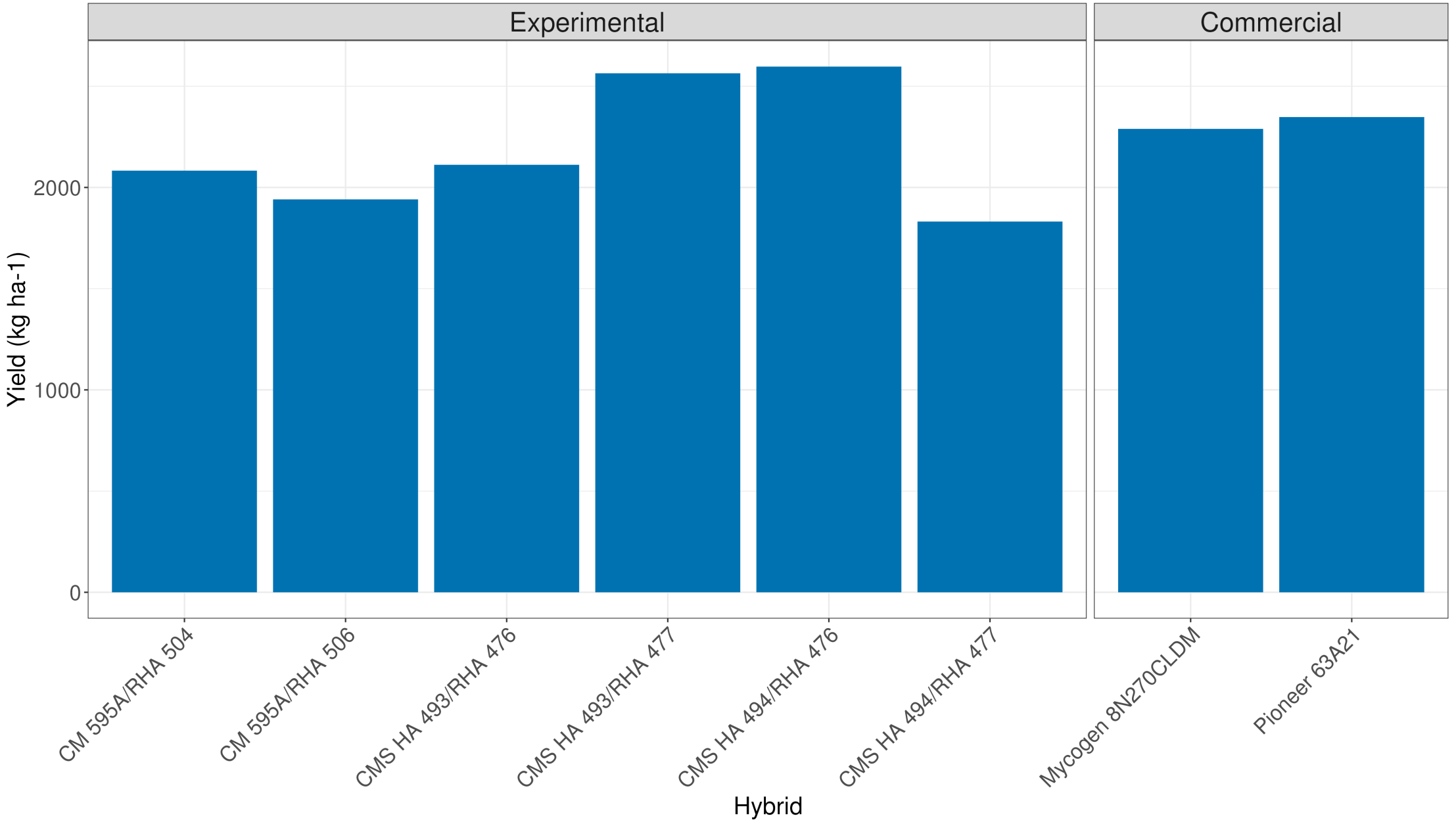

Experimental
Commercial
Stalk Rot (% infected)
0
10
20
30
CMS HA 412HO/RHA 499
CMS HA 412HO/RHA 500
CMS HA 412HO/RHA 501
CMS HA 412HO/RHA 502
CMS HA 467/RHA 499
CMS HA 467/RHA 500
CMS HA 467/RHA 501
CMS HA 467/RHA 502
CMS HA 498/RHA 464
CMS HA 498/RHA 468
Croplan 549CL
Mycogen 8H449CLDM
Hybrid

