Groundwater irrigation and on-farm residues as means to improve cash crop production.

Initial results with Morning Glory from the Faculty of Water Resources Demonstration Site, Tad Thong Campus, Lao P.D.R.

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Introduction:

- Despite the rise of some agricultural technologies in Lao PDR, the area under irrigated agriculture is low and the use of groundwater for irrigation is still virtually non-existent. Expansion of small-scale groundwater irrigation offers an attractive option for smallholder farmers to improve food security, diversify to cash crops and adapt to climate change.

- Low soil fertility is known to be a major constraints in lowland rainfed agricultural systems in Lao P.D.R.[1]. Applying on-farm residues can be an effective means to improve soil properties and fertility.[3,4,5,6.]

Methodology:

A groundwater irrigation trial and demonstration site has been established at the Faculty of Water Resources, National University of Laos *(Figure 1).* Effects of alternative treatments using on-farm residues were studied on Morning Glory (*Ipomoea aquatica)* cultivation between January and mid-March 2015.

The treatments tested were:

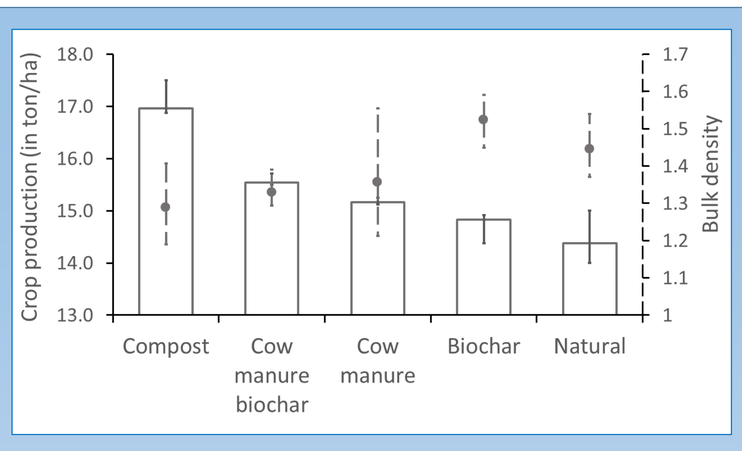
- Cow manure (collected from surrounding farms);
- Rice-husk biochar (produced through slow pyrolysis in a pitch of 2*2m and 1.5m depth using methods inspired by traditional charcoal production in rural areas);
- Cow manure inoculated with rice-husk biochar;
- Compost (prepared with cow manure, rice-husk biochar and vegetable waste with the following ratio (1:2:3) (Figure 1);
- Control soil (referred to as “natural”);

Agricultural plots were plowed and fertilized with treatments at a 20 tons/ha rate. Every fertilization treatments were studied on three plots, each 8 m^2 in size and sown at 30 plants/m^2. Each plot, received 4 mm of irrigation water per day using a sprinkler irrigation system. Water supply comes from a 30 m deep tubewell situated nearby ensuring sufficient water over the crop cycle.

Environmental datas are monitored with a meteorological station, an evaporation pan and a groundwater level data logger.

Figure 1: Top and bottom left: the groundwater irrigation system and research plot. Top right: Compost preparation. Bottom right: Morning glory harvesting and data collection.

Figure 2 (right): Average Morning glory yield and average soil density at the end of the growing season (dashed line). Error bars show maximum and minimum value collected.



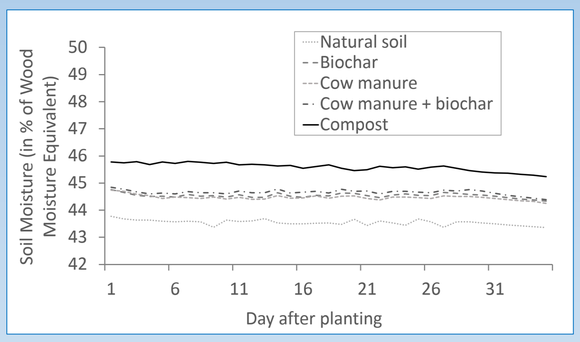


Figure 4: Soil moisture content along the growing season (measured before the daily irrigation)

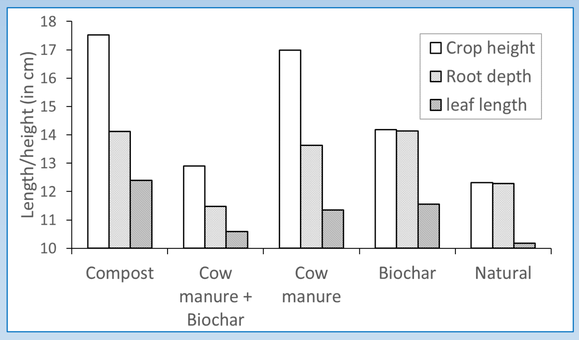


Figure 3: Morning glory physiological characteristics before harvest, according to fertilization treatments. (Average data)

Results:

- Morning glory yields grown with compost, cow manure and cow manure combined with rice-husk biochar were demonstrably increased. Highest yield increases were obtained with compost application (20% higher relative to natural). *(Figure 2)*

- Compost and cow manure treatments increased crop height and rooting depth by 3 and 2 cm respectively. *(Figure 3)*

- On-farm residue fertilizers significantly improved soil moisture content with better results under compost treatments. *(Figure 4)*

- Interestingly the increase in crop productivity seems correlated to a soil bulk density decrease.

- Rice-husk biochar application improve soil moisture content, root depth and leaf length but effect on yield is limited.

- Soil NPK analysis were done but no differences were found between treatments (potential laboratory error)

Conclusion:

- This study shows that using groundwater for irrigation provides a reliable and flexible water supply under field conditions which would allow farmers to grow dry-season cash crops in Lao P.D.R.
- Applying on-farm residues fertilizer increased crop productivity and soil water content and soil density. This innovative soil amendment practice will help farmers to improve crop yields and reduce growing cost by using on-farm fertilizer instead of chemical one.
- On-farm residues applications decrease soil bulk density underlining potential improvement of the whole soil structure and properties. This rejoin the results of previous studies results[3.] Complementary long-term study will be done on order to balance today’s results.
- With appropriate management of the groundwater resource, larger-scale groundwater irrigation is theoretically feasible which can contribute to national food and nutritional security goals.

References:

[1]Inthavong T. et al. (2011). DOI: 10.1626/pps.14.184
[2] Whitbread A. et al. (2003). DOI: 10.1016/S0167-8809(03)00189-0
[3] Asai H. et al. (2009). DOI: 10.1016/j.fcr.2008.10.008
[4] Linquist B.A. et al. (2007). DOI: 10.1007/s10705-007-9095-5
[5] Lu S. et al. (2014) DOI: 10.1016/j.catena.2013.10.014
[6] Macedo et al (2015)

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