Evaluation of annual forage legumes under partial and full sunlight in the Southern Great Plains

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BACKGROUND

Southern Great Plains (New Mexico):

- Predominant dairy industry
- Quality forage supply for silage
- Corn and sorghum based silage are lack of protein
- Shortage of water for crop production necessitates selection of high WUE cropping systems
- Legumes as intercrop with corn/sorghum improves silage quality
- Identification of appropriate legumes for intercropping
- Lack of information on potentiality of individual legumes for intercropping

Desirable legume characteristics considered:

- **Biomass potential and its quality**
- **Phenology of legume and sorghum is important (days to harvest) and rate of juvenile growth**
- **Competition for natural resource with main crop**
- **Shade tolerance capacity**

Artificial shade

v/s

Natural intercropping shade

Clovis'09

Hypothesis

Shade effect has influence on legume plant morphology, physiology, forage productivity and quality

Objectives

- To know the growth and development of individual legumes under shade environment
- To know shade effect on physiological and morphological traits of each legume
- Comparison on forage production potential of each legume species under artificial shade

Materials and Methods

Legume species	Scientific Name	Variety
Lablab	*Lablab purpureus* (L.) Sweet	Rio Verde
Cowpea	*Vigna unguiculata* (L.) Walp.	Iron Clay
Limabean	*Phaseolus lunatus L.*	Willow Leaf
Pole bean	*Phaseolus vulgaris L.*	Genuine Corn Field
Pigeon pea	*Cajanus cajana* (L) Millsp.	GA-1

- **Year of study : 2009 and continued this year**
- **Planting season : 8th June -10th October (harvest 124 DAP)**
- **Experimental design : Randomized Block Design**
- **Replications: Four**
- **Plant population: 60,000 /acre**
- **Row spacing: 0.75 m and Plot size: 18 m x 3 m**
- **Irrigation : Center pivot system**
- **Artificial Shade : Aluminet shade cloth (60%)**

Observations recorded

- Leaf area and leaf area index (sun scan probe)
- Specific leaf dry weight
- Chlorophyll content (SPAD meter)
- Canopy temperature (Infra red gun)
- Photosynthetic rate (Li Cor- 6400)
- Biomass production