Early Maturing Parental Lines

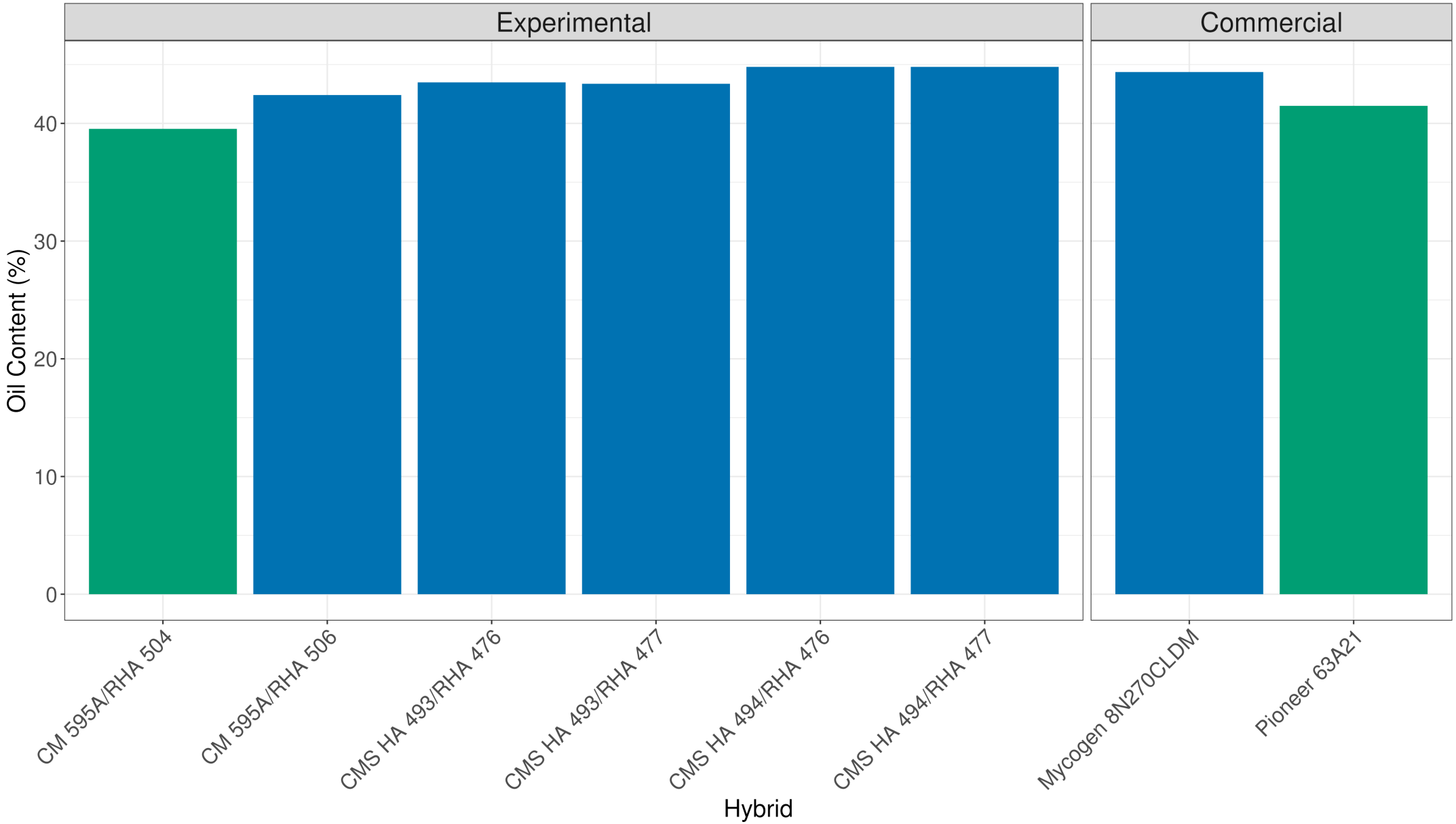
HA 493, HA 494, HA 503, RHA 504-507

- HA 493 – short stature/early maturing – HO/Clearfield version in 2025
- HA 494 – early and higher oil/yield – HO/Clearfield version in 2025
- HA 503 – Phomopsis resistance
- RHA 504 – HO/Clearfield
- RHA 505 – HO
- RHA 506 – HO
- RHA 507 – HO

