Topic

Rhizobia inoculants containing synthetic Lipo-chitin oligosaccharides, LCO (*Rhizobia* signal molecules) improves pea plant establishment, vigor and yield

By

Eric K. Asare (Ph.D, P.Ag)

Outline

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- Materials and Methods
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Introduction

Pea, Field Pea, Dry Pea (*Pisum sativum* L.)

- Family: *Leguminosae* (N_2 fixing plants)
- Adapted to cooler temperatures of the world
- Grown on 8m ha and yields 12m ton/yr. worldwide
- Provincial average is 2 ton/ha (32 bu/ac)

Introduction cont'd

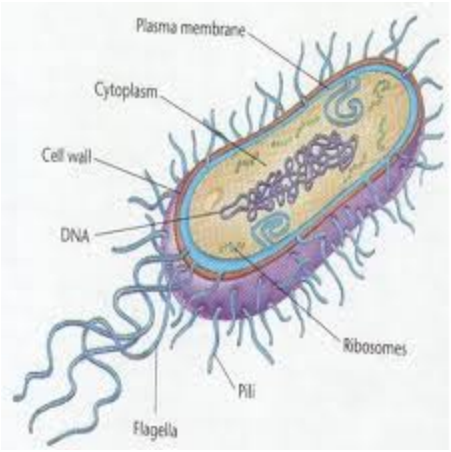
Agricultural and other benefits:

- Crop rotation issues
- Soil fertility management (texture, H_2O holding capacity etc)
- Reduced pest and diseases build up
- Properly nodulated pea fix 75 kg/ha N during the cropping season (Santalla et al., 2001)
- Uses:
  - Food
  - high protein source for animal feed

Processes of nitrogen fixation in legumes

Step 1

Legume roots synthesize flavanoids (signal molecules)



Step 2

Bacteria recognizes flavonoids

Nod factor genes switched on

Lipo-chitin oligosaccgaride (LCO) synthesized

Step 3

LCO mediates a host-specific biological activity in roots

Gene expression and cell division results in nodule development

Justification

• processes that initiate nodulation work slower in:

- cold soils

- wet soils

- high pH soils

Trial Objectives

- Determine the potential benefit(s) of synthetic LCO in *Rhizobium* inoculant formulation on:

  - days to nodule initiation
  - nodule number and weight (mg) plant^{-1}
  - nodule sizes (cm)
  - biomass production (g)
  - number of pods plant^{-1}
  - number of seeds pod^{-1}
  - seed yield plant^{-1}
  - harvest yield (bu/ac)

Materials and Methods

Treatments:

- Inoculant A – No LCO
- Inoculant B – contains LCO
- Control C – (no inoculant)

- Plots size: 14 x 300 m
- Sub (Data) plots size: 3 x 3 m

- Inoculants application rate: 12.3 kg/ha
- Fertilizer(N-P-K-S): 13-20-45-8 and 3.4 kg/ha $MnSO_4$

- Seed treatment : Trilex Al amd Omex seed primer
- Seeder : Flexi coil 5000 (10 in opener and 4 in pair row)
- Data collection and analysis :
  - 10 plants used for each data
  - SPSS / ANOVA using

