GROWTH PERFORMANCE AND NUTRIENT UPTAKE OF FALCATA (*Paraserianthes falcataria*) AS INFLUENCED BY CHEMICAL FERTILIZER, ARBUSCULAR MYCORRHIZAL FUNGAL INOCULATION, AND TYPES OF POTTING MIX

Angela Ferraren, Nestor Gregorio, Lourdes Agne
Mayet Avela and Arturo Pasa

Greening the Philippines

- NGP requirement: rapid production of high quality seedlings

- The successful establishment of seedlings after outplanting, especially in stressful sites, depends upon good seedling quality

The forests of tomorrow depend on the seedlings of today

Why falcata?

Falcata is the most dominant species planted by farmers involved in NGP in Northern Mindanao (Region 10)

Why chemical fertilizer?

Seedling establishment in nursery and in the field

-Physico-chemical characteristics of potting media

Small scale tree seedling nurseries

-use the soils collected locally

- deficient in mineral nutrients

Why Arbuscular Mycorhizal Fungi (AMF) inoculation ?

- mutualistic symbioses with most tropical forest species

- may provide better growth, and vigour of seedlings to cope with transplantation stress.

- AMF population is low :
  - -soils used in the nursery are often collected from barren surroundings
  - - may have been stored for a long time

Why rice hull potting mix?

- To improve aeration, drainage and water retention of the potting mix
- To provide a means of disposal of rice hull

Research Questions: Expt 1

Will AMF inoculation improve the nursery growth performance of *P. falcataria* using a potting medium of low fertility?

Will addition of small amount of chemical fertilizer improve the effectiveness of AMF inoculation in nursery seedlings with less fertile potting medium?

Which will have the strongest effect (potting medium, fertilizer or AMF) on the growth, biomass production, photosynthetic rate, nutrient concentration and AMF infection of *P. falcataria* seedlings in the nursery?

Experimental design

2x2x2 factorial in Randomized Complete Block

Factor A

Potting Mix : Soil alone, Soil + Rice Hull

Factor B

Fertilizer level: Distilled Water, Nutrient Solution - 8 mg N - 6 mg P – 6 mg K/seedling

Factor C

AMF Inoculation: Without AMF, With AMF

Replications:3

Measurements

- Seedling height and base diameter: bi-weekly from two to 14 weeks after
- At harvest, four months after potting: seedling photosynthetic rate
- Harvested seedlings: nodulation, biomass, N, P and K concentration, AMF infection

Characteristics of Potting Mix

	Soil Alone	**Soil + rice hull**
pH	5.19	5.04
Total OC (%)	5.22	5.47
Total N (%)	0.40	0.43
Total P (%)	0.05	0.08
Total K (%)	0.06	0.08

Key Results on Main Effects of Chemical Fertilizer

- In soils where soil fertility is low, application of small amount of chemical fertilizer to the potting mix enhances growth, nodulation, biomass production and shoot and root K and mycorrhizal infection of *P. falcataria seedlings*.

- Application of small amount of chemical fertilizer has stronger effect than AMF inoculation on seedling performance when the potting medium has indigenous AMF and low fertility

Key Results on Main Effects of Chemical Fertilizer

- The rate of chemical fertilizer used did not inhibit the native AMF to form association with *P. falcataria* seedlings as shown by the positive effect of chemical fertilizer on mycorrhizal infection

Key Results on Effects of Potting Mix

- Incorporation of rice hull in the potting mix increases Ps rate, nodule number and weight , shoot biomass and concentration of N and P in shoot and root
- The increase in nodule number with rice hull incorporation could have contributed to improved nitrogen nutrition of *P. falcataria* seedlings grown in soil with low fertility.

Key Results on Main Effects of AMF Inoculation

- AMF inoculation did not improve the nursery growth performance of *P. falcataria* grown in a potting medium of low fertility.