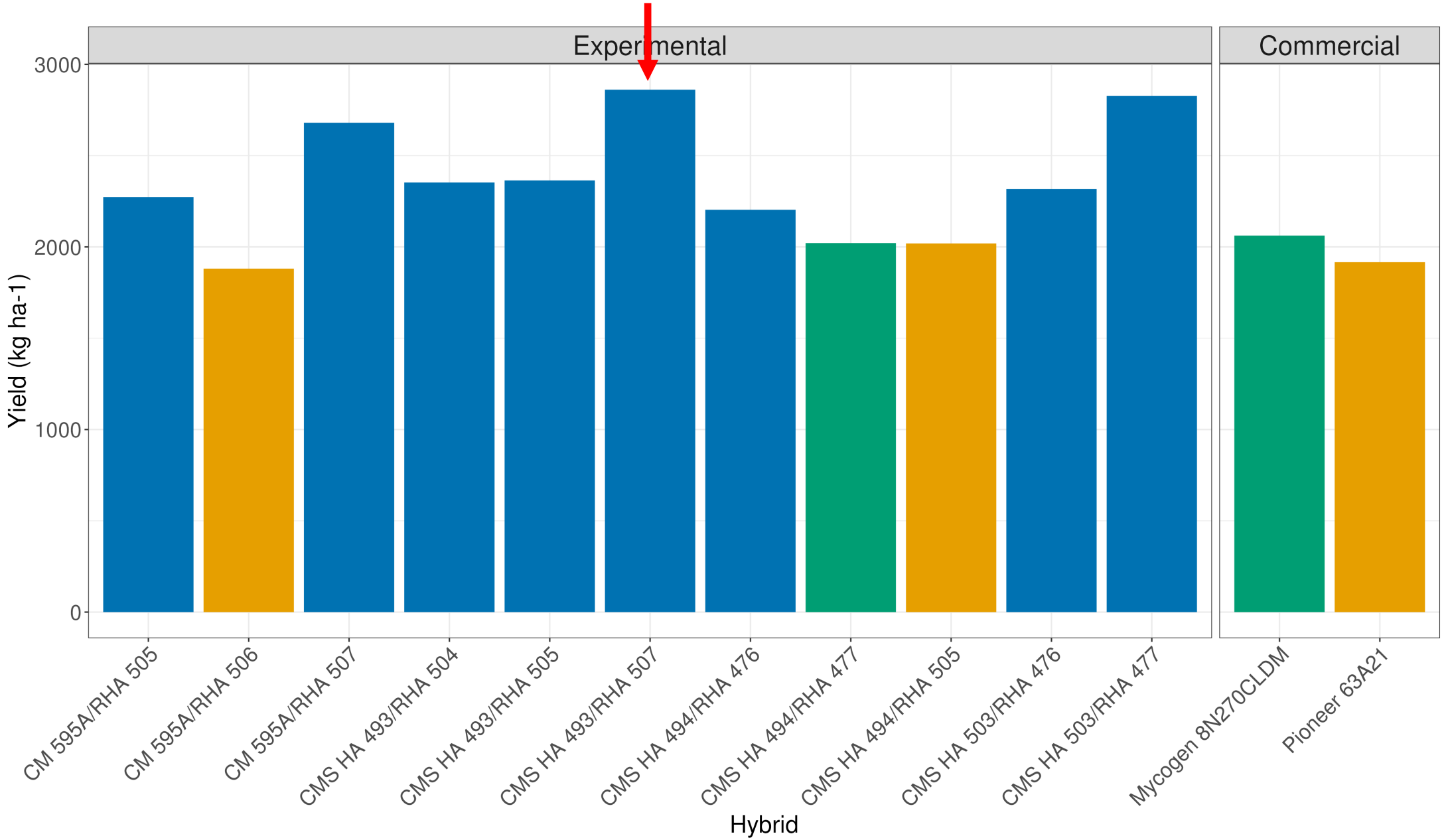
Indianhead, SK 2017



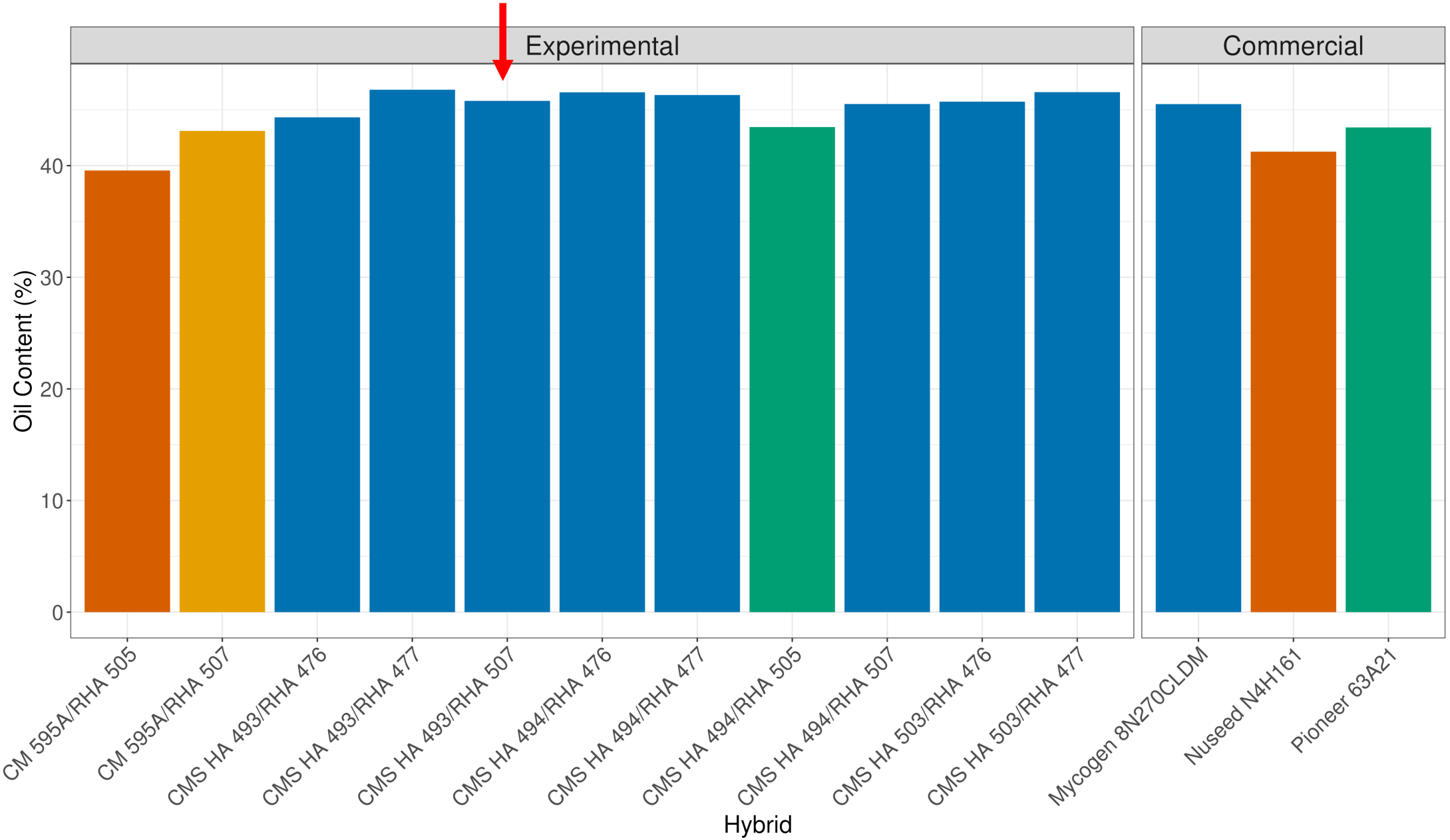
Indianhead, SK 2017

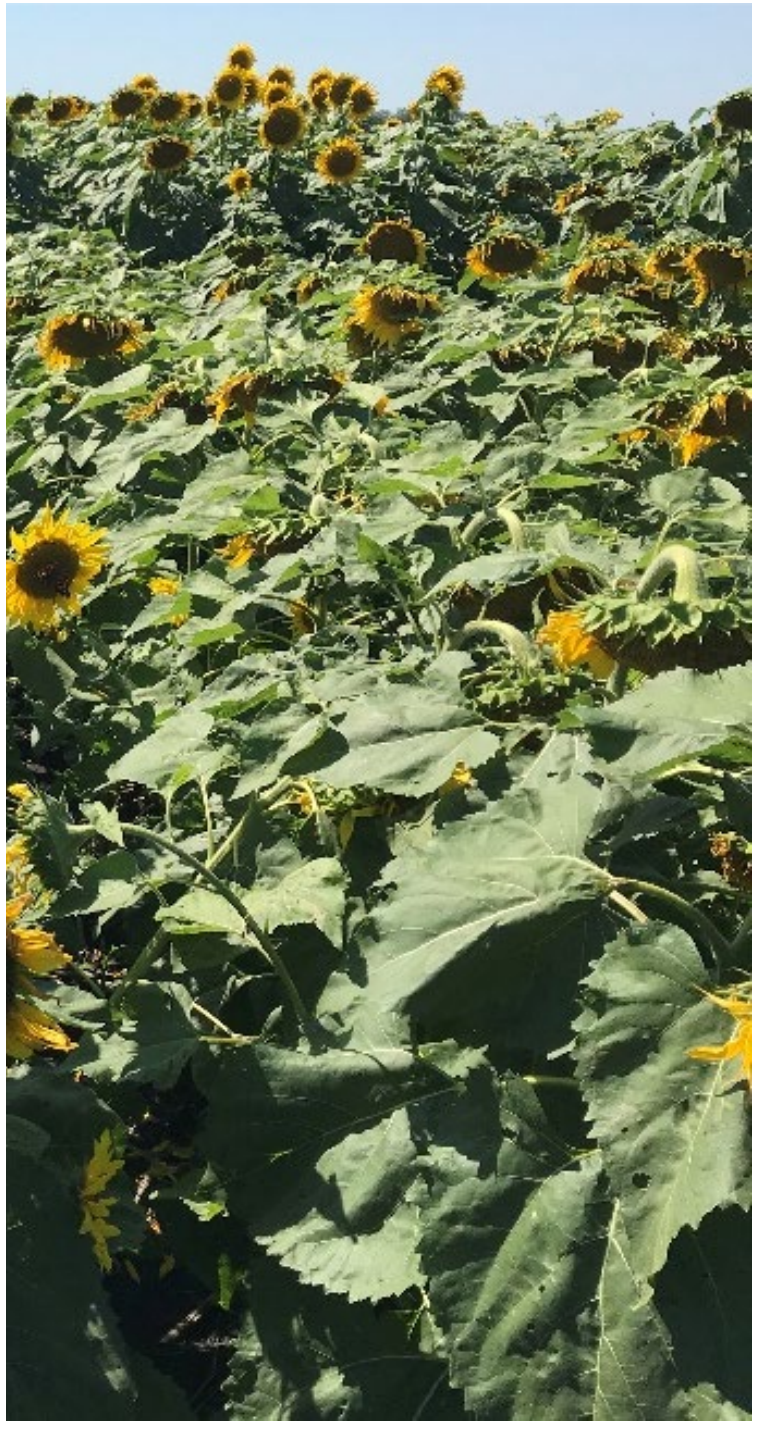


Moorhead, MN mid-June plant 2020



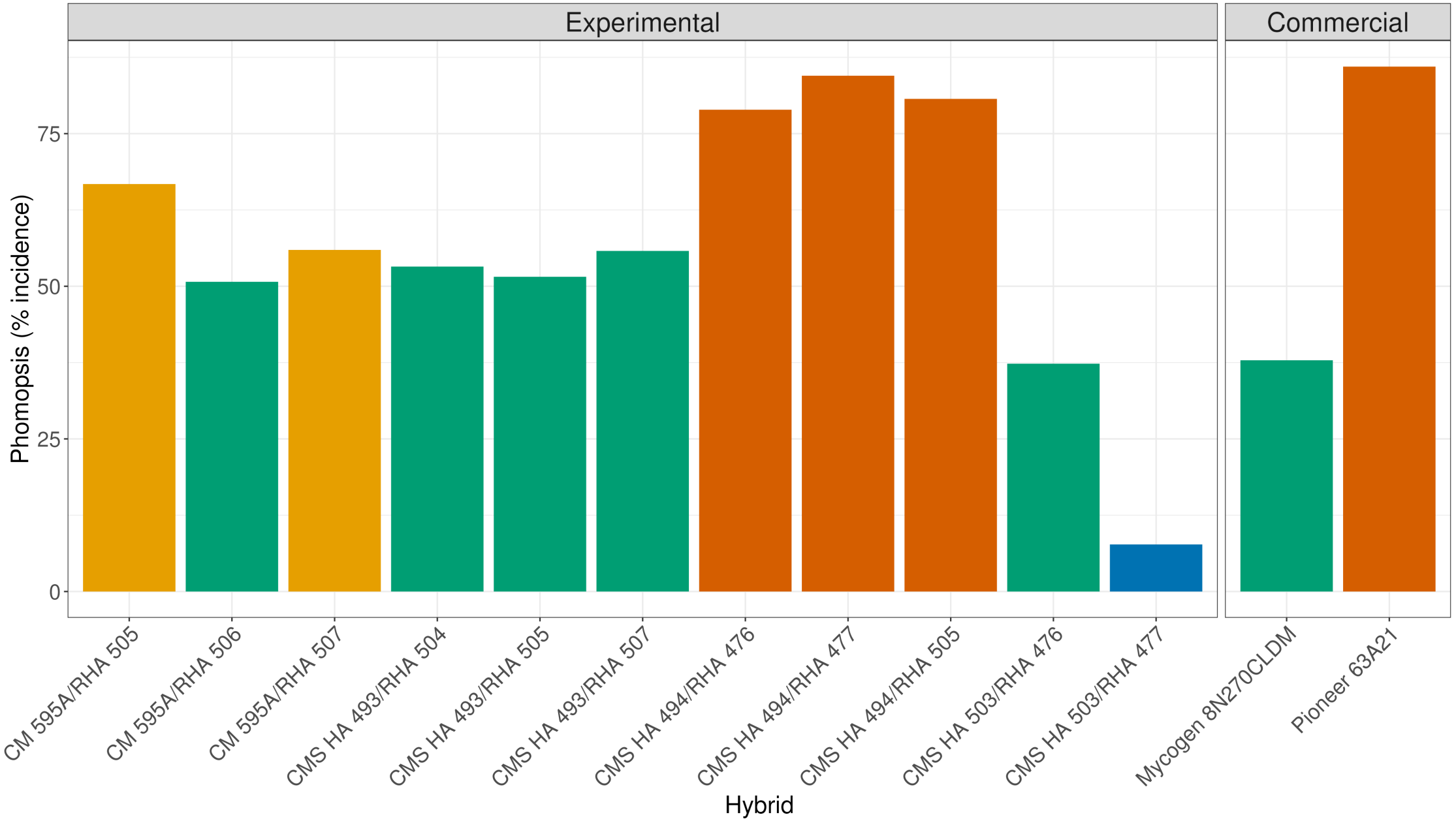
Moorhead, MN mid-June plant, 2021



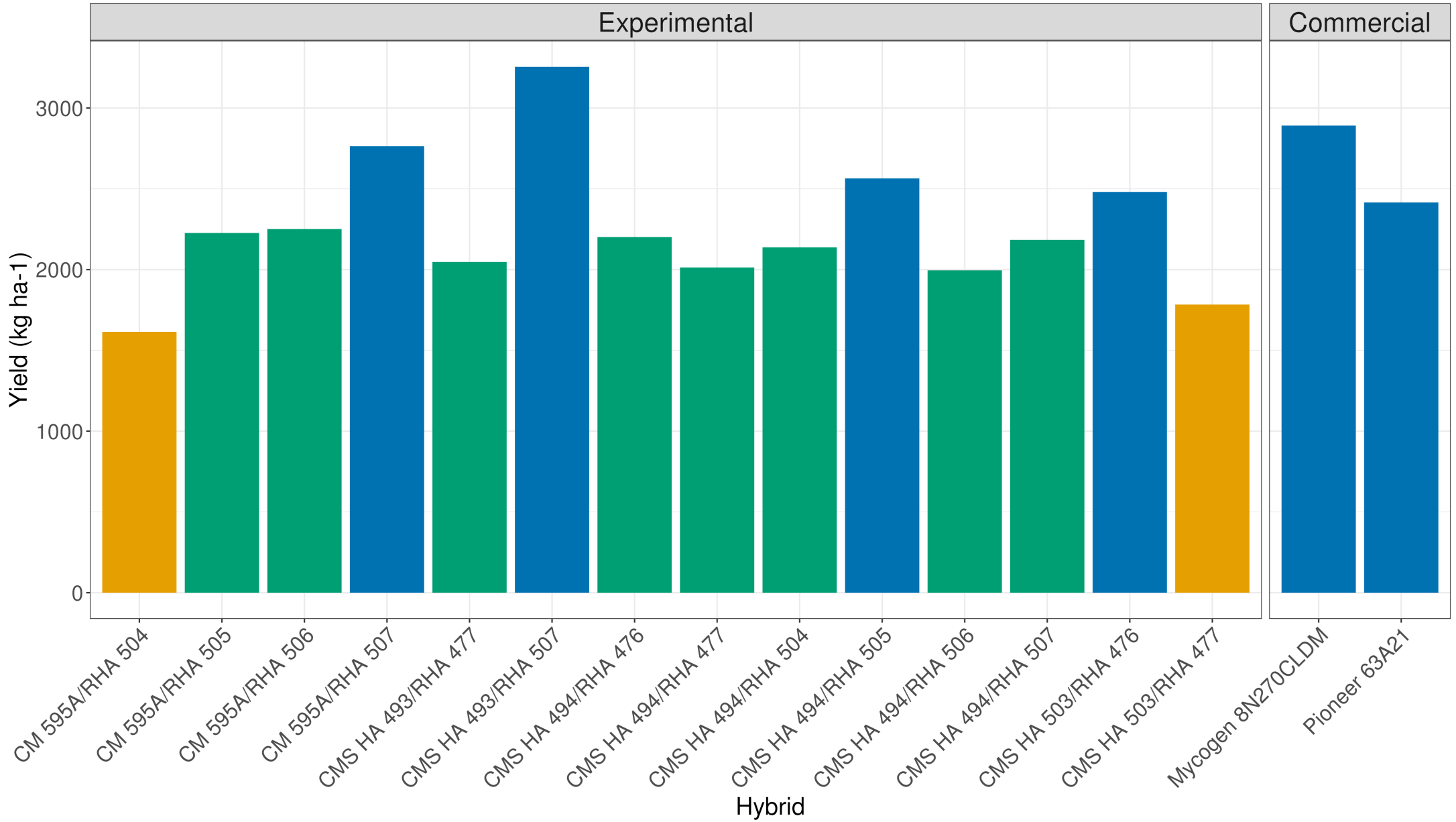


CMS HA 493/RHA 507

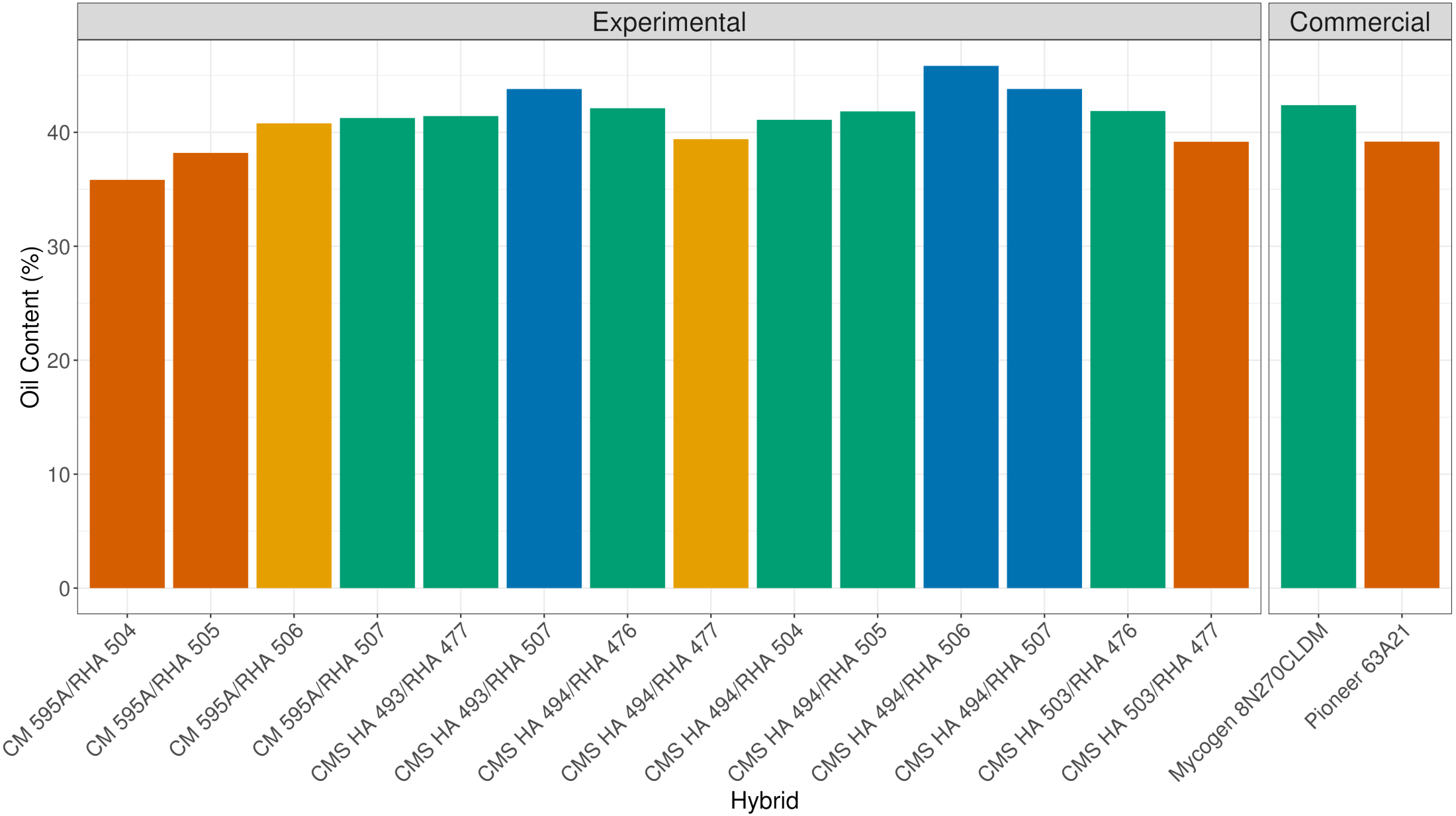
Moorhead, MN mid-June plant 2020