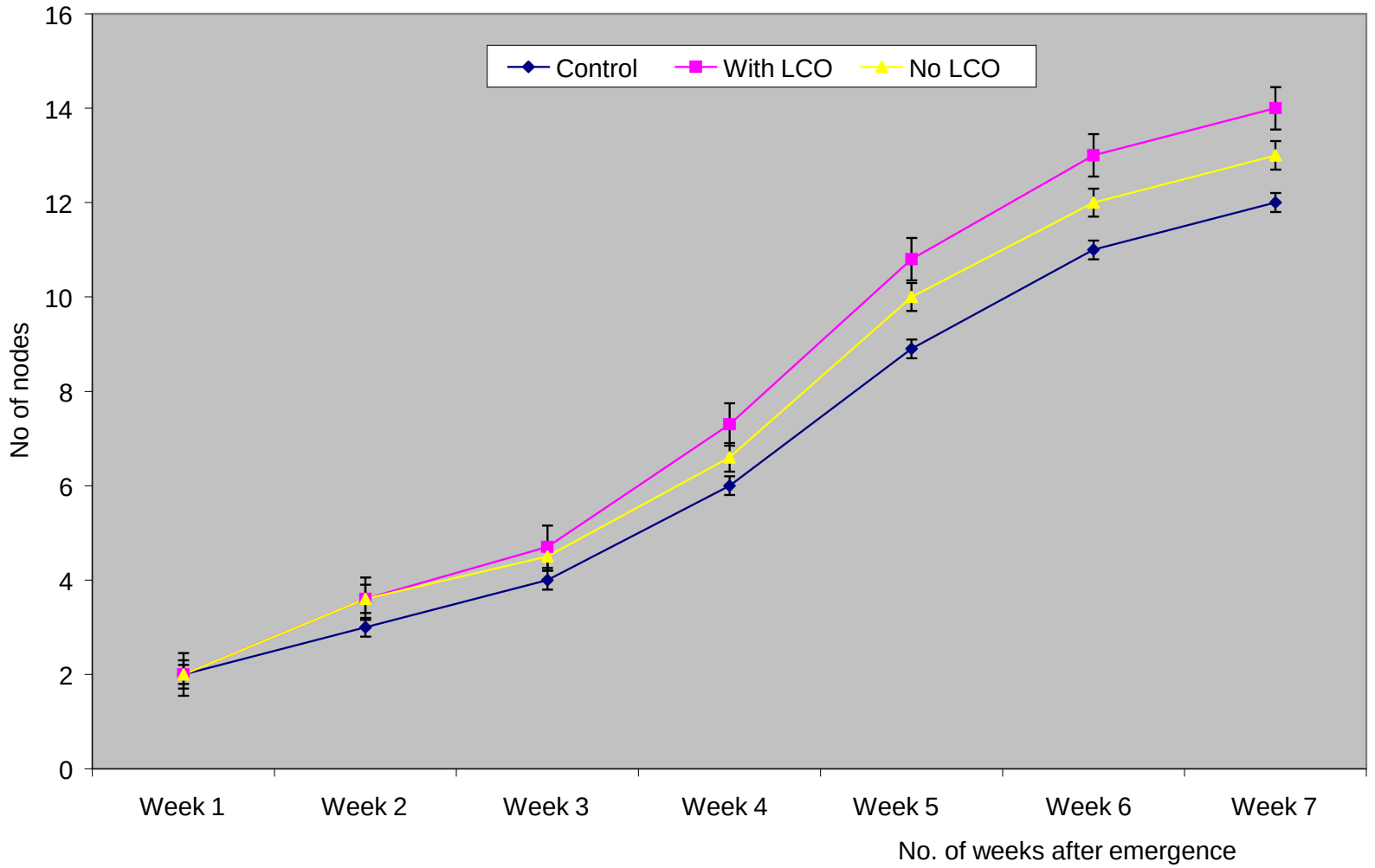


Figure 1. Pea nodal development.