Main effects: seedling height from two to 14 weeks after potting

Source of variation	Empirical Probability Values						
	2	4	6	8	10	12	14
Potting mix	0.730^{ns}	0.809^{ns}	0.359^{ns}	0.310^{ns}	0.310^{ns}	0.160^{ns}	0.121^{ns}
Fertilizer	0.677^{ns}	0.524^{ns}	0.162^{ns}	0.141^{ns}	**0.025***	0.060^{ns}	**0.053***
Inoculation	0.397^{ns}	0.357^{ns}	0.950^{ns}	0.650^{ns}	0.969^{ns}	0.985^{ns}	0.990^{ns}

Main Effects: seedling base diameter at two to 14 weeks after potting

Source of variation	Empirical Probability Values						
	2	4	6	8	10	12	14
Potting mix	0.709^{ns}	0.561^{ns}	0.386^{ns}	0.524^{ns}	0.606^{ns}	0.954^{ns}	0.645^{ns}
Fertilizer	0.958^{ns}	0.335^{ns}	0.065^{ns}	0.072^{ns}	**0.010***	**0.006***	**0.006***
Inoculation	0.571^{ns}	0.475^{ns}	0.848^{ns}	0.715^{ns}	0.630^{ns}	0.792^{ns}	0.977^{ns}

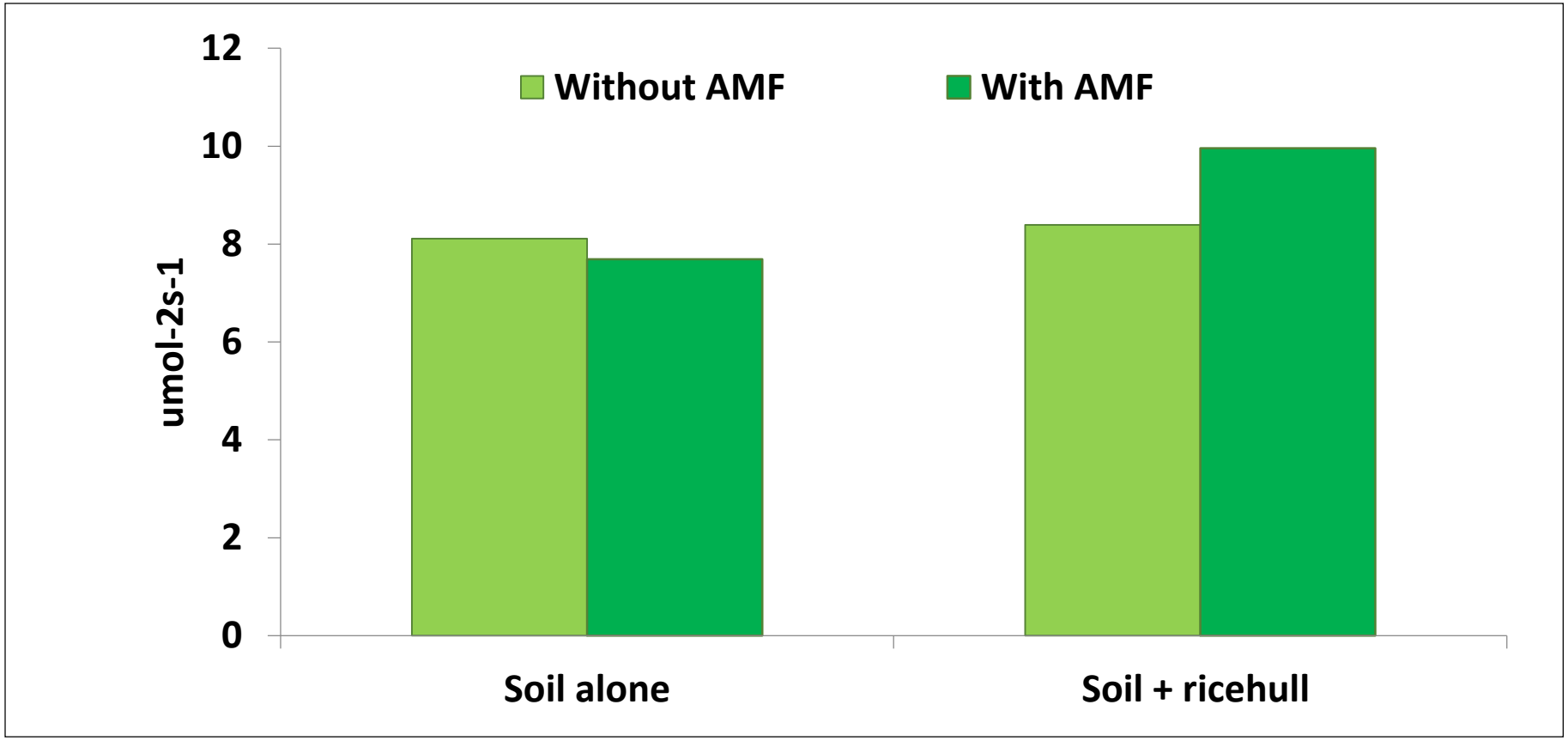
Main effects: Ps rate, nodule number, nodule dry weight, shoot and root dry weight and root:shoot ratio