Results and Discussion

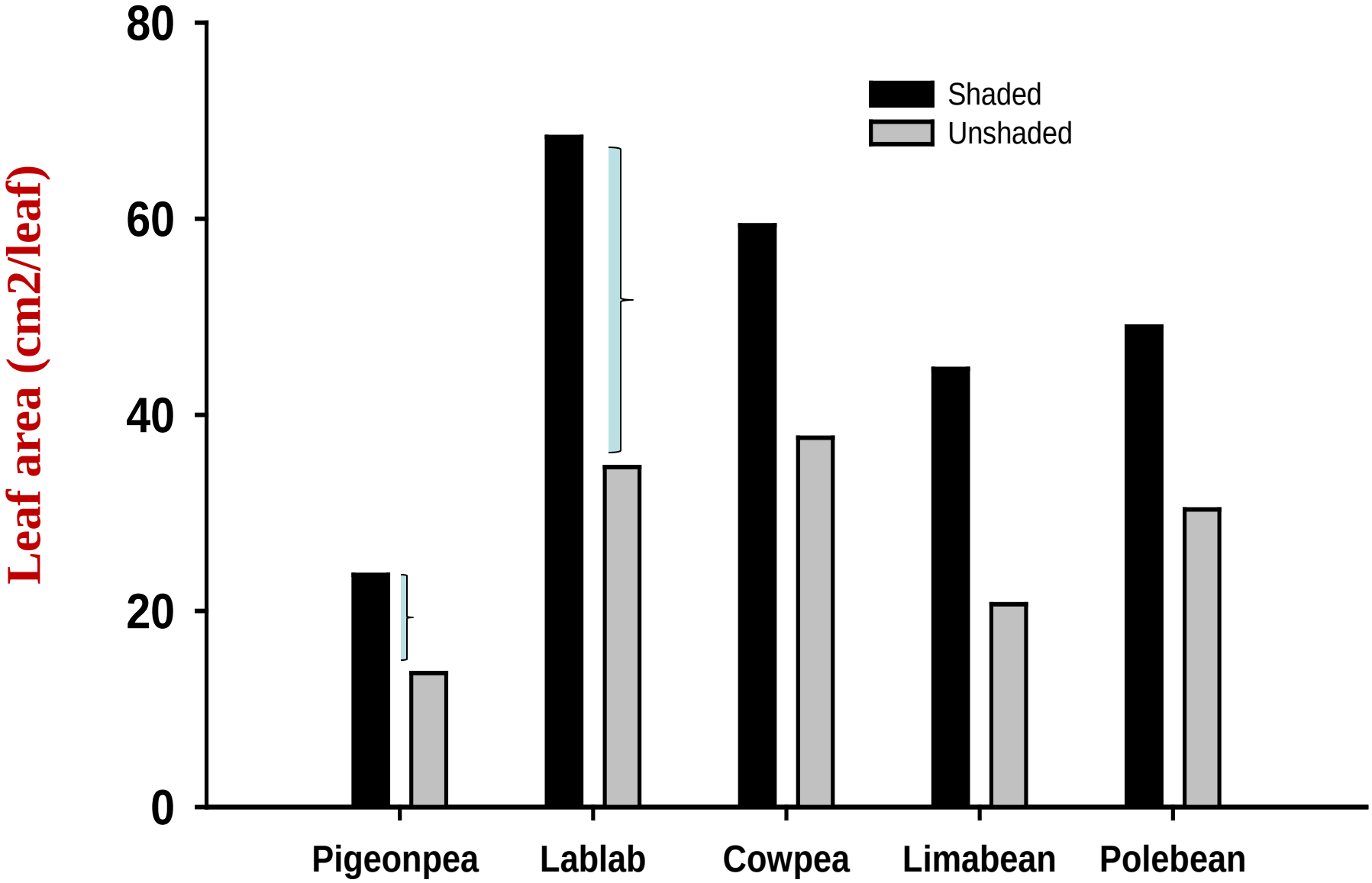

Fig. : Shade effect on leaf area (cm^2) per leaf at 110 days after planting

(Clovis'09)

