# Parallel monitoring of shoot and root characteristics by using a semi-automatic phenotyping platform

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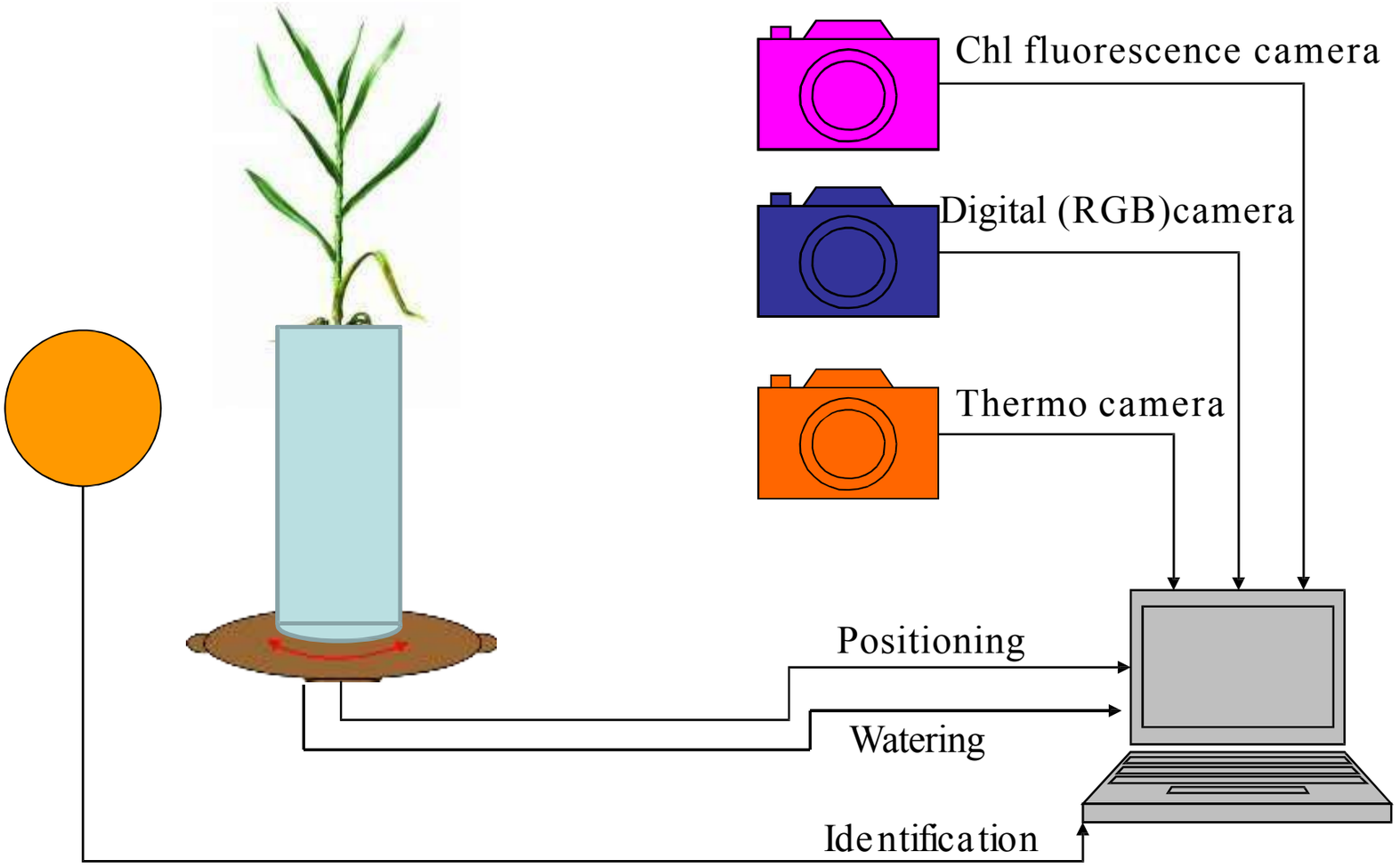
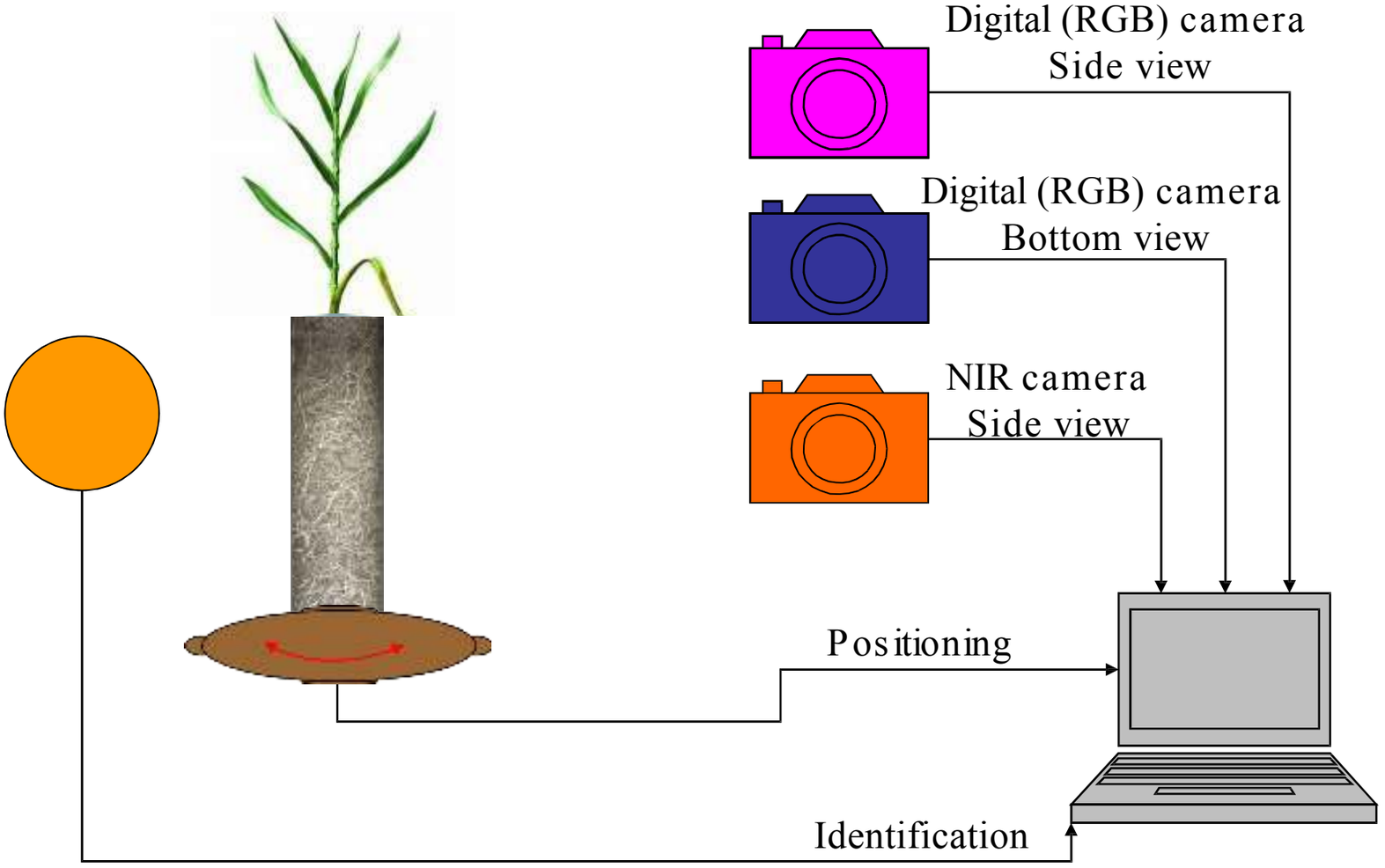
European Regional Development Fund