Source of variation	Empirical Probability Values					
	Ps rate	Nodule Number	Nodule Dry Weight	Root Dry Weight	Shoot Dry weight	Root: shoot ratio
Potting mix	**0.005****	**<0.001****	**0.000****	0.804ns	**0.019***	0.358^{ns}
Fertilizer	0.190^{ns}	**<0.001****	**0.007****	**0.024***	**0.005****	0.447^{ns}
Inoculation	0.153^{ns}	0.925^{ns}	0.908^{ns}	0.577^{ns}	0.945^{ns}	0.605^{ns}

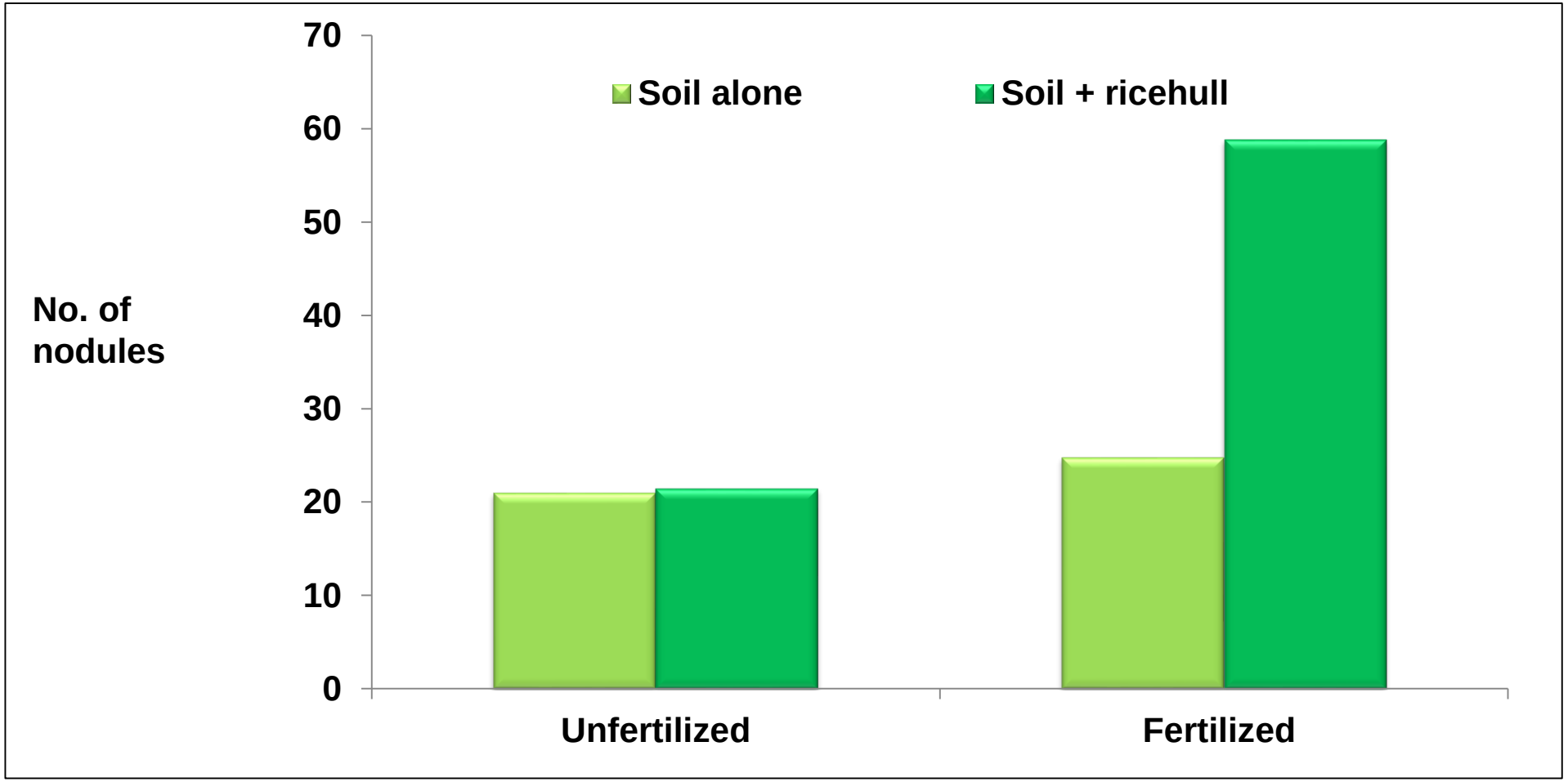
Main Effects: Shoot and root nutrient concentration, and mycorrhizal infection