Leaf surface area of unshaded lablab

Leaf surface area of shaded lablab

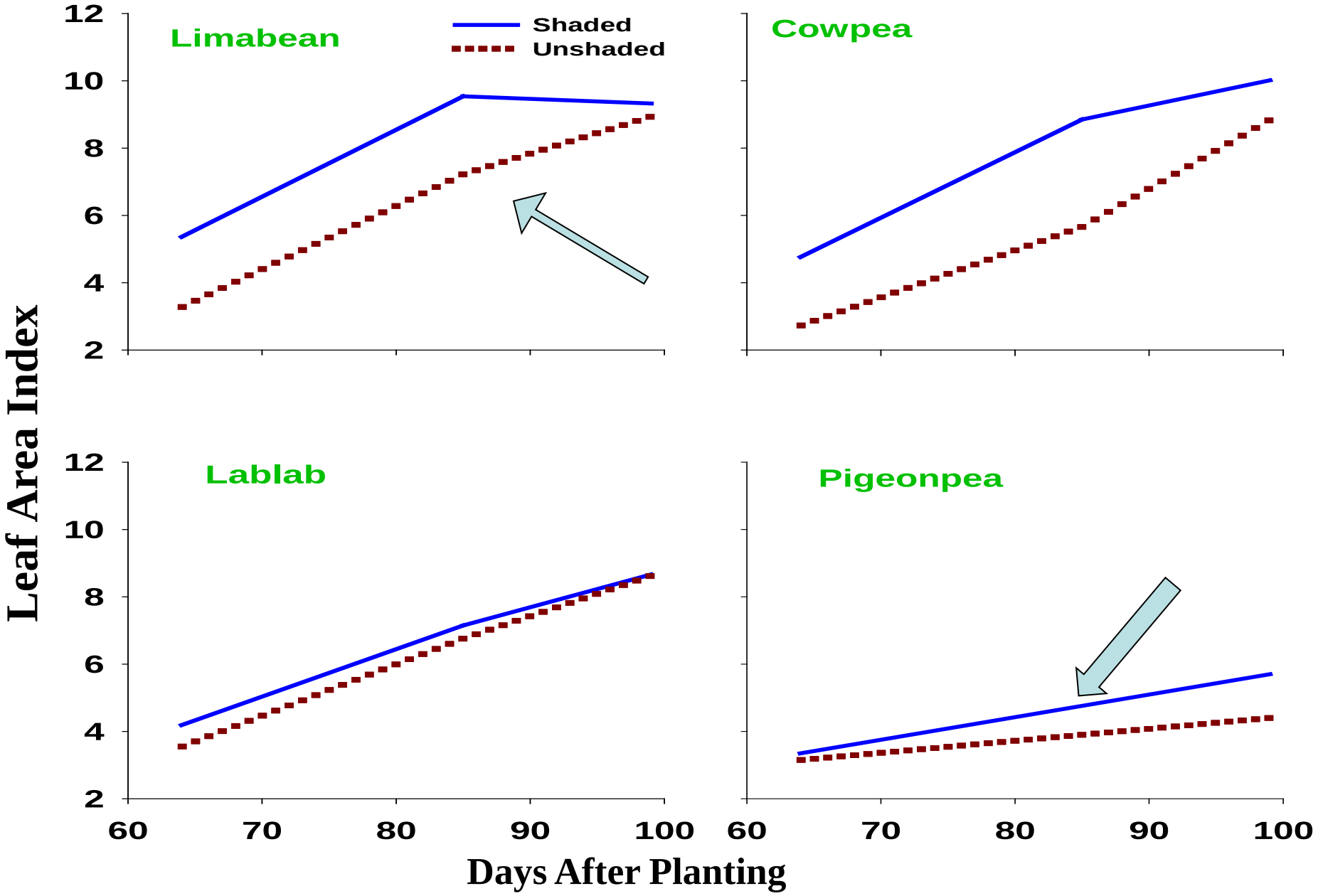

Fig.: Shade effect on leaf area index of legumes at Clovis'09

Shade effect on specific leaf dry weight (mg/dm^2) of legumes

Legume	Shaded	Unshaded	Difference
Pigeonpea	5.3	7.8	2.5
Lablab	4.1	6.7	2.6
Limabean	3.8	6.4	2.6
Polebean	3.6	5.4	1.8
Cowpea	4.3	6.0	1.7
Mean	4.2	6.5	2.3

Clovis' 09

Shade effect on leaf chlorophyll content (µ g cm^{-2}) of legumes at Clovis' 09

Legumes	58 DAP		92 DAP	
	Shaded	Unshaded	Shaded	Unshaded
Pigeon pea	44.6	47.8	47.6	59.2
Lablab	43.6	50.5	43.7	52.9
Cowpea	48.4	58.8	41.4	54.9
Lima bean	43.0	50.8	38.0	47.8
Pole bean	34.9	42.2	37.8	39.5

Shade effect on canopy temperature (°C) difference at Clovis' 09

Legume	88 DAP		106 DAP	
	Shaded	Unshaded	Shaded	Unshaded
Pigeonpea	17.2	20.5	18.5	22.8
Lablab	19.9	20.1	17.7	22.1
Cowpea	18.9	22.0	16.3	21.5
Limabean	19.1	20.1	15.8	19.7
Pole bean	16.4	22.3	18.8	24.1