# HAS-SSDS (Szeged):
# Low cost, semi-automatic platform for shoot imaging



# HAS-RSDS (Szeged):
# Low cost, semi-automatic platform for root imaging



# HAS-SSDS platform

# RGB imaging, digital photography

## Detection of reflected light in the visible region

Original RGB picture

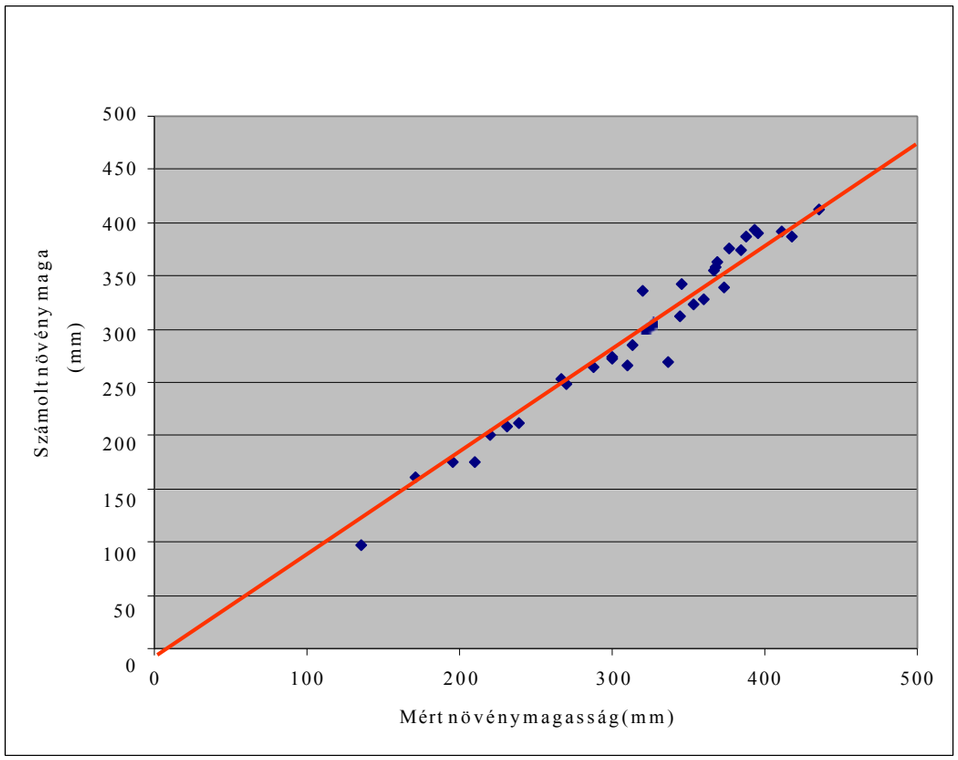
„Green” pixels

Identifier: 123456789012
Pixel no.: 189009
Height: 64.4 cm

# Determination of plant height by RGB imaging

„Green” pixels

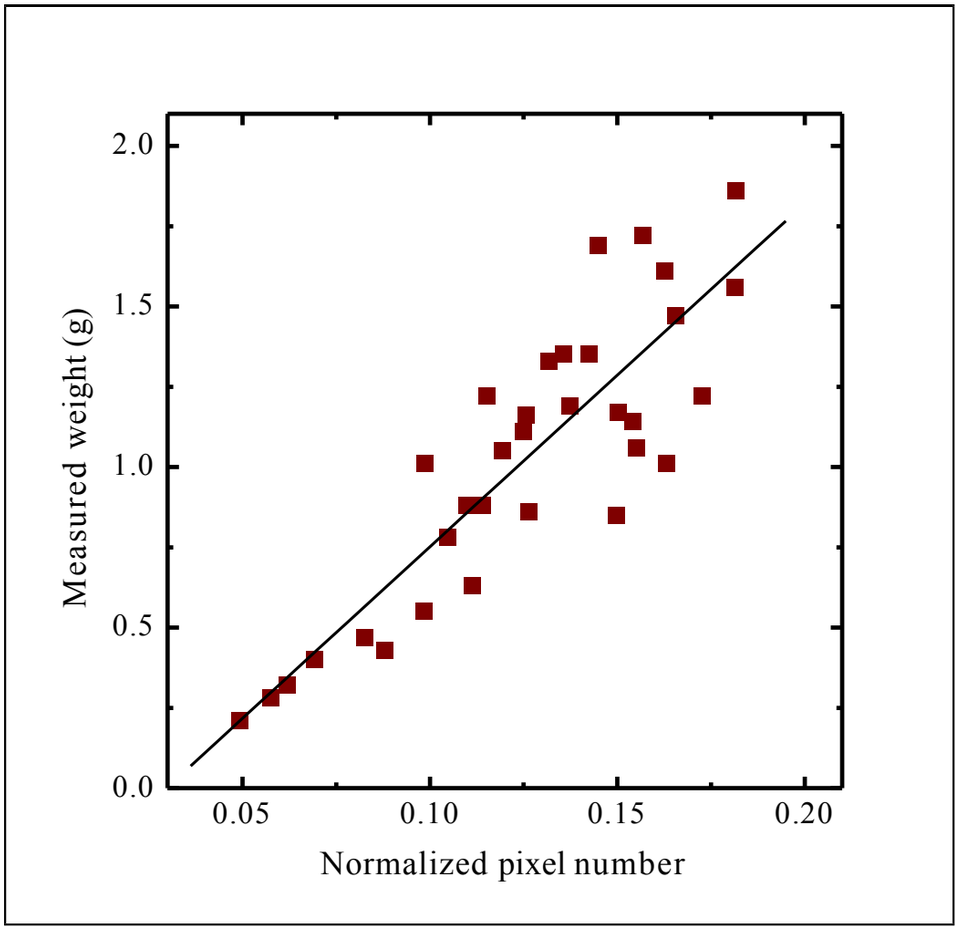
Identifier: 123456789012
Pixel no.: 189009
Height: 64.4 cm



# Determination of green biomass by RGB imaging

„Green” pixels

Identifier: 123456789012
Pixel no.: 189009
Height: 64.4 cm



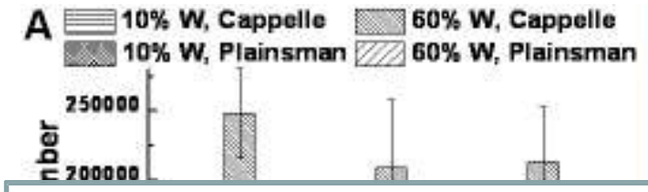
Seed analysis unit

# Seed analysis unit

# Determination of root density by RGB imaging

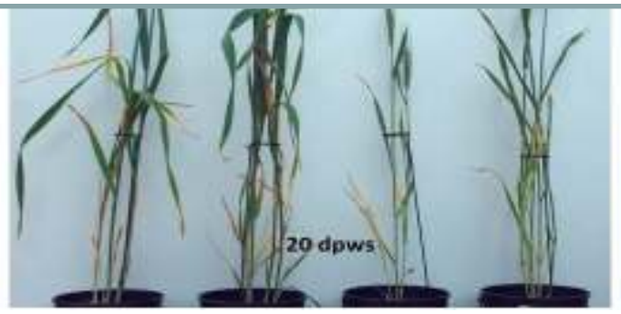
Can we predict grain yield from from phenotyping green biomass?

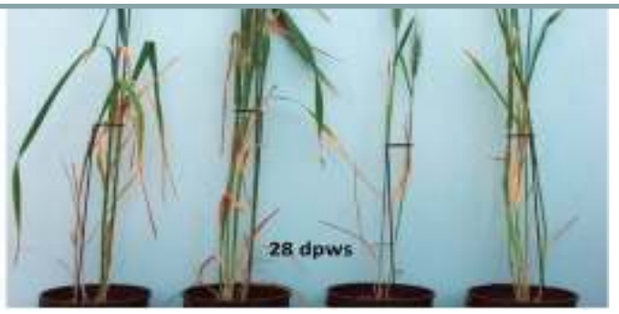
Response of Cappelle Deprez (DS) and Plainsman (DT) biomass to drought stress