Hutchinson, KS, double crop 2020

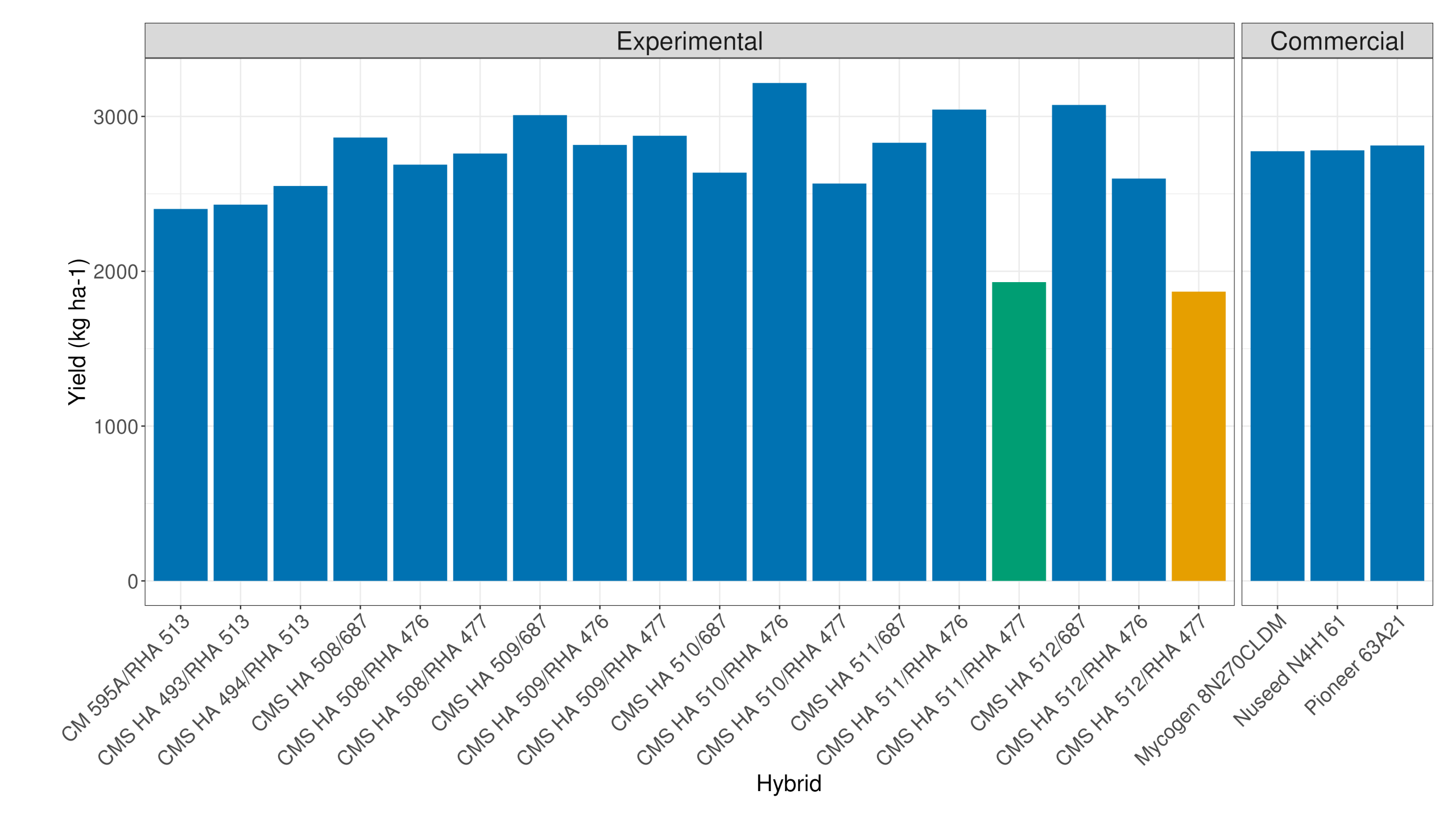


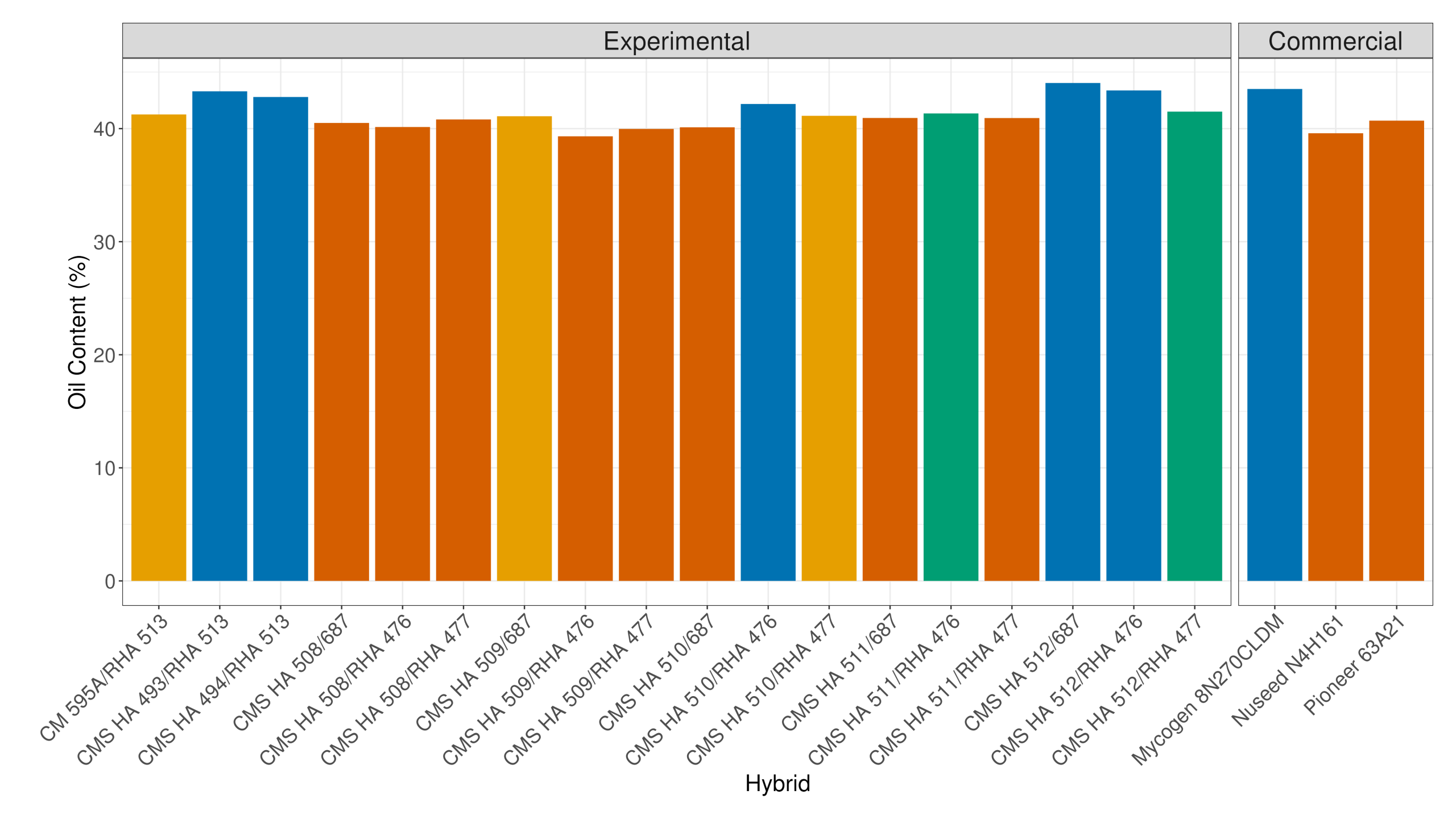
Hutchinson, KS, double crop 2020

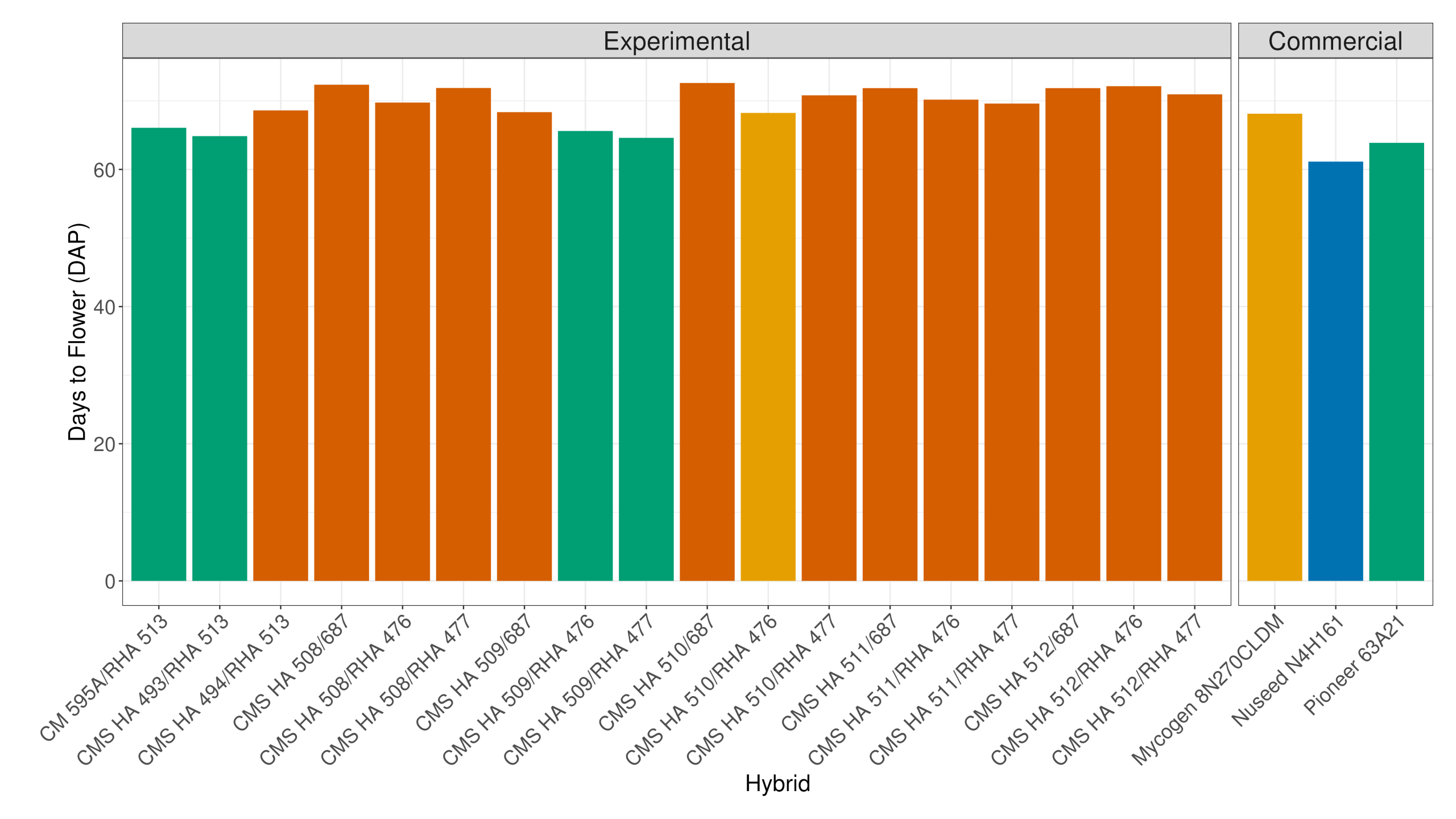


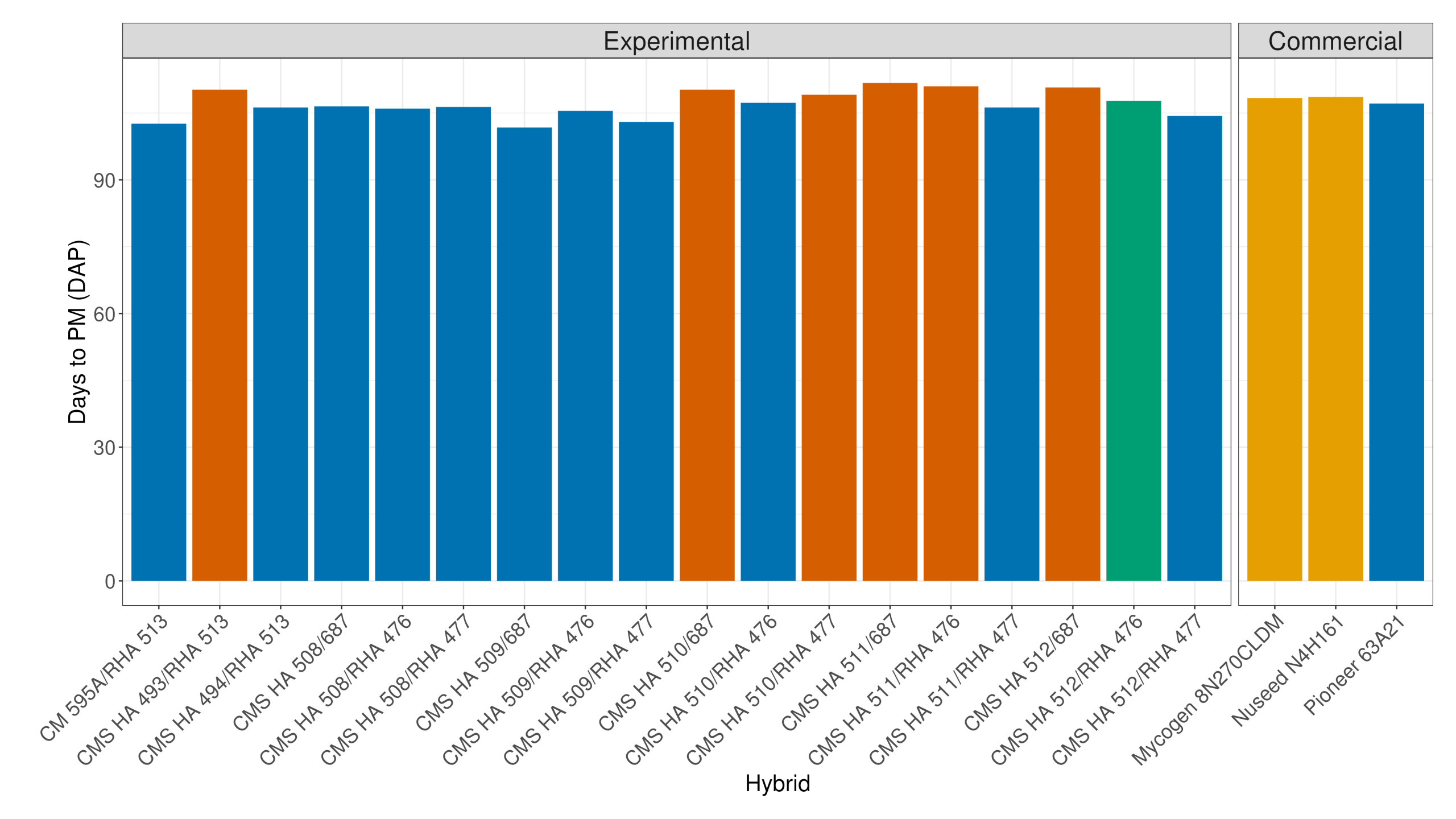
HA 508 to 512, RHA 513

- HA 508 – Clearfield/HO
- HA 509 -- Clearfield/HO
- HA 510 -- Clearfield/HO
- HA 511 -- Clearfield/HO
- HA 512 -- Clearfield/HO
- RHA 513 – PlArg DM, HO


Experimental
Commercial