Results and Discussions

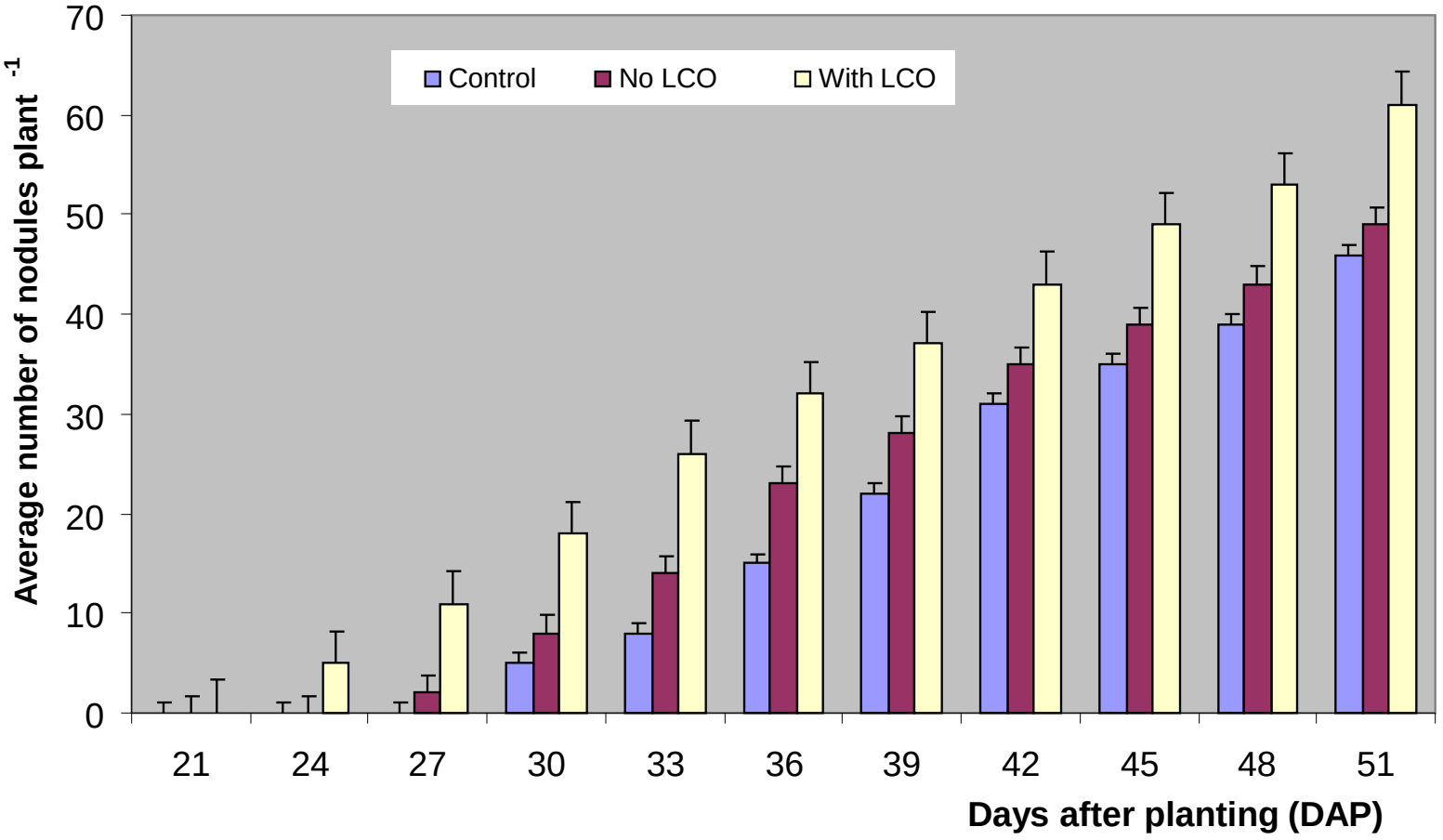


Figure 2. Nodule formation and plant development from planting to physiological maturity