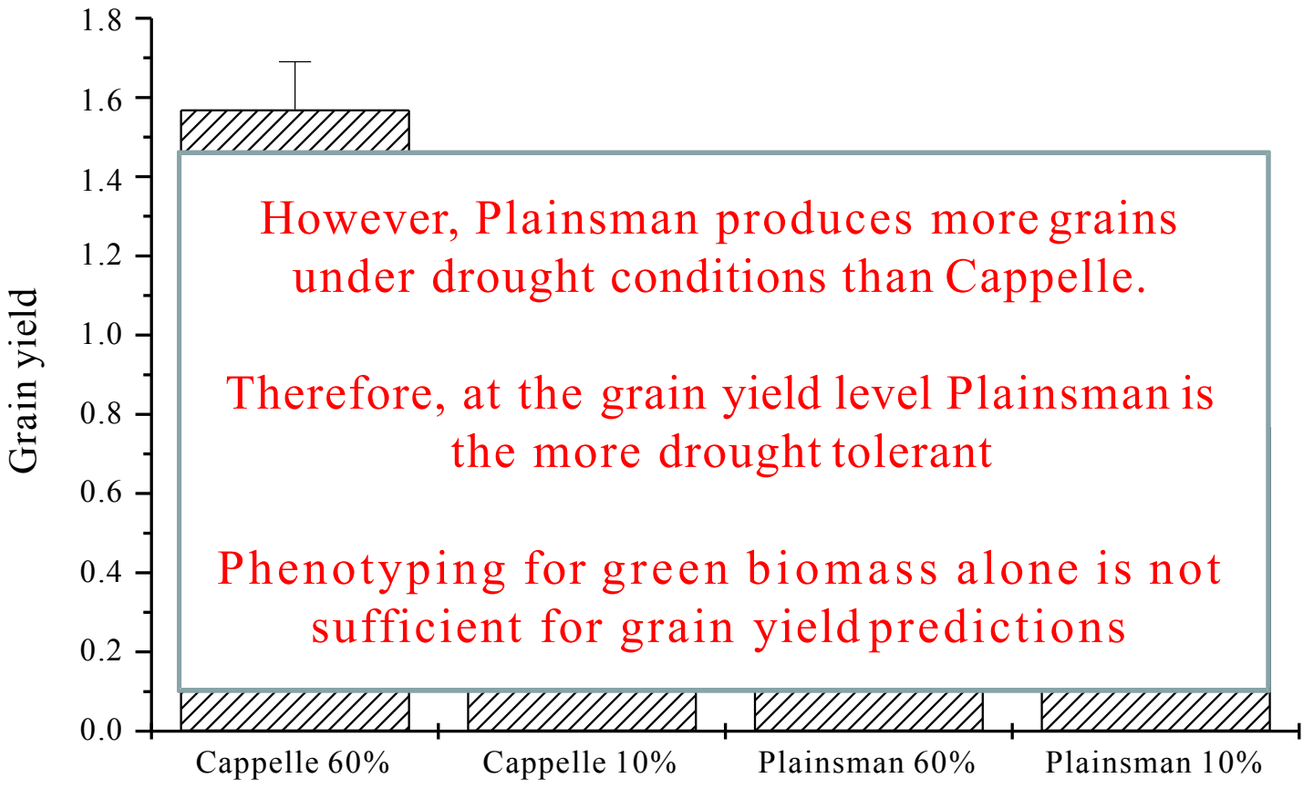


Cappelle retains higher biomass under droughtconditions than Plainsman, so Capelle appears to be more drought tolerant at the level ofbiomass



Response of Cappelle Deprez (DS) and Plainsman (DT) grain yield to drought stress




Paul et al. 2016, . PeerJ 4:e1708; DOI 10.7717/peerj.170

# Combined effects of drought- and salt stress in wheat

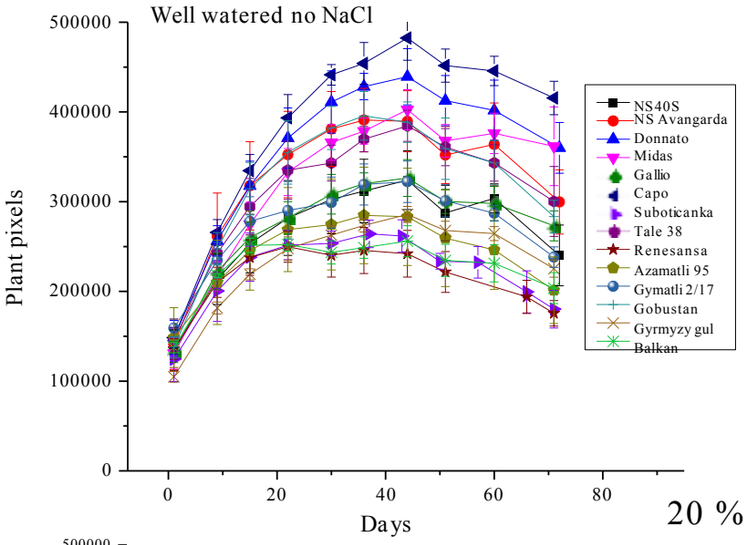
EPPN TA-project (Serbia/Novi Sad-Austria/Vienna- Azerbaijan/Baku)

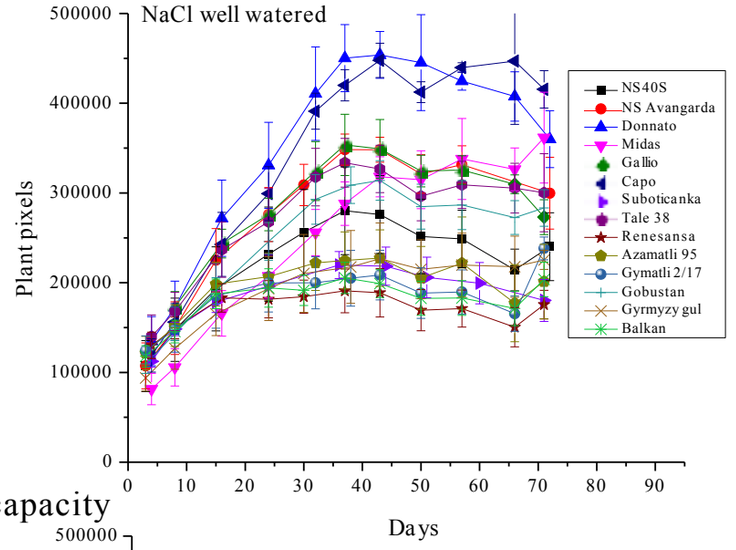
14 cultivars – 2 water treatments (60 %, 20%) – 2 salt treatments (0, 0.2 %)

| Serbian | Austrian | Azeri |
|---|---|---|
| Balkan | Donnato | Tale 38 |
| NS 40S | Midas | Azamatli 95 |
| NS Avangarda | Gallio | Giymatli 2/17 |
| Suboticanka | Capo | Gobustan |
| Renesansa | | Gyrmyzy gul |

