

Comparative Evaluation of CA Practices on Productivity and Sustainability of Pigeonpea - Wheat rotation in IGP of India

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CA: Key to Intensifying Crop Production



IGP ~ 13% of the total geographical area of India

Produces 50% of total foodgrains to feed 40% population of the country

Legume-based technologies in rice-wheat production system (Mungbean residue + DSR-zero-till wheat+rice residue-mungbean)

Pigeonpea-wheat cropping system is a viable option (3.58 mha)

Why pigeonpea for sustainability?

- ❑ **Contributes organic matter in the form of senesced leaves, root residue, and releases P from fixed forms**
- ❑ **Add protein to complement cereals : mungbean-rice-wheat and pigeonpea-wheat**
- ❑ **ESD Pigeonpea - wheat rotation:**
 - **140 to 160 days: Pusa 992, Pusa 84, Pusa 2001, Pusa 2003**
 - **ESD pigeonpea yield ~3 t/ha**
 - **Up to about 1 t/ha extra yield of wheat could be harvested when it followed ESD pigeonpea; rice-wheat (3.64 t/ha); SD pigeonpea-wheat (3.79 t/ha); ESD pigeonpea-wheat (4.51 t/ha)**



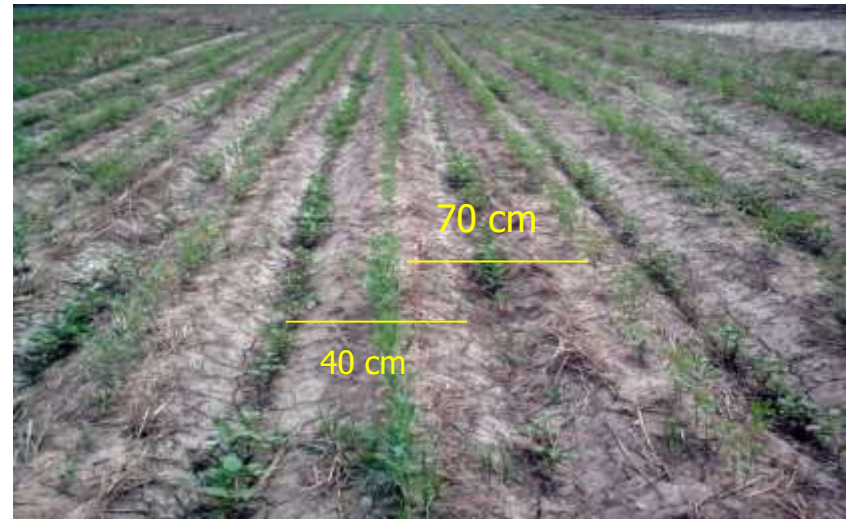
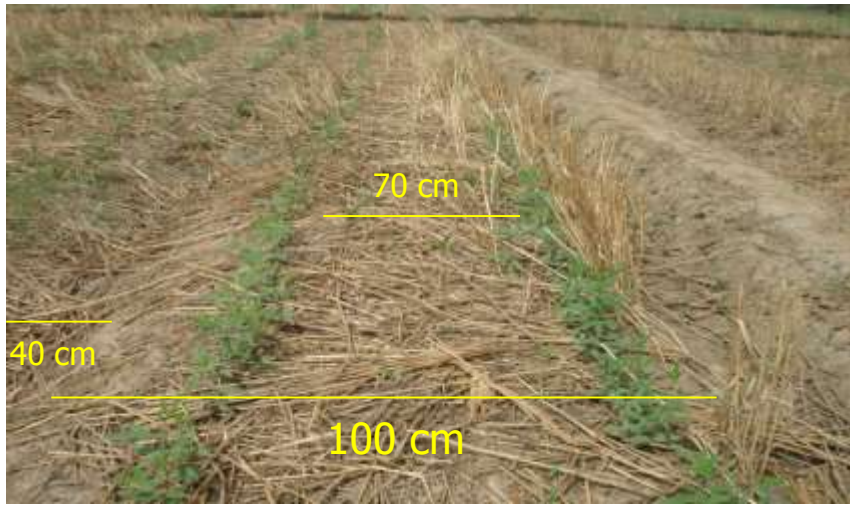
Evaluation of Determinate Early maturing Pigeonpea Genotypes with Short Compact Plant Type under Improved Agronomy (Reduced Row to row Spacing)