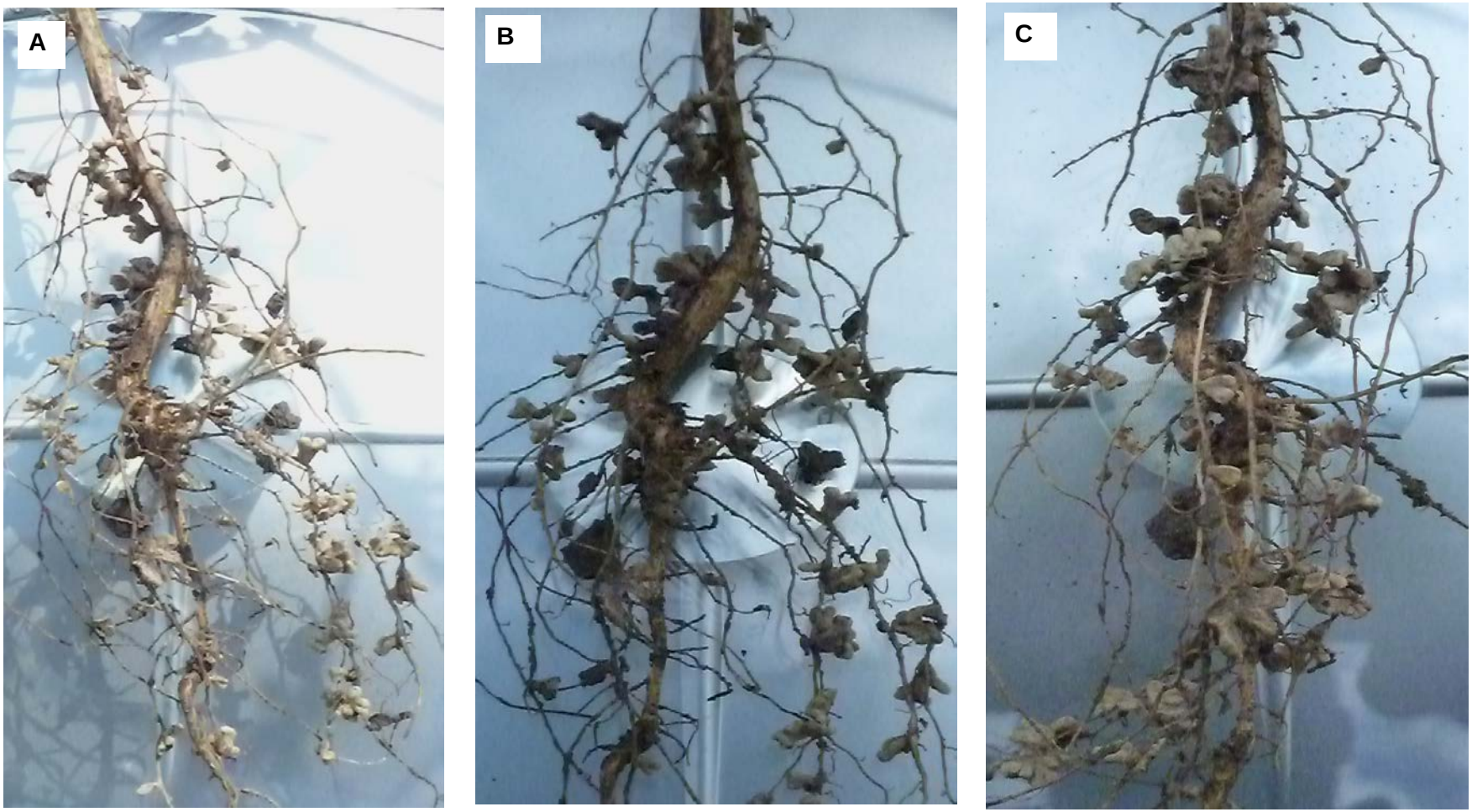
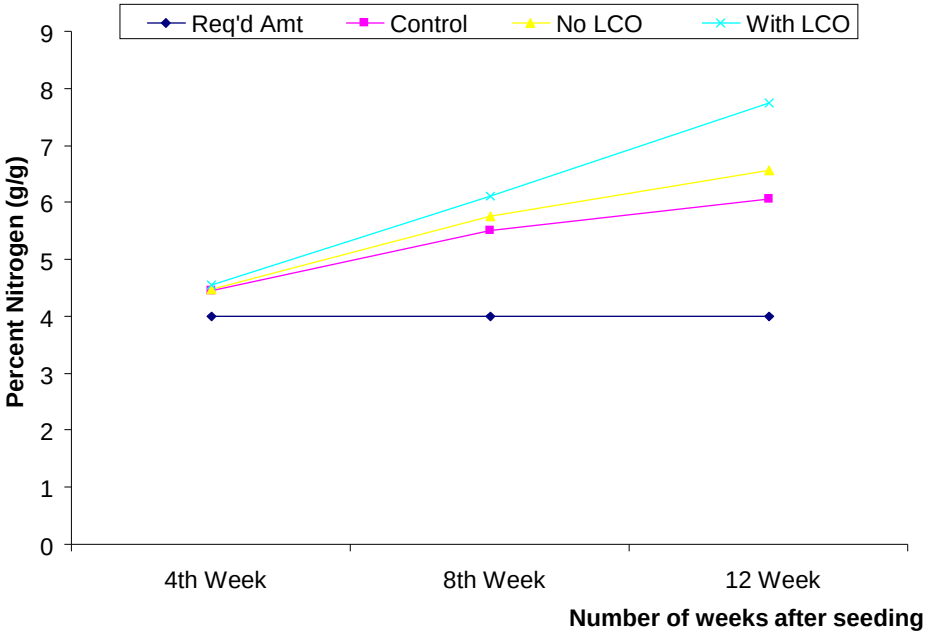