# Effect of drought- and salt stress on green biomass (plant pixels)

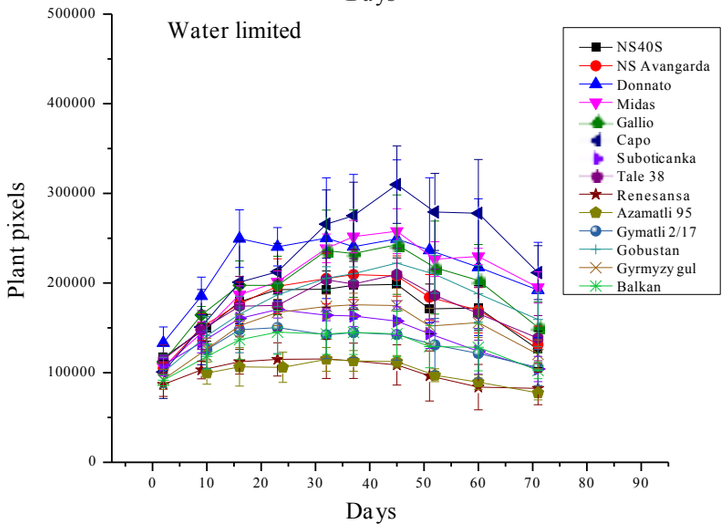
60 % field capacity

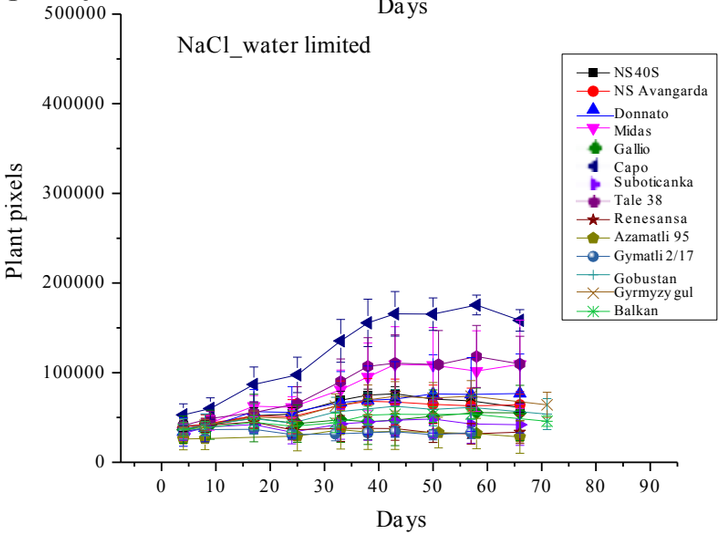



0.2 % NaCl: 2g/1 kg soil

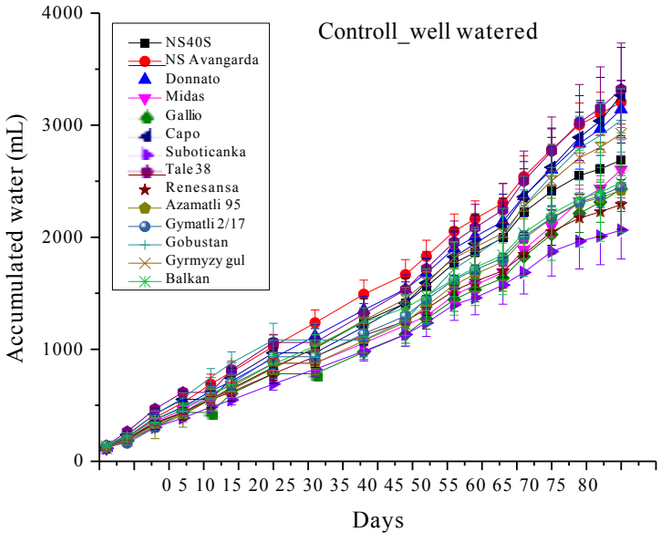
20 % field capacity

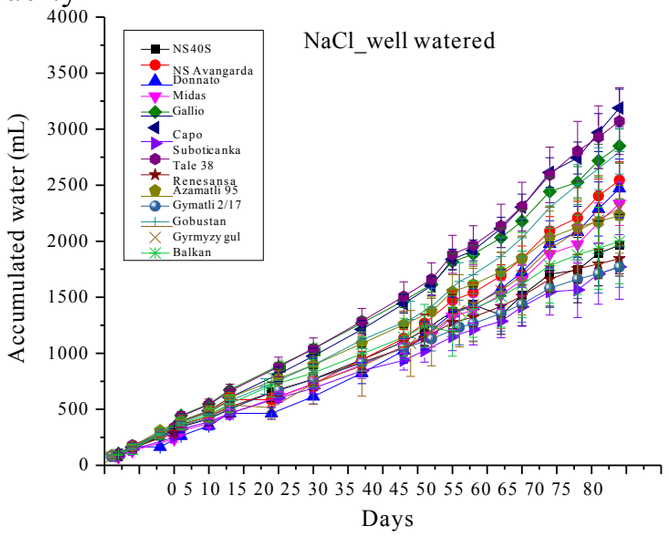


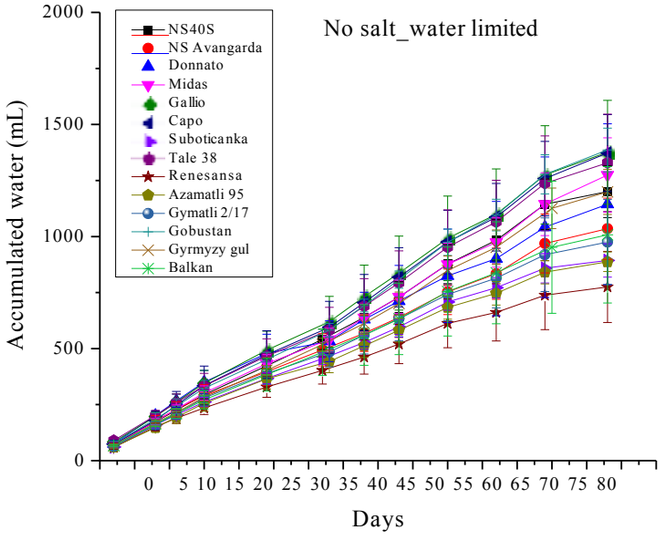
# Effect of drought- and salt stress on water usage