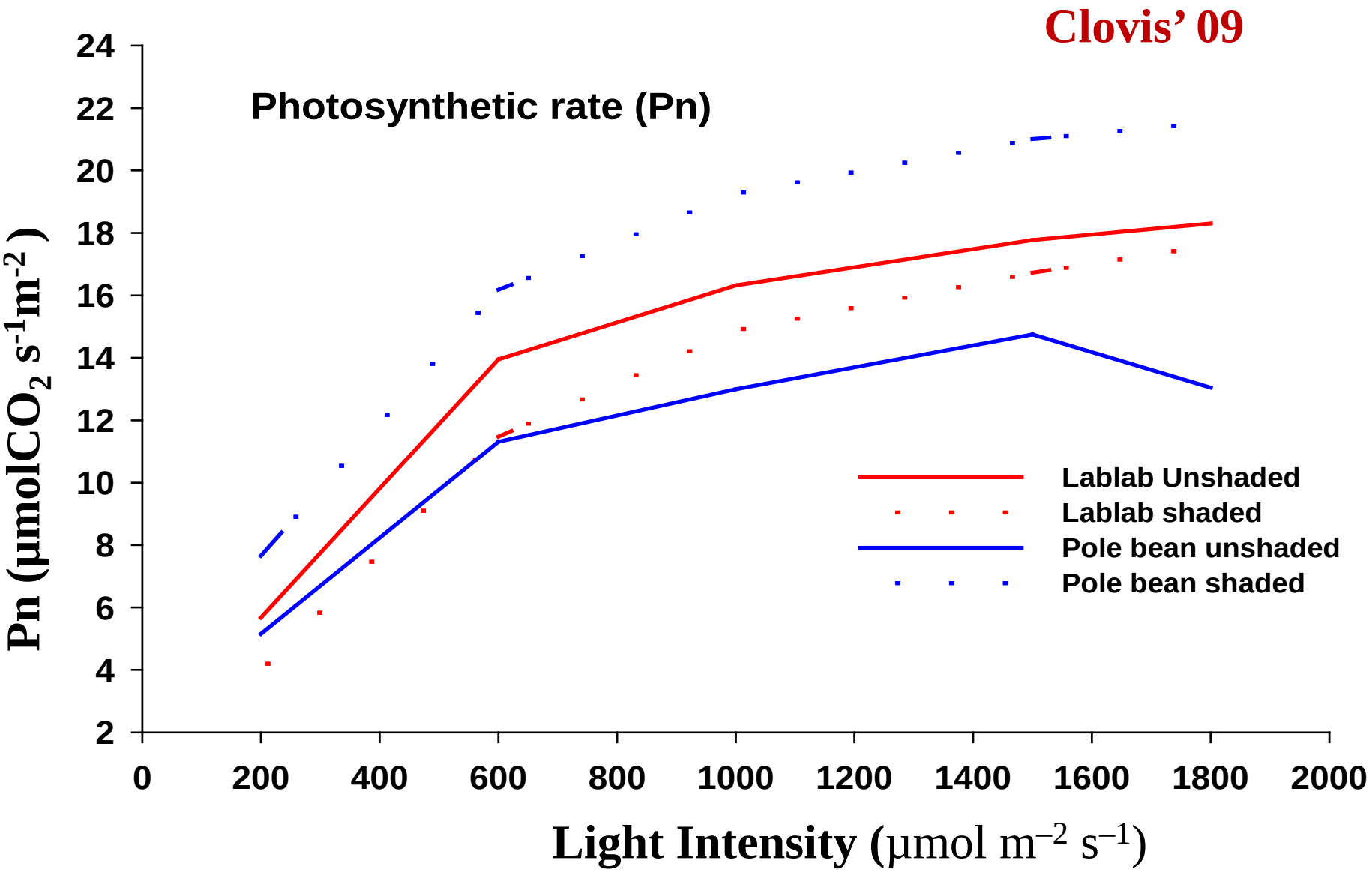

Fig. : Shade effect on photosynthetic rate of lablab and pole bean at 88 Days after planting