अरहर की बौनी प्रजातियों का भिन्न कतार से कतार अन्तर पर परीक्षण
EVALUATION OF DWARF PIGEONPEA GENOTYPES OVER TWO SPACING
Treatment detail:
Main Plot:
1. 30 cm. (Row Spacing)
2. 45 cm.
Sub-Plot: (Genotypes)
1. PADT - 6
2. PADT - 10
3. PADT - 1
4. PADT - 4
5. PADT - 25
6. PADT - 39
7. PADT - 16
8. PADT - 5
9. PADT - 27
10. P S - 4242
11. ICPL - 88039
बुआई की तिथि - 04-07-2012 (Design - Split-Plot, Repl. - 3)
Dox - 04-07-2012

Experimental Detail

- ✦ **Conventional-till flat bed (CT-F)**
 - ✦ **Zero-till permanent narrow-raised bed without residue (PNB)**
 - ✦ **Zero-till permanent narrow-raised bed with residue (PNB+R)**
 - ✦ **Zero-till permanent broad-raised bed without residue (PBB)**
 - ✦ **Zero-till permanent broad-raised bed with residue (PBB+R)**
 - ✦ **Zero-till flat bed without residue (ZT)**
 - ✦ **Zero-till flat bed with residue (ZT+R)**
-
- ✦ **Pigeonpea 'Pusa 992'; wheat 'HD 2932'**
 - ✦ **Sandy clay loam; pH 7.7; SOC 5.2 g/kg; N-182.3 kg/ha; P-23.3 kg/ha; K 250.5 kg/ha**



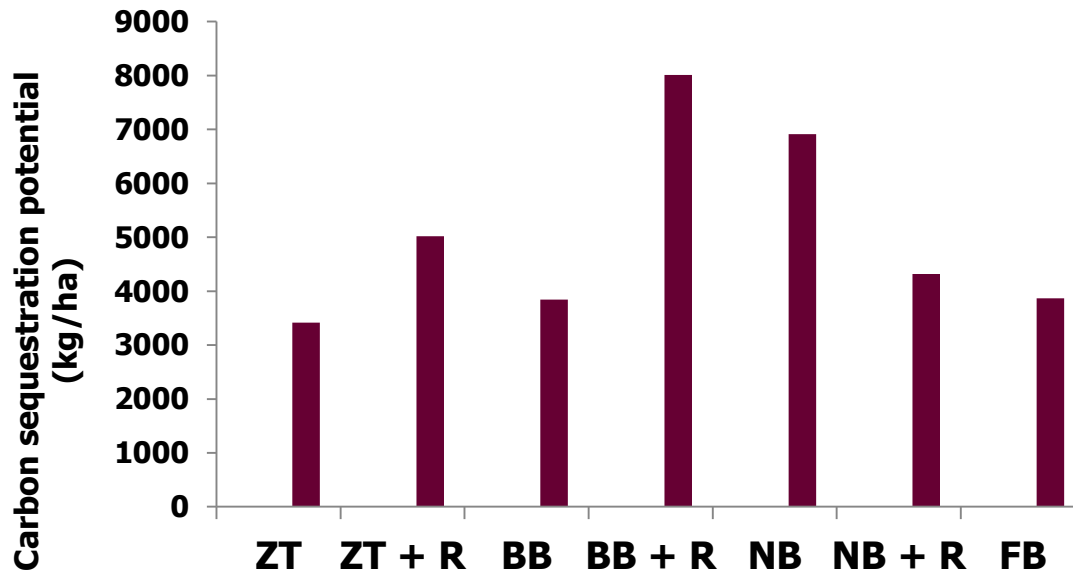
System productivity of pigeonpea-wheat cropping system (t/ha)

	2011-12	2012-13
CT-F	7.81	8.80
PNB	8.10	8.93
PNB+R	8.28	9.25
PBB	8.85	9.16
PBB+R	9.05	9.83
ZT-F+R	-	10.03
ZT-F	-	9.41
LSD(P=0.05)	-	0.41