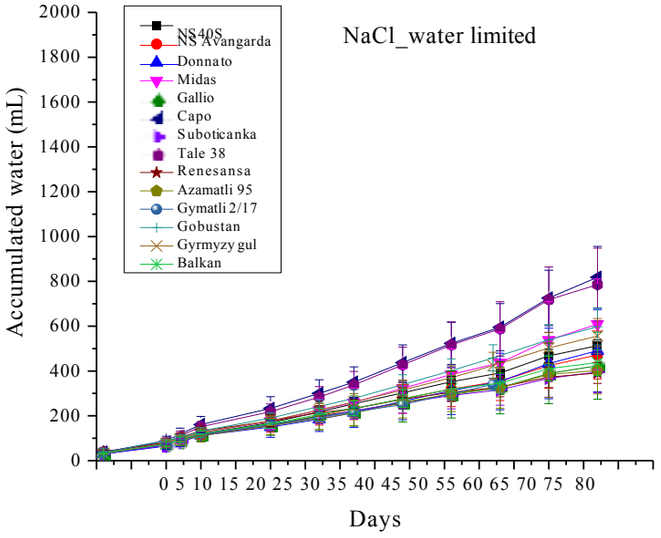
## 60 % field capacity



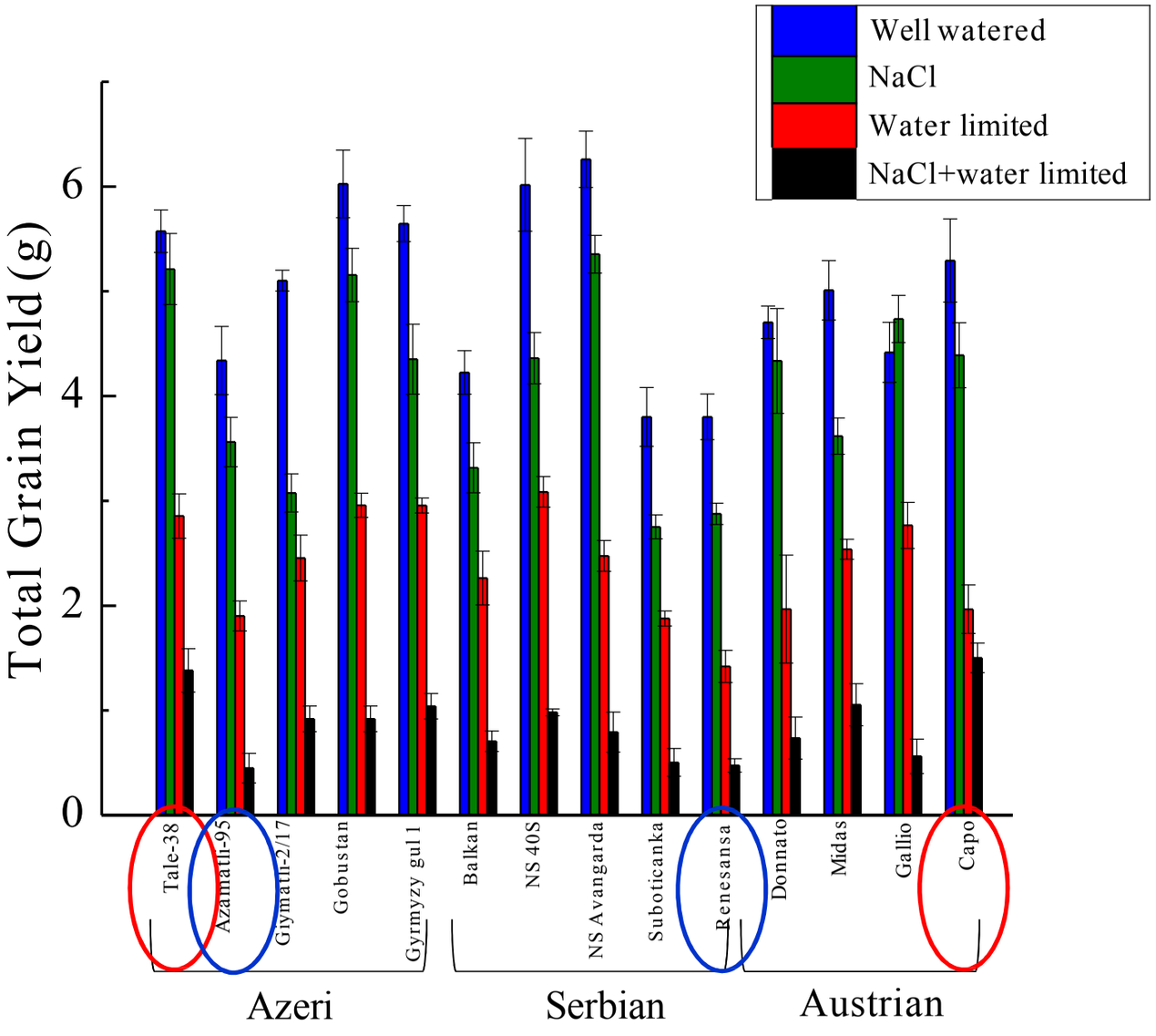

## 20 % field capacity



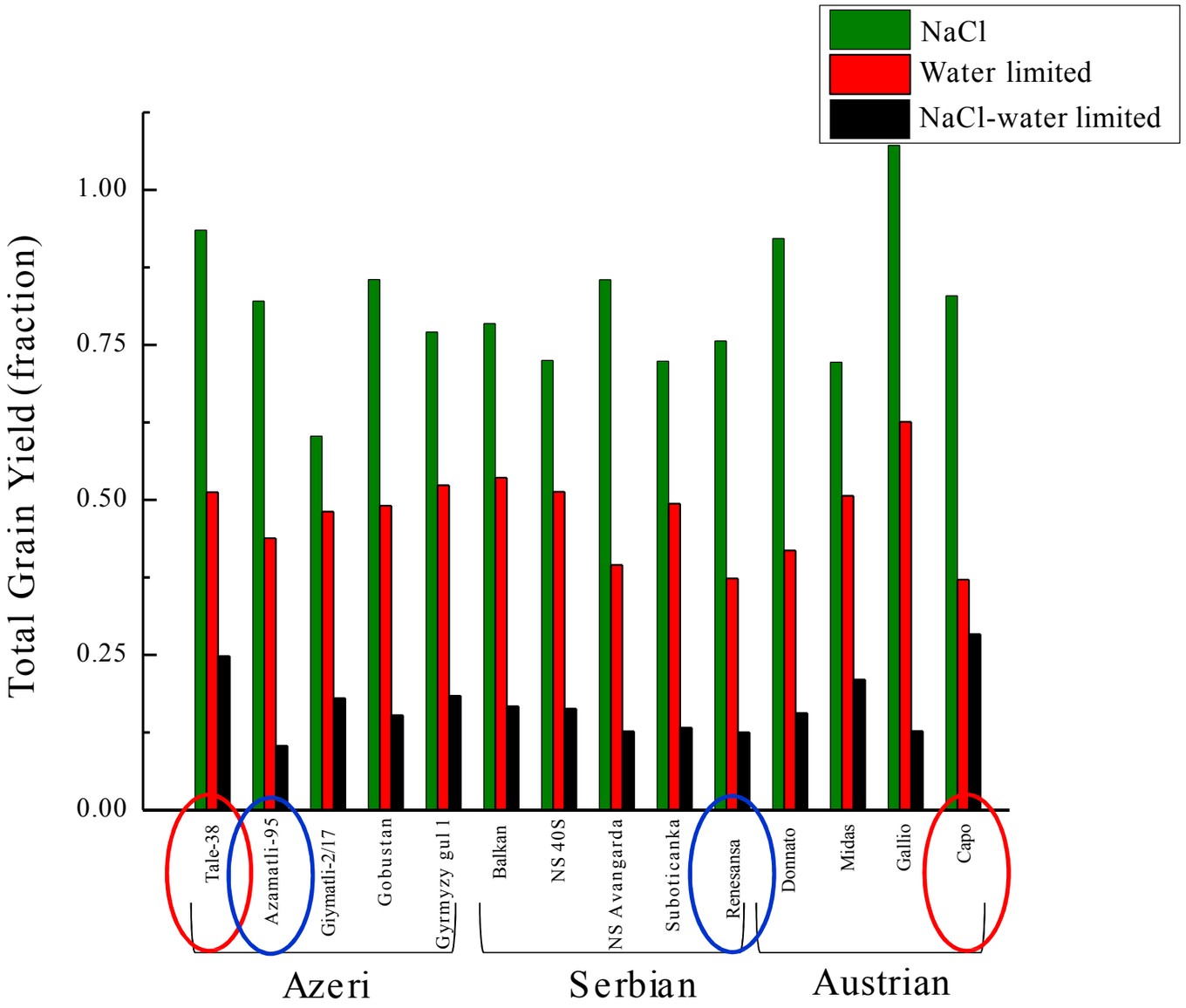




0.2 % NaCl: 2g/1 kg soil

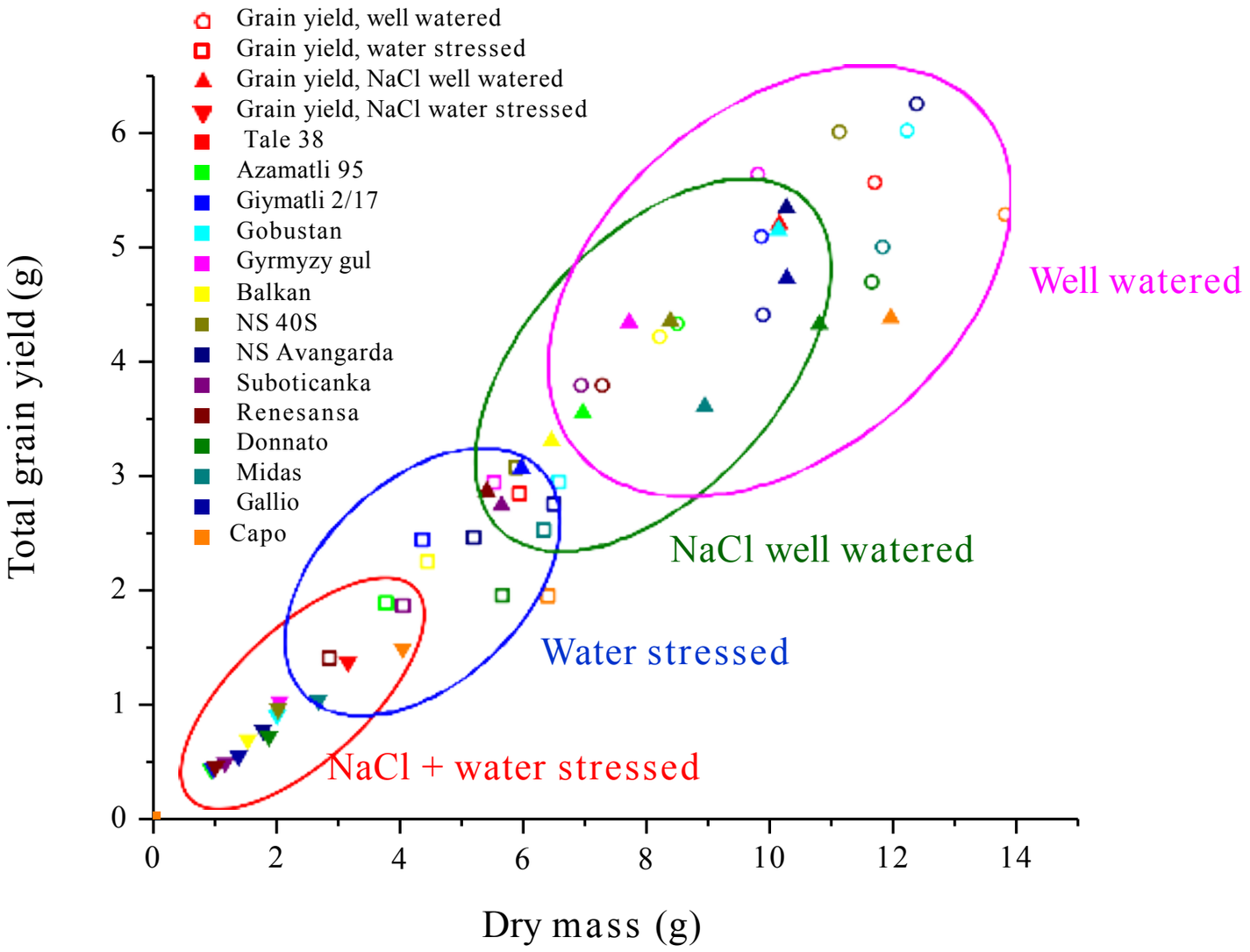
# Effect of drought- and salt stress on grain yield



