On behalf of Federal Ministry for Economic Cooperation and Development

World Vegetable Center
Beans with Benefits

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Residual Nitrogen Effect of Mungbean (*Vigna radiata*): Affected by Regulated Deficit Irrigation?

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Background

Mungbean produces high-protein food and nitrogen-rich residues through biological nitrogen (N) fixation. Dryland cultivation in Asia is constrained i.a. by shortage of water and poor soil fertility.

We studied the potential N input through mungbean residues to a cropping system by:

- Traditional variety (**V1**) and improved variety (**V2**; heat/salt tolerant)
- Assessing their biomass distribution and N accumulation under water stress
- Investigating decomposition of residues under limited water availability

Methods

Greenhouse trial (1) with three irrigation treatments: **control (45% deficit)**, **moderate (65% deficit)**, **severe (85% deficit)**

- Harvest at maturity
- Assessment of dry matter
- Stable isotope ($^{13}C/^{15}N$) composition of above- and belowground plant parts

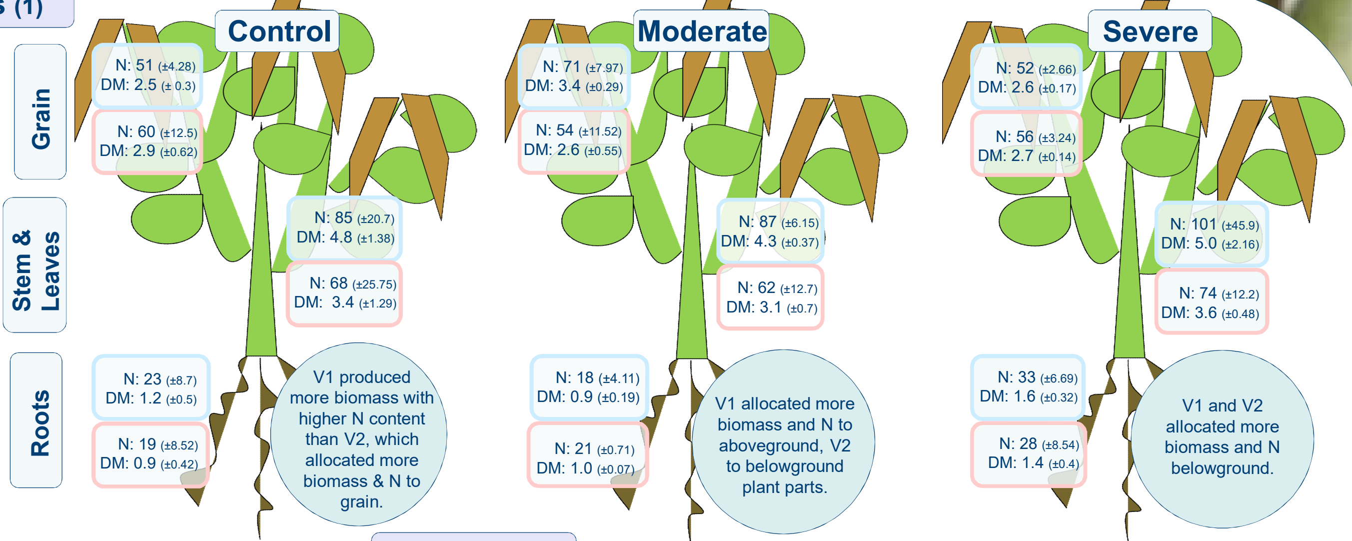
Greenhouse trial (2) with two mungbean residue treatments:

- Applied **(AP)** on the surface or incorporated **(IN)** in potted soil
- Exposed to 45% and 65% deficit irrigation
- N_{min} (nitrate & ammonium) and soil respiration were assessed

Results (1)

V 1

V 2

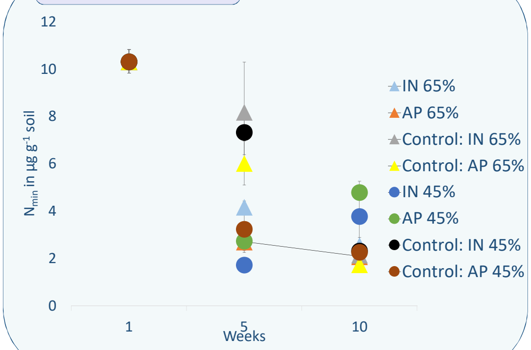


Dry matter (DM) distribution in g plant^{-1} and nitrogen distribution in mg plant^{-1}

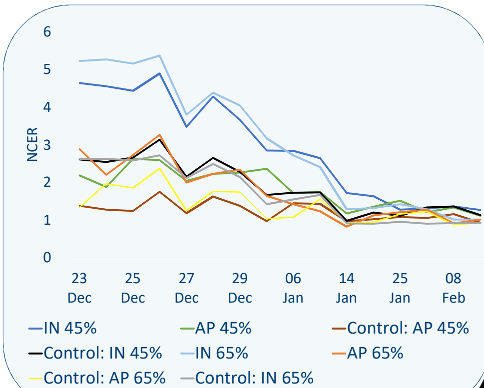
Treatment	Variety	HI	Total plant-N (mg)	%Ndfa	δ13C
Control	1	**0.41** (±0.07)	**159** (±21.2)	**25** (±19.7)	**-27.0** (±1.11)
Control	2	**0.67** (±0.06)	**147** (±46.3)	**17** (±10.0)	**-28.8** (±2.3)
Moderate	1	**0.65** (±0.01)	**177** (±15.2)	**7** (±2.1)	**-26.8** (±1.24)
Moderate	2	**0.64** (±0.03)	**137** (±22.7)	**22** (±5.2)	**-26.2** (±1.63)
Severe	1	**0.39** (±0.06)	**186** (±54.7)	**57** (±5.7)	**-27.0** (±1.62)
Severe	2	**0.54** (±0.03)	**158** (±23.4)	**19** (±5.9)	**-27.7** (±0.52)

Harvest Index (HI), total plant-N (mg), plant nitrogen deriving from the atmosphere (%Ndfa) and $\delta^{13}C$ of the seeds

Results (2)



N_{min} (nitrate & ammonium) at two sampling dates after mungbean residue application (IN & AP) with two watering regimes (45% & 65% deficit)



Soil respiration (NCER) over 9 weeks after residue application (IN & AP) with two watering regimes (45% & 65% deficit)

Conclusion

- N_{min} affected by moisture content rather than residue management technique ⟺ Soil respiration affected by residue management (aeration) rather than moisture content
- Severe deficit irrigation resulted in more biomass and N allocated belowground and an increase of total plant-N and N fixation ⟹ probably higher fixation rates due to lower soil-N mineralization
- Deficit irrigation was not reflected in the $\delta^{13}C$ signature of seeds
- V2 showed a stable HI throughout the treatments, but accumulated less N than V1

⟹ V1 delivered enriched-N residues, also under dry soil conditions

⟹ V2 seems to be better adapted to changing water availability, delivering more stable yields and could be a good choice for farmers in areas with frequent drought events

⟹ Depending on local weather and the subsequent crop the residue management needs adaptation: Under humid/irrigated conditions (45% deficit) and residue incorporation N_{min} will be faster available (→ leaching losses)

⟹ Residue incorporation fosters N mineralization, mulching slows mineralization down