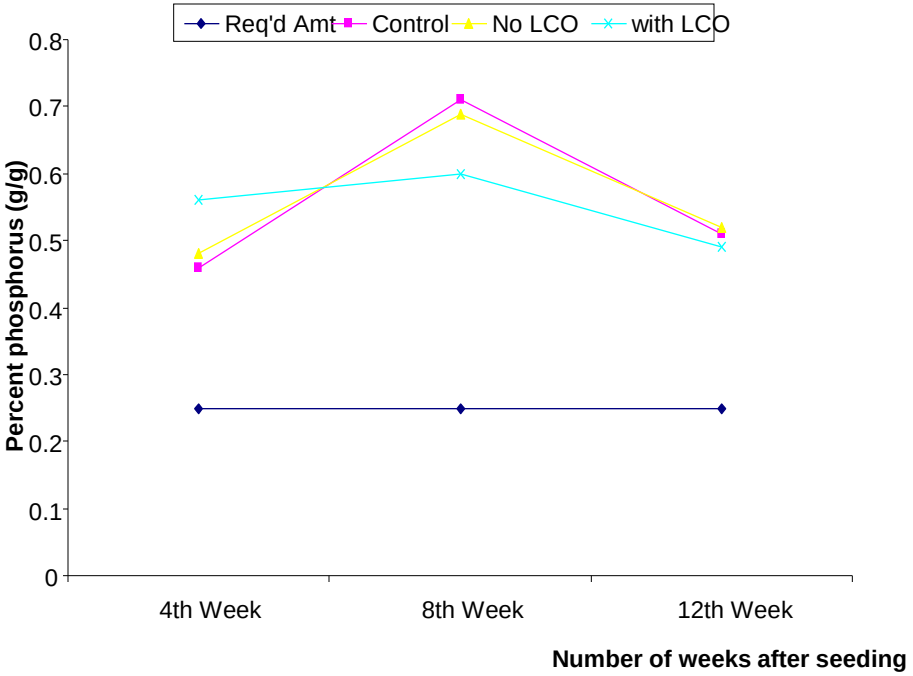
Figure 3. Root nodule shapes, sizes and arrangements in the control (A), No LCO (B) and With LCO (C) treated pea plants.

Table 1. Effect of different *rhizobia* inoculants on nodulation, plant growth and development

Treatments	Nodule number plant^{-1}	Nodule size (cm)	Nodule dry weight (mg) plant^{-1}	Shoot dry weight (g) plant^{-1}	Root dry weight (mg) plant^{-1}
Control	46.1^{a}	0.35^{a}	440.2^{a}	7.18^{a}	223^{a}
A-No LCO	49.3^{a}	0.44^{b}	458.3^{b}	8.42^{b}	230^{a}
B-With LCO	61.1^{b}	0.76^{c}	614.1^{c}	10.05^{c}	254^{b}

Means followed by the same letter(s) are not significantly different at $p< 0.05$. Dry weight values were obtained by air drying samples for one week