Yield (kg ha-1)
3000
2000
1000
0
CM 595A/RHA 513
CMS HA 493/RHA 513
CMS HA 494/RHA 513
CMS HA 508/687
CMS HA 508/RHA 476
CMS HA 508/RHA 477
CMS HA 509/687
CMS HA 509/RHA 476
CMS HA 509/RHA 477
CMS HA 510/687
CMS HA 510/RHA 476
CMS HA 510/RHA 477
CMS HA 511/687
CMS HA 511/RHA 476
CMS HA 511/RHA 477
CMS HA 512/687
CMS HA 512/RHA 476
CMS HA 512/RHA 477
Mycogen 8N270CLDM
Nuseed N4H161
Pioneer 63A21
Hybrid


Experimental
Commercial
Oil Content (%)
0
10
20
30
40
CM 595A/RHA 513
CMS HA 493/RHA 513
CMS HA 494/RHA 513
CMS HA 508/687
CMS HA 508/RHA 476
CMS HA 508/RHA 477
CMS HA 509/687
CMS HA 509/RHA 476
CMS HA 509/RHA 477
CMS HA 510/687
CMS HA 510/RHA 476
CMS HA 510/RHA 477
CMS HA 511/687
CMS HA 511/RHA 476
CMS HA 511/RHA 477
CMS HA 512/687
CMS HA 512/RHA 476
CMS HA 512/RHA 477
Mycogen 8N270CLDM
Nuseed N4H161
Pioneer 63A21
Hybrid


Experimental
Commercial
Days to Flower (DAP)
0
20
40
60
CM 595A/RHA 513
CMS HA 493/RHA 513
CMS HA 494/RHA 513
CMS HA 508/687
CMS HA 508/RHA 476
CMS HA 508/RHA 477
CMS HA 509/687
CMS HA 509/RHA 476
CMS HA 509/RHA 477
CMS HA 510/687
CMS HA 510/RHA 476
CMS HA 510/RHA 477
CMS HA 511/687
CMS HA 511/RHA 476
CMS HA 511/RHA 477
CMS HA 512/687
CMS HA 512/RHA 476
CMS HA 512/RHA 477
Mycogen 8N270CLDM
Nuseed N4H161
Pioneer 63A21
Hybrid


Experimental
Commercial
Days to PM (DAP)
0
30
60
90
CM 595A/RHA 513
CMS HA 493/RHA 513
CMS HA 494/RHA 513
CMS HA 508/687
CMS HA 508/RHA 476
CMS HA 508/RHA 477
CMS HA 509/687
CMS HA 509/RHA 476
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CMS HA 510/687
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CMS HA 511/687
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CMS HA 512/RHA 476
CMS HA 512/RHA 477
Mycogen 8N270CLDM
Nuseed N4H161
Pioneer 63A21
Hybrid