



Division of Agronomy Indian Agricultural Research Institute



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Comparative performance of System of Wheat Intensification and other methods of wheat cultivation in north western plain zone of India



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SYSTEM OF WHEAT INTENSIFICATION

The technology which has high potentiality to provide high yield per drop of water and per kg of agricultural inputs like fertilizer, seed and application of other SRI principle to wheat crop, which gave very enthusiastic results, this method of wheat cultivation is now known as **System of Wheat Intensification (SWI)**.



Principles of System of Wheat Intensification (SWI)

- ❑ Principle of root development and
- ❑ Principle of intensive care

Basic Practices followed in SWI

- Priming of seeds
- sprouted seeds at each marked intersection of lines
- Irrigate the field during flowering and grain filling
- Care in the field



Constraints of SWI



- **Time-bound operations**
- **Labour-intensive**
- **Accessibility to weeders and markers**

Experience at IARI

Treatment	Cultural operations
CIP	<ul style="list-style-type: none"> • Seed treatment with bavistin/ thiram, 100 kg ha⁻¹ seed, line sowing at 20 cm by seed drill • 150:60:60 kg NPK ha⁻¹ through fertilizers • 6 irrigations at crown root initiation (CRI), tillering (T), late jointing (LJ), boot stage (B), flowering (F) and at grain filling (GF) stage at 21, 45, 65, 85, 105 and 115 DAS, respectively. • One hand weeding (HW) or spray of 25g ha⁻¹ sulfosulfuron
SWI-D	<ul style="list-style-type: none"> • Seed treatment with mixture of jaggery, cow urine, compost and hot water, seed rate-25 kg ha⁻¹, sowing by dibbling of 2 sprouted seeds per hill at 20x20cm² • <i>Trichoderma</i> treated (2.5 kg t⁻¹) compost @ 2.0 t ha⁻¹ + 68 kg DAP + 33 kg ha⁻¹ MOP before sowing; 68 kg ha⁻¹ Urea on 16th day; Vermicompost @ 500 kg ha⁻¹+ PSB culture 6.25 kg ha⁻¹ on 20th day; 34 kg ha⁻¹ Urea+34 kg ha⁻¹ MOP on 36th day; Vermicompost@500 kg ha⁻¹ on 40th day • 6 irrigations as SWI protocol at 15, 25, 35, 60, 95 and at 105 DAS. • Three weeding using cono-weeder at 20, 30 and 40 DAS

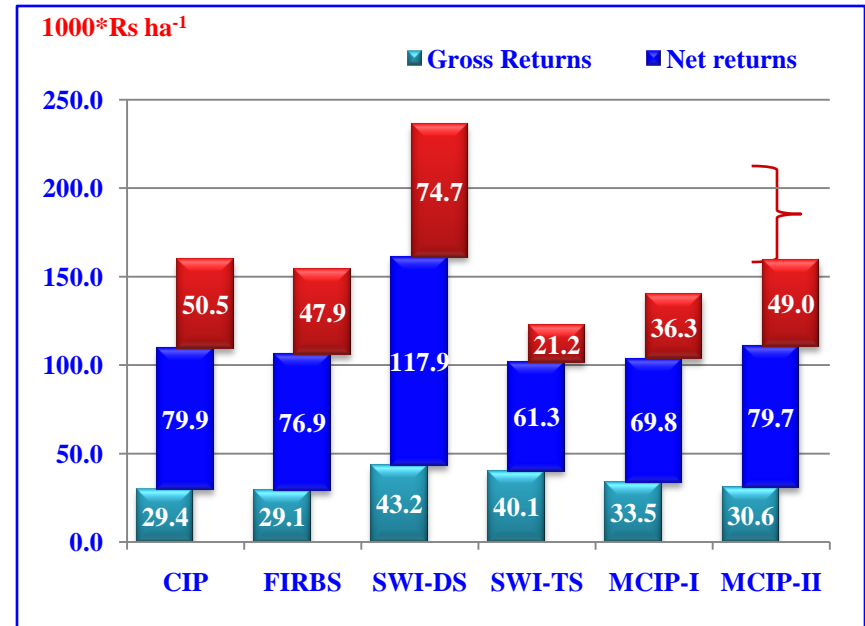
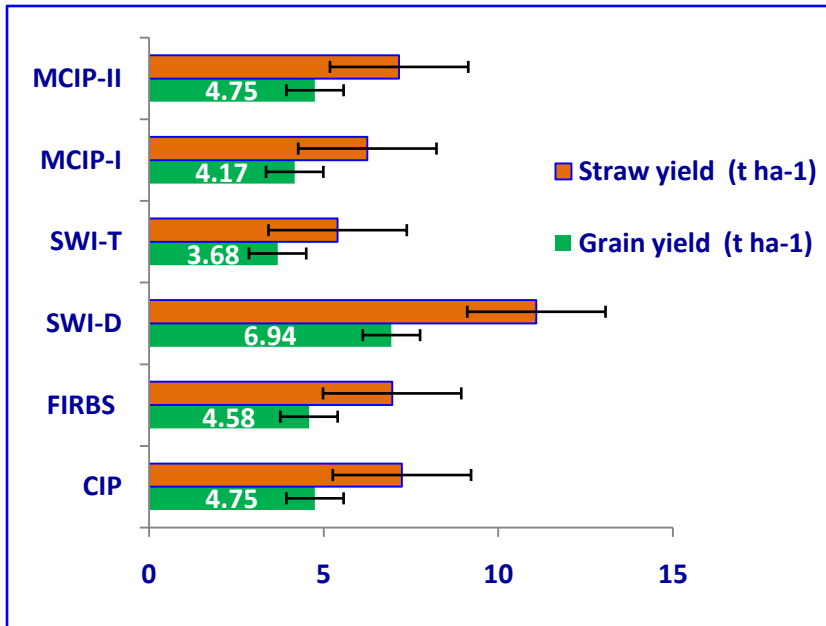
Plant height and root parameters (60 DAS) of wheat under different planting options