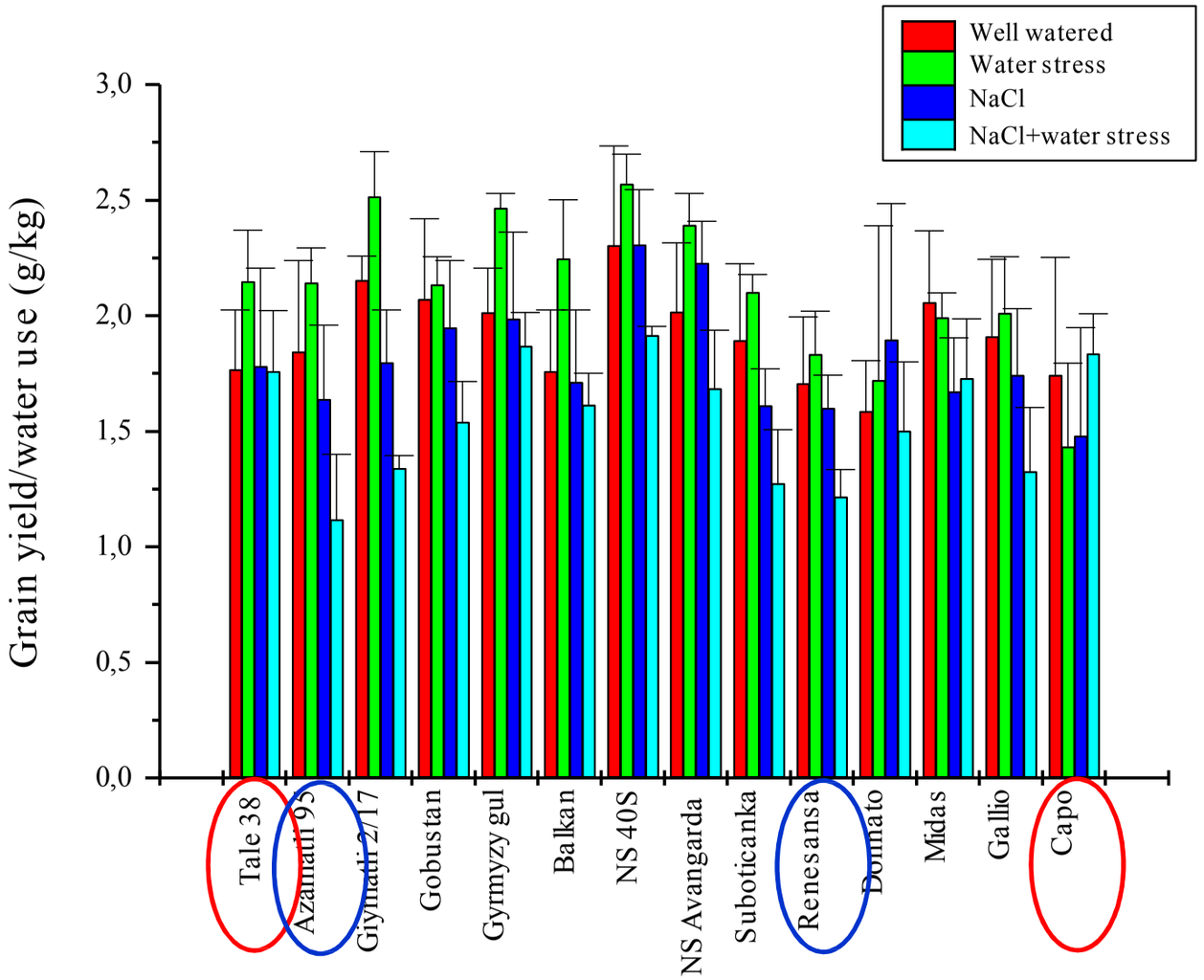
# Relative grain yield loss by drought- and salt stress



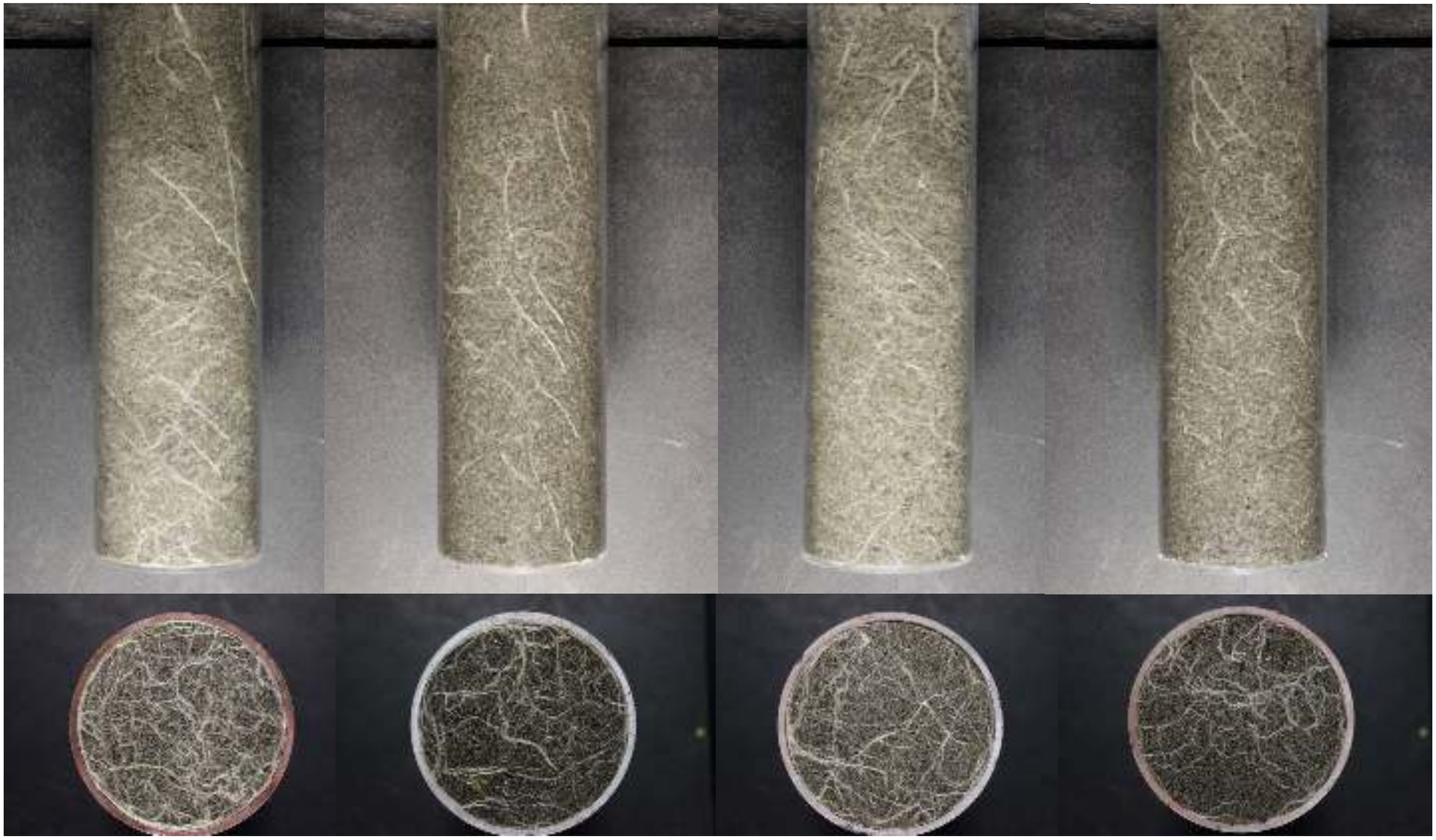
# Correlation of grain yield and dry biomass