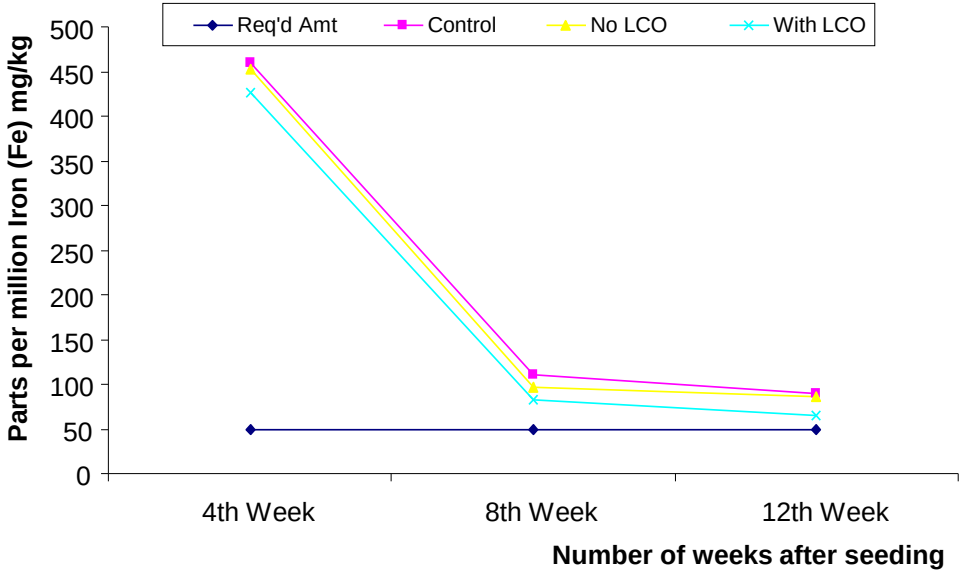


Figure 4. Nitrogen, (N), phosphorus (P) and iron (Fe) composition in shoot samples at 4, 8 and 12 weeks after seeding.

Table 2. Effect of *Rhizobium* inoculant formulation type on pea yield and yield components of pea, number of pods plant-1; number of seeds pod-1; thousand seed weight (g), seed yield (g) plant-1 and harvest yield bushel/acre (bu/ac).

Treatments	Number of pods plant^{-1}	Number of seeds pod^{-1}	Seed yield (g) plant^{-1}	TSW (g)	Harvest yield (kg ha^{-1})
Control	5.0^{a}	4.1^{a}	3.21^{a}	150.6^{a}	3151.68^{a}
A No LCO	5.1^{a}	4.1^{a}	3.26^{a}	155.9^{b}	3171.84^{a}
B With LCO	5.5^{b}	4.0^{a}	3.59^{b}	168.2^{c}	3480.96^{b}

Means followed by the same letter(s) are not significantly different at $p < 0.05$. Dry weight values were obtained by air drying samples for one week

Observations from trial

- days to nodule initiation was shorter (24 days) in B (with LCO) than A (No LCO), 27 days and Control, 30 days
- root nodules plant^{-1} as well as nodes plant^{-1} followed the order B (with LCO) > A (No LCO) > Control
- differences in nodule sizes (cm) were significantly high ($p < 0.05$) in B (with LCO), 0.76 cm compared to A (No LCO) 0.44 cm and Control (0.35 cm)
- no differences in number of pods plant^{-1}
- seed yield plant^{-1} was significant among treatments
- TSW was high in B compared to A and Control. Differences were significant ($p < 0.05$)

Observations cont'd

• differences in harvest yield kg/ha (bu/ac) was significant among treatments:-

- With LCO 3480.96 kg/ha (51.8 bu/ac)
- No LCO 3171.84 kg/ha (47.2 bu/ac)
- Control 3151.68 kg/ha (46.9 bu/ac)

• differences between No LCO and Control not significant

Conclusions

• the LCO positively influenced pea growth, nodules development and pea yield

• native *Rhizobium* population performed almost the same as Inoculant A.

Acknowledgements

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Thank you!

Questions?