Treatment	Plant height (cm)				Root length (cm)		Root volume (cm ³)	
	60 DAS		Maturity		2011-12	2012-13	2011-12	2012-13
	2011-12	2012-13	2011-12	2012-13				
CIP	34.3	33.5	96.0	94.0	252.8	232.6	4.04	3.92
FIRBS	35.7	35.2	98.0	97.0	235.6	228.0	4.43	4.12
SWI-D	40.7	38.5	102.0	96.0	279.2	255.5	5.10	4.76
SWI-T	32.7	31.3	84.7	79.0	245.8	231.2	4.38	3.80
MCIP-I	35.7	34.6	92.7	96.0	258.4	239.0	4.78	4.35
MCIP-II	35.3	32.6	97.3	91.0	207.4	202.5	4.68	4.28
LSD(P=0.05)	1.13	1.21	5.41	3.7	24.1	17.2	0.37	0.34

Yield attributes of wheat under different methods of cultivation

Treatment	Effective tillers (m ⁻²)		Spikelet earhead ⁻¹		Grains earhead ⁻¹		1000 grain wt. (g)	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
	CIP	445	363	24.3	22.7	67.3	67.0	35.6
FIRBS	358	345	24.7	23.7	72.0	71.0	36.3	32.7
SWI-D	479	363	25.3	26.3	76.0	78.0	36.9	33.5
SWI-T	269	256	24.2	23.3	72.3	70.3	36.7	32.0
MCIP-I	459	369	21.7	22.7	72.7	68.0	36.2	30.6
MCIP-II	423	377	22.7	22.7	66.0	69.1	36.7	29.6
LSD(P=0.05)	7.8	31.0	1.47	0.92	4.48	3.95	NS	1.67