# Effect of drought- and salt stress on water use efficiency

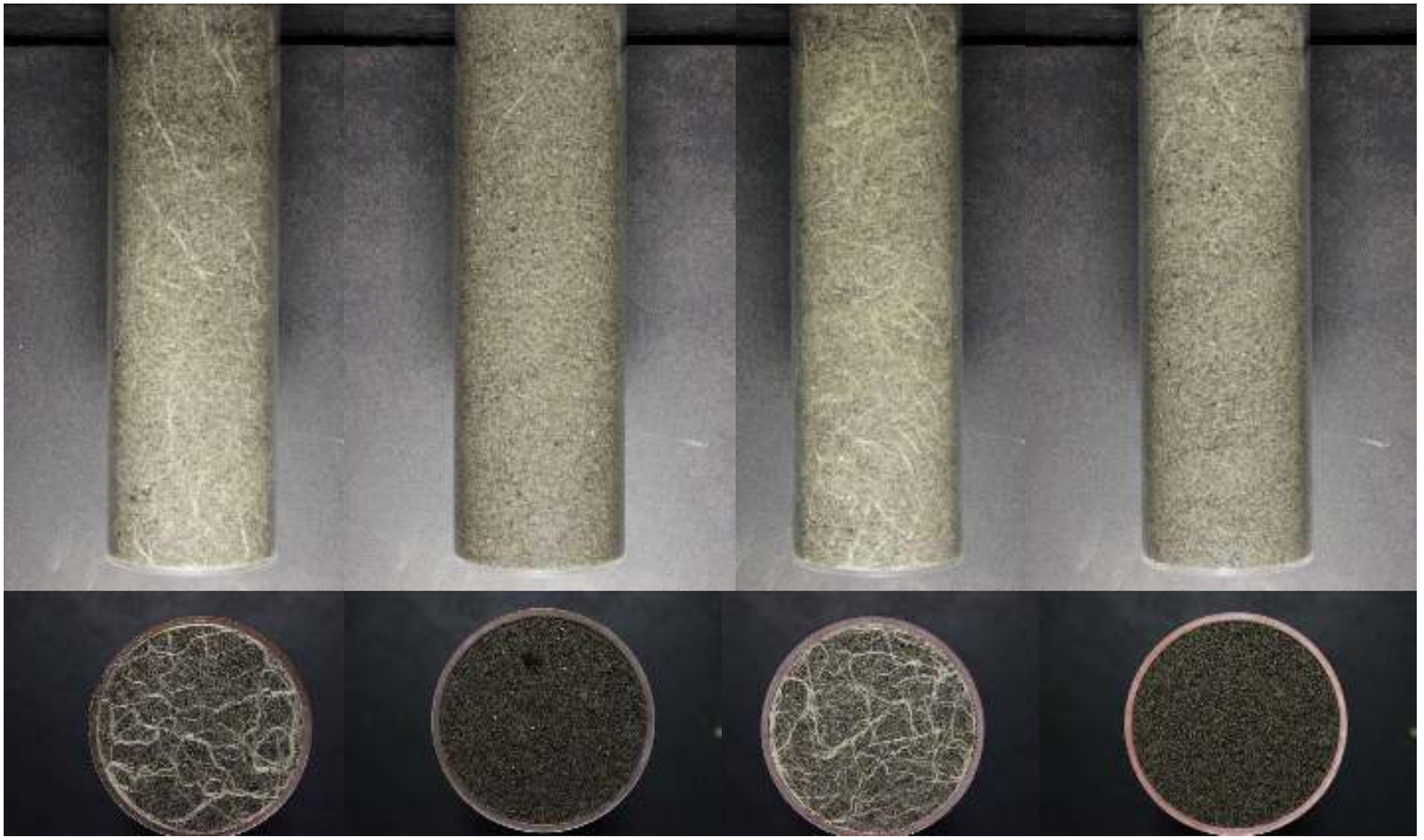


Capo



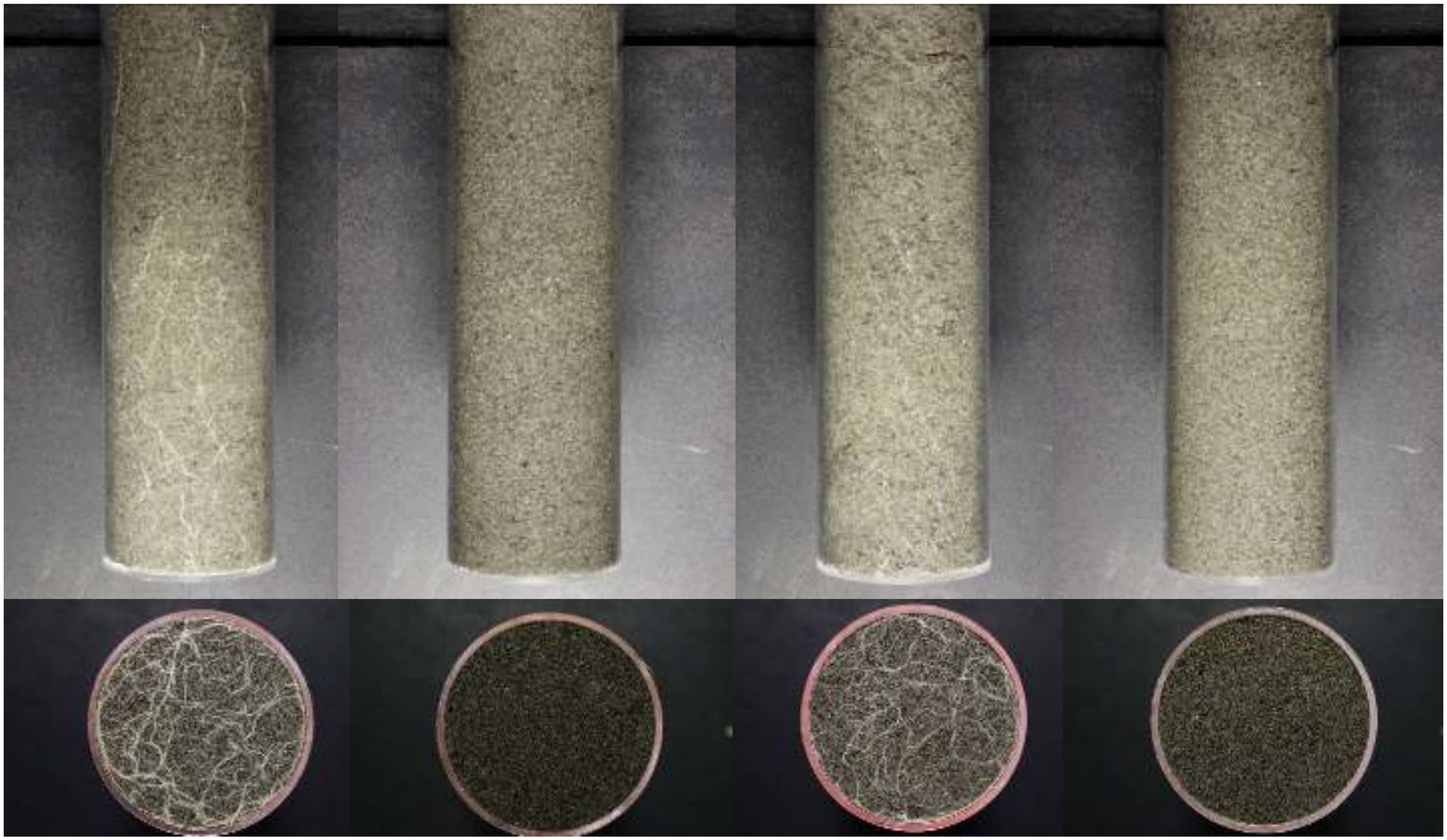
Well watered NaCl Water limited NaCl+water limited