System productivity of pigeonpea-wheat cropping system (t/ha)

	System productivity (wheat equivalent) (t/ha)	Cost of cultivation (x10³ Rs/ha)	Net returns (x10³ Rs/ha)
Direct seeded rice – ZT-wheat	10.91	55.53	99.02
Transplanted rice –ZT- wheat	11.88	67.43	100.11
Transplanted rice – CT-wheat	11.60	68.63	95.16
Pigeonpea – wheat (ZT Flat+residue)	10.03	41.27	87.59

Carbon sequestration potential (0-15 cm) as influenced by tillage



- ❑ ZT permanent broad bed with residue had significantly higher SOC pool and maximum carbon sequestration potential in 0-15 cm soil depth than CT flat bed.

Tillage and crop establishment

Conventional till raised bed (CT-B)

Conventional till flat bed (CT-F)

Zero till raised bed (ZT-B)

Zero till flat bed (ZT-F)

Residue application

No residue (R_0)

Wheat residue (R_W)

Pigeonpea residue (R_{PP})

Pigeonpea + wheat residue (R_{PP+W})



❑ Pigeonpea cv 'Pusa 992' ; wheat 'HD 2895'

❑ Rainfall; 303, 610, 990 and 730 mm during 2008–09, 2009–10, 2010–11 and 2011–12, respectively

❑ Sandy loam; SOC 3.6 g/kg; available N 163.7 kg/ha; available P 10.2 kg/ha; available K 270 kg/ha

□ On an average 1.3, 0.11 and 1.2 % NPK and 0.5, 0.18 and 1.9 % NPK was found in pigeonpea and wheat residue, respectively.

□ The mean leaf litter fall of pigeonpea was 0.90–1.15 t/ha; added ~ 36–52 kg N/ha and 5–7.2 kg P/ha

□ Almost similar net returns were obtained with pigeonpea + wheat residue @ 3 t/ha (Rs 84,500) and sole pigeonpea residue @ 3 t/ha (Rs 84,200) application,