Clovis' 09

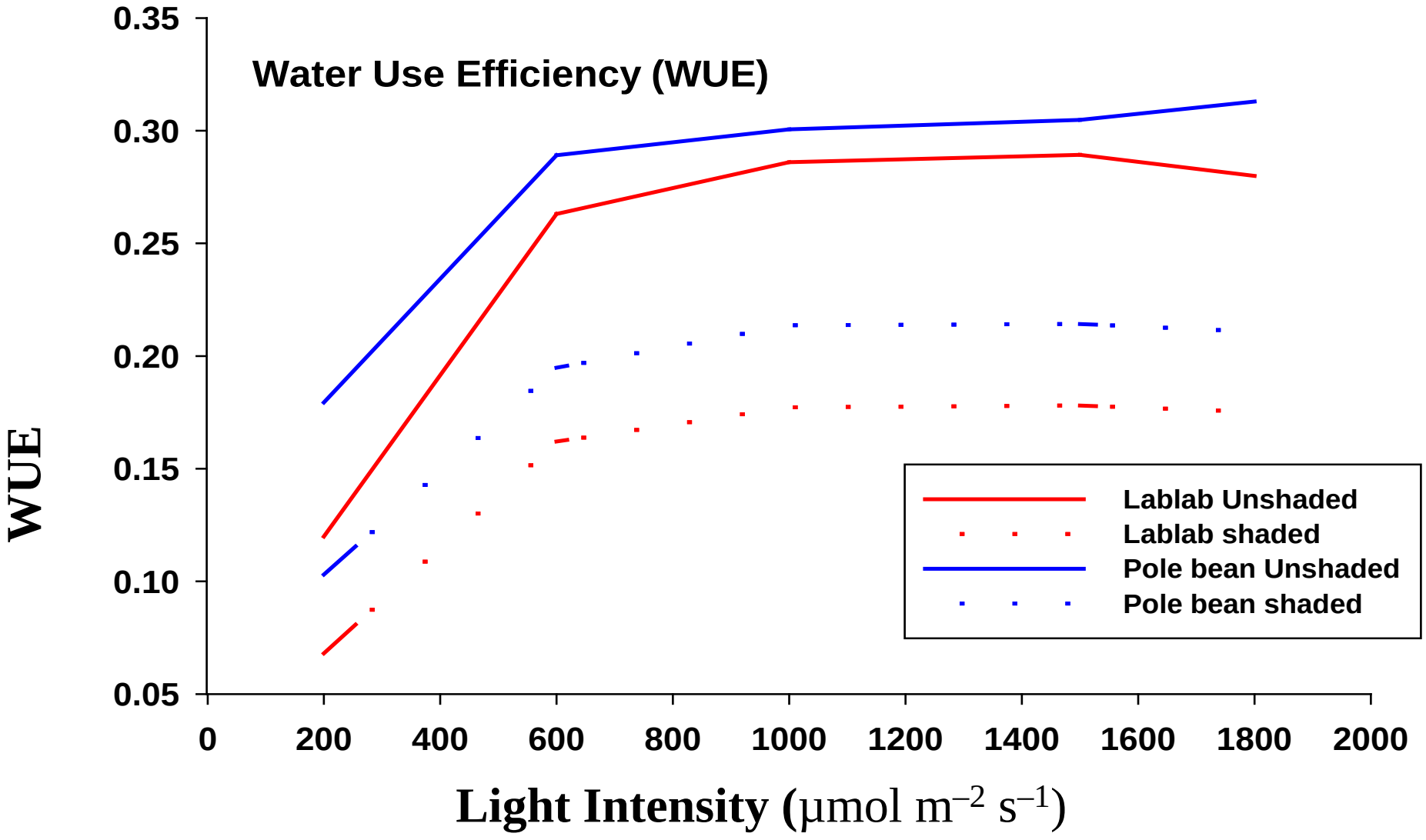

Fig. : Shade effect on WUE of lablab and pole bean at 88 DAP

Photosynthesis observation under shade cloth

Photosynthesis observation in unshaded plants

Biomass production (kg/ha) of different legumes

Legume	58 DAP			124 DAP		
	Shaded	Unshaded	% Reduction	Shaded	Unshaded	% Reduction
Pigeon pea	279	501	44	4588	7544	39
Lablab	1108	2169	49	7253	9675	25
Cowpea	1227	2106	42	6208	8088	22
Limabean	1375	2129	35	7055	11090	36
Pole bean	1300	2004	35	6154	8549	28
LSD (P=0.05)		463			2224	

DAP: Days After Planting

Conclusion

- **Legume species differed in their response to shade**
- **In general, legumes improved light capture by increasing leaf size and leaf area**
- **Biomass productivity was higher in unshaded plants due to thicker leaves, more chlorophyll content and higher photosynthetic rate**
- **Lablab and cowpea were more promising legumes under shade while pigeonpea was least suitable**

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