Source of variation	Empirical Probability Values						
	Shoot			Root			Mycorrhizal infection
	Total N	Total P	Total K	Total N	Total P	Total K	
Potting mix	**0.012***	**<0.001****	0.064^{ns}	**0.007***	**<0.001****	0.260^{ns}	0.066^{ns}
Fertilizer	0.280^{ns}	0.279^{ns}	**0.050***	0.078^{ns}	0.855^{ns}	**0.016***	**<0.001****
Inoculation	0.213^{ns}	0.621^{ns}	0.082^{ns}	0.277^{ns}	0.606^{ns}	0.489^{ns}	0.785^{ns}

AMF Inoculation X Potting Mix Interaction effect: Ps rate



Fertilizer X Potting Mix Interaction effect: Nodule number



Experiment 2:Research Question

- Will doubling the rate of Mycovam (10g) improve the growth performance of seedlings grown in potting medium enriched either with raw rice hull or carbonized rice hull ?

Gall Rust infestation on Falcata Seedlings

Gall rust was more prevalent in uninoculated seedlings grown in soil +rice hull.

Experiment 2:Treatments & Experimental design

2x4 factorial in Randomized Complete Block

Factor A: Potting Mix

Soil+ raw rice hull, Soil + Carbonized Rice Hull

Factor B: AMF level: uninoculated, 5 g DASS inoculum

5 g Mycovam, 10 g Mycovam

Replications:3

Blanket application of fertilizer:

8 mg N - 6 mg P – 6 mgK/seedling

Characteristics of Potting Mix

	Soil +Raw Rice Hull	**Soil +Carbonized rice hull**
pH	5.39	5.18
Total OC (%)	3.84	8.43
Total N (%)	0.46	0.62
Total P (%)	0.10	0.12
Total K (%)	0.19	0.21

Key Points

- Carbonized rice hull in the potting mix provides greater benefits on seedling growth biomass production and nutrient uptake than raw rice hull
- AMF alone failed to promote growth , and biomass production but improved total N and total P in shoots and K in roots

Key Points

- The varied responses of seedling grown in two types of potting mixes to inoculation suggest that fertility of the potting medium can influence the benefits AMF inoculation.

Main and interaction effects

Source of variation	Empirical Probability Values					
	Height	Base diameter	Nodule Number	Nodule Dry Weight	Root Dry Weight	Shoot Dry weight
Potting mix (P)	**0.040***	**<0.001****	0.492^{ns}	0.143 ^{ns}	0.093^{ns}	**0.007****
Inoculation level (I)	0.359^{ns}	0.423^{ns}	0.266^{ns}	0.481^{ns}	0.235^{ns}	0.641 ^{ns}
P x I	0.641^{ns}	**<0.001****	0.741 ^{ns}	0.979 ^{ns}	0.247^{ns}	0.0514 ns

Main and Interaction Effects: Shoot and root nutrient uptake

Source of variation	Empirical Probability Values					
	Shoot			Root		
	Total N	Total P	Total K	Total N	Total P	Total K
Potting mix (P)	**0.001****	**<0.001****	**0.002****	0.230^{ns}	**0.010****	**0.031***
Inoculation level (I)	**0.003****	**0.010****	0.033^{ns}	0.434^{ns}	0.171^{ns}	**0.030***
P x I	**0.019***	0.096^{ns}	0.201^{ns}	0.555^{ns}	0.232^{ns}	0.349^{ns}

Potting mix x Inoculation Level: Shoot nitrogen uptake (mg plant^{-1})

	Soil +Raw Rice Hull	Soil +Carbonized Rice Hull
Uninoculated	68.76 c	97.66 a
5 g DASS AMF	83.33 b	105.57 a
5 g Mycovam	95.7ab	94.82 ab
10 g Mycovam	104.06a	107.52a

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