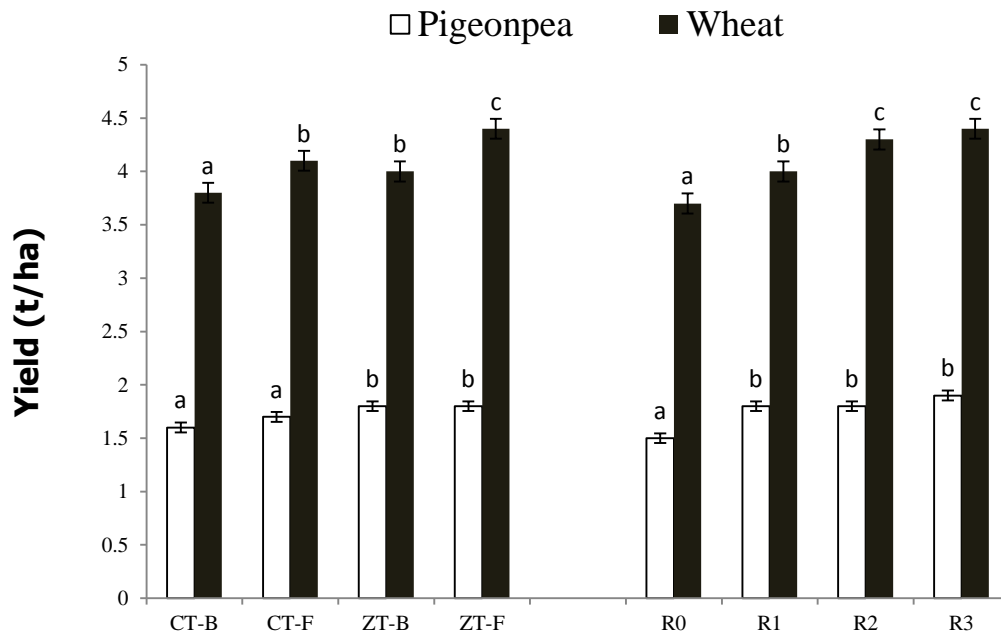


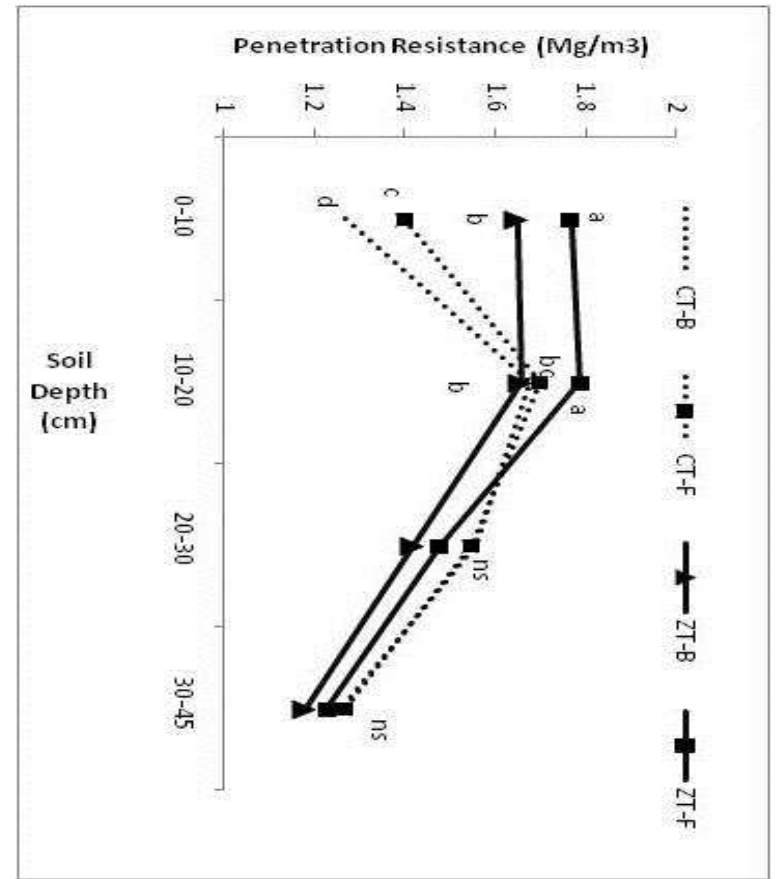
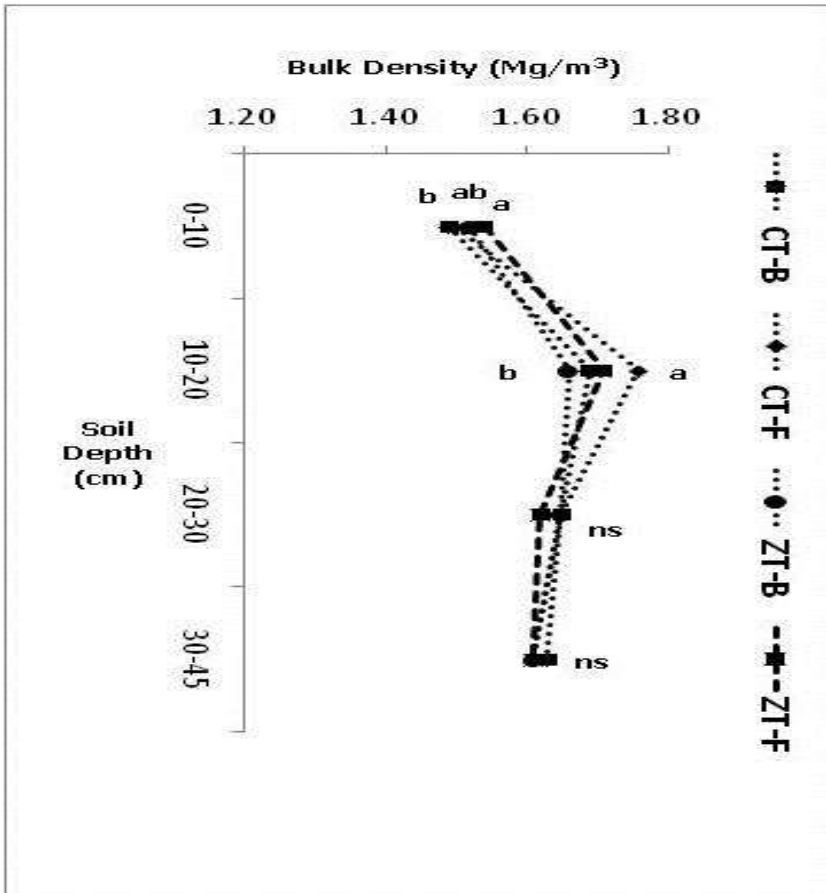
Fig. 1 Yield of pigeonpea and wheat