Tale-38



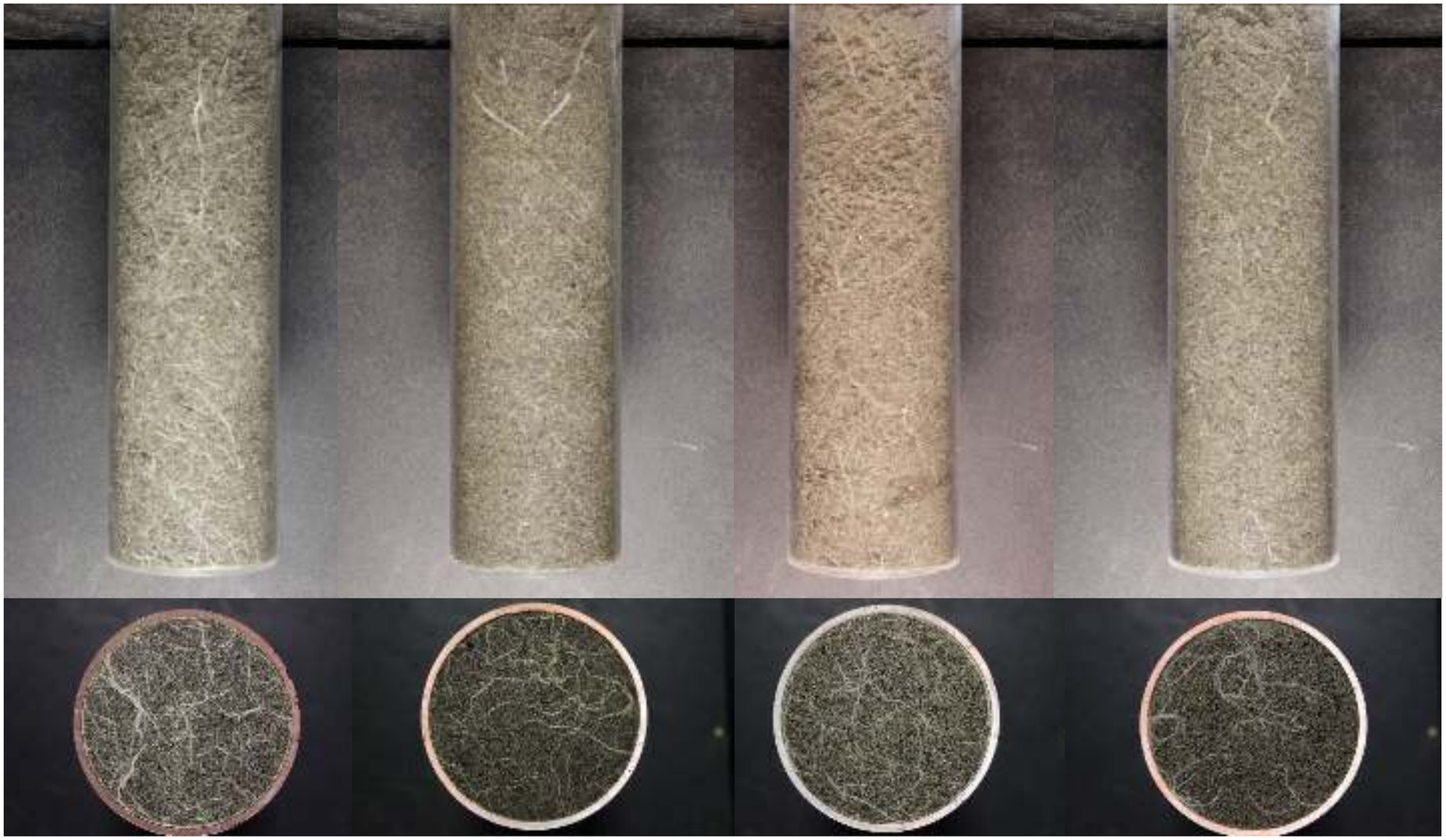
Well watered NaCl Water limited NaCl+water limited

Azamatli-95

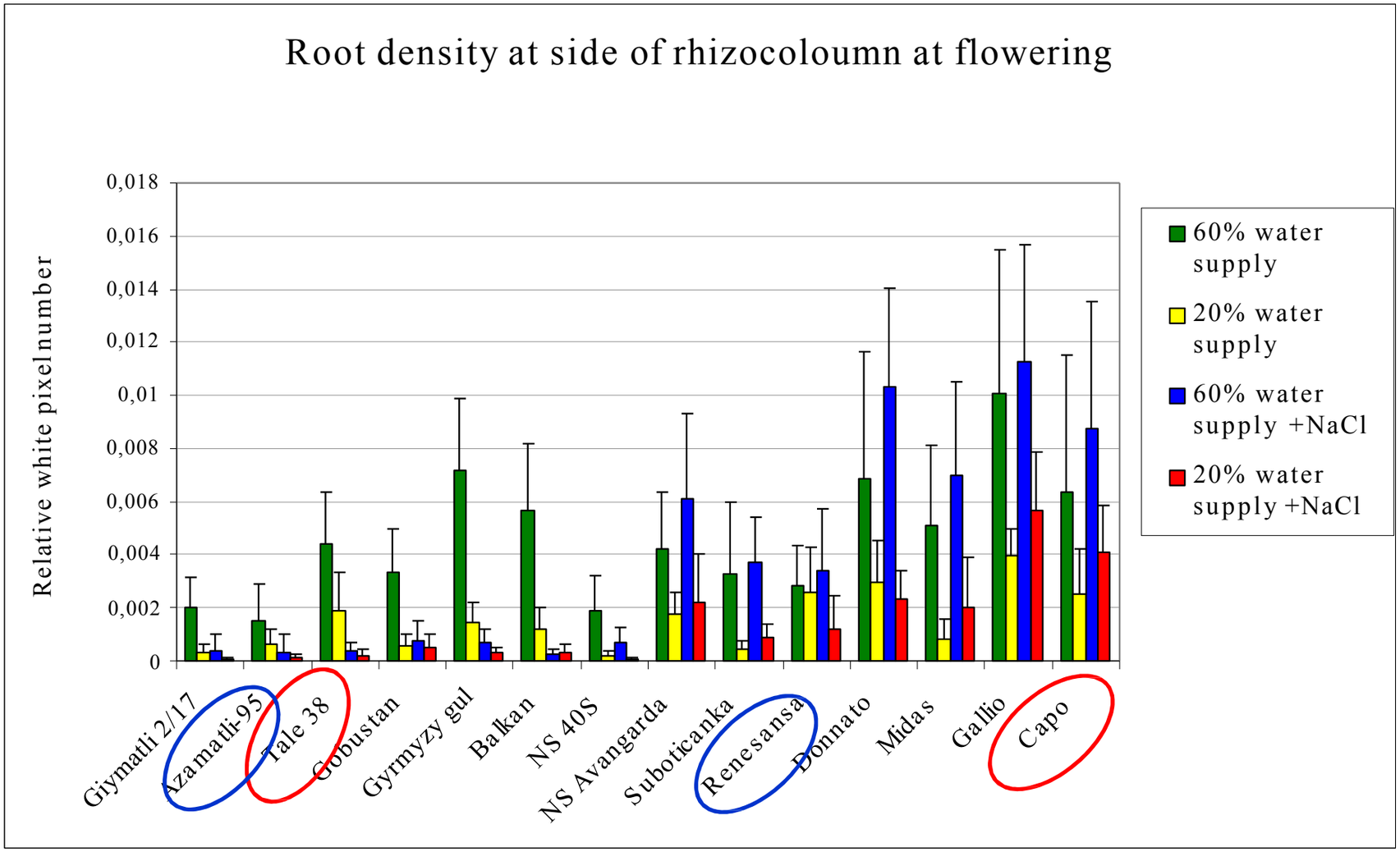


Well watered NaCl Water limited NaCl+water limited

Suboticanka



Well watered | NaCl | Water limited | NaCl+water limited


Root density at side of rhizocoloumn at flowering
Relative white pixel number
0,018
0,016
0,014
0,012
0,01
0,008
0,006
0,004
0,002
0
Giymatli 2/17
Azamatli-95
Tale 38
Gobustan
Gyrmyzy gul
Balkan
NS 40S
NS Avangarda
Suboticanka
Renesansa
Donnato
Midas
Gallio
Capo
60% water supply
20% water supply
60% water supply +NaCl
20% water supply +NaCl

# Conclusions, shoot phenotyping

Green plant pixels estimated from digital plant imaging provide a reasonably good indicator of (wet and dry) biomass.

However, biomass is not a good general indicator of grain yield in wheat.

Grain production has to be measured directly (or estimated by specific imaging) if the target ofphenotyping is grain yield optimization.

Salt stress induces more severe effects under water limitation than under well watered conditions.

Water use efficiency remains unaffected by salt stress in well performing wheat lines, but drops significantly in salt sensitive lines.

# Conclusions, root phenotyping

- Acharacteristic response to combined water limitation and salt stress was a significant decrease of the root density (with the exception of Capo). The root density also decreased when only water limitation was applied as a single stress factor in the absence of salt addition. Application of salt stress alone induced variable root density responses ranging from significant decrease (all Azeri and 2 Serbian) to almost no effect (all Austrian varieties).
- Comparison of the root density with the shoot development and grain yield data showed a positive correlation between grain yield and root density in some cultivars, such as Capo and Suboticanka, which were among the best and worst performing lines under double salt and water stress, respectively. However, this correlation was not general and other lines, such as Tale-38, which showed high biomass and grain yield even when the root density was apparently low. Apossible interpretation of this finding is that the estimation of root density at the surface of the transparent plexiglass cylinder may not work equally well for all cultivars in the case of wheat plants.

## Contributors

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## Support:
## European Plant Phenotyping Network

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