✓ Under ZT, the average yield of pigeonpea and wheat was 1.8 and 4.1 t/ha, respectively.

✓ Grain yield for CT was 1.7 and 4.0 t/ha, respectively.

✓ Grain yield of pigeonpea and wheat in ZT was 5.4 and 2.5 % higher over CT, respectively.

✓ Application of crop residue gave 14.4 and 28.2 % higher pigeonpea and wheat grain yield over no residue.



Tillage effects on soil physical parameters

Soil microbial properties

	MBC (mg C/kg)	MBN (mg N/kg)	DHA (μg TPF/g /h)	GLC (μg PNP/g/ h)
Tillage and crop establishment				
CT-B	371.4	62.8	18.0	136.1
CT-F	353.0	59.9	16.0	135.0
ZT-B	427.8	74.3	20.0	129.8
ZT-F	405.4	70.8	21.0	128.1
CD (P=0.05)	12.4	5.7	3.2	NS
Residue management				
R₀	297.8	51.5	14.8	103.9
R_W	385.0	67.0	18.9	136.3
R_{PP}	420.0	72.7	20.4	143.4
R_{PP+W}	454.8	76.6	20.9	145.4
CD (P=0.05)	11.6	3.6	1.7	11.5

✚ Zero tillage caused an increase of 15.0, 18.3 and 20.6 % in MBC, MBN and DHA activities respectively, over CT

✚ Residue application recorded 41.0, 39.8, 35 and 48 % higher MBC, MBN, DHA, b-and GLC respectively, over no residue application

Residual soil fertility status after completion of 4 yr PW rotation

	Organic C (%)	Kjeldahl-N (kg/ha)	Olsen's P (kg/ha)	NH ₄ OAc-extractable K (kg/ha)
Tillage and crop establishment				
CT-B	0.434	197.1	13.97	347.1
CT-F	0.430	184.5	13.72	342.9
ZT-B	0.452	215.6	14.40	361.2
ZT-F	0.440	202.8	13.89	351.3
CD (P=0.05)	NS	12.2	NS	10.0
Residue application 3 t/ha				
R ₀	0.416	190.2	13.25	330.7
R _W	0.441	200.0	14.08	354.6
R _{pp}	0.448	204.4	14.31	352.4
R _{pp+W}	0.452	205.4	14.34	364.6
CD (P=0.05)	0.024	10.4	0.70	9.7

Initial soil fertility: Organic C, Kjeldahl-N, Olsen's P and NH₄OAc-extractable K was 0.36%, 163, 10.2 and 270 kg/ha, respectively.

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RESEARCH ARTICLE

Productivity, Organic Carbon and Residual Soil Fertility of Pigeonpea–Wheat Cropping System Under Varying Tillage and Residue Management

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T. K. Das · Ranjan Bhattacharyya

Conclusions

Pigeonpea-wheat system with permanent ZT broad bed with residue could be a potential alternative to conventional transplanted puddled rice - conventional till wheat system

- ❑ ZT broad, narrow and flat beds with residue resulted in higher system productivity than their respective no residue plots and CT flat bed.**
- ❑ Pigeonpea-wheat could be a potential alternative to rice-wheat system, if ESD PP and dal making is taken into consideration**
- ❑ Zero-till permanent broad-bed with residue resulted in significantly higher SOC, particularly in the surface 0-5 cm layer.**
- ❑ This could be another important adaptation and mitigation strategy to climate change as well.**



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