Yield and economic returns of wheat under different methods of cultivation



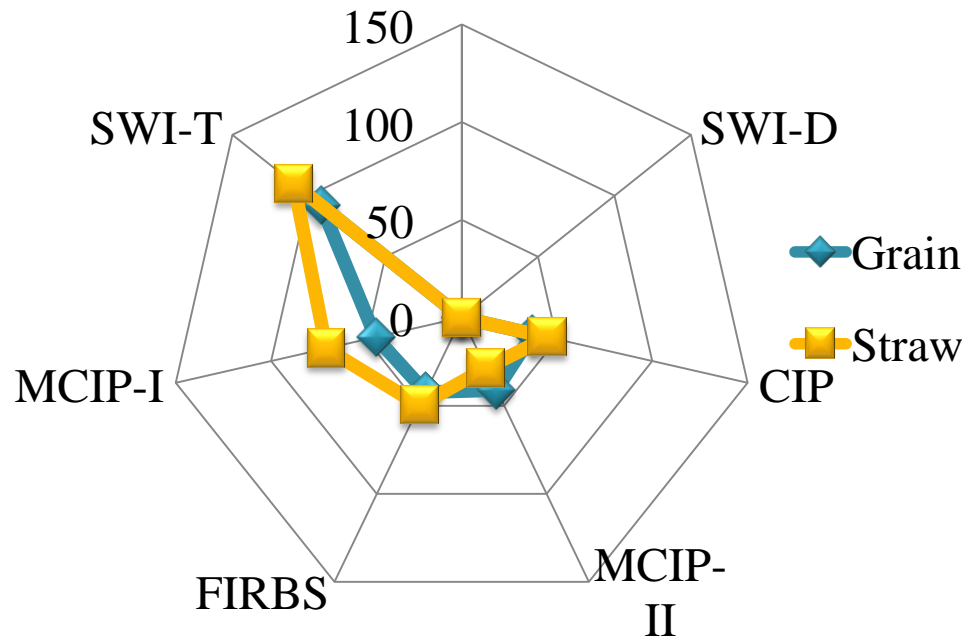
❑ Significantly higher grain and straw yields were obtained with direct seeded system of wheat intensification over all other methods.

❑ Highest cost of cultivation involved with SWI-DS but gross and net returns were significantly higher than other systems

Yields and harvest index of wheat under different planting methods

Treatment	Grain yield (t ha ⁻¹)		Straw yield (t ha ⁻¹)		TBY (t ha ⁻¹)		HI (%)	
	2011- 12	2012- 13	2011- 12	2012- 13	2011- 12	2012- 13	2011- 12	2012- 13
CIP	6.08	4.75	9.05	7.24	15.13	11.99	40.2	39.61
<i>FIRBS</i>	5.87	4.58	8.81	6.96	14.68	11.54	40.0	39.71
SWI-D	7.93	6.94	12.53	11.09	20.46	18.03	38.8	38.49
SWI-T	4.07	3.68	5.86	5.40	9.93	9.08	41.0	40.53
MCIP-I	6.08	4.17	7.56	6.25	13.64	10.41	44.6	40.01
MCIP-II	5.80	4.75	11.19	7.16	16.99	11.91	34.1	39.89
LSD (P=0.05)	1.06	0.82	2.33	1.98	3.9	4.1	3.1	NS

Yield advantage (%) of grain and straw through SWI-D over other methods of wheat cultivation (mean of two years)



Economic returns and cost of cultivation (Rs*1000 ha⁻¹) of different methods of wheat cultivation

Treatment	Total cost		Gross Return		Net profit		B:C ratio	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
CIP	26.7	29.4	98.6	79.9	71.9	50.5	1.89	2.08
FIRBS	26.4	29.1	95.4	76.9	69.0	47.9	1.81	2.01
SWI-D	39.3	43.2	130.5	117.9	91.2	74.7	1.90	1.92
SWI-T	36.5	40.1	65.5	61.3	29.1	21.2	0.58	0.63
MCIP-I	30.5	33.5	100.5	69.8	70.0	36.3	1.19	1.59
MCIP-II	27.9	30.6	94.9	79.7	67.0	49.0	1.76	1.90

Available nutrients in soil after harvest of wheat under different methods of cultivation

Treatment	Available N (kg ha ⁻¹)		Available P (kg ha ⁻¹)		Available K (kg ha ⁻¹)	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
CIP	157.2	125.4	13.9	12.0	301.8	311.1
FIRBS	168.3	135.0	14.1	13.0	308.4	324.3
SWI-D	188.3	175.6	14.7	14.1	316.6	327.5
SWI-T	199.2	188.9	15.1	14.3	341.9	335.3
MCIP-I	155.2	132.2	13.9	12.0	307.9	316.2
MCIP-II	159.1	130.5	13.8	14.0	303.5	312.5
Initial value	159.6	133.9	14.4	13.9	312.6	307.6

Per cent change in soil available nutrients from its initial value at sowing and to after harvest of crop under various methods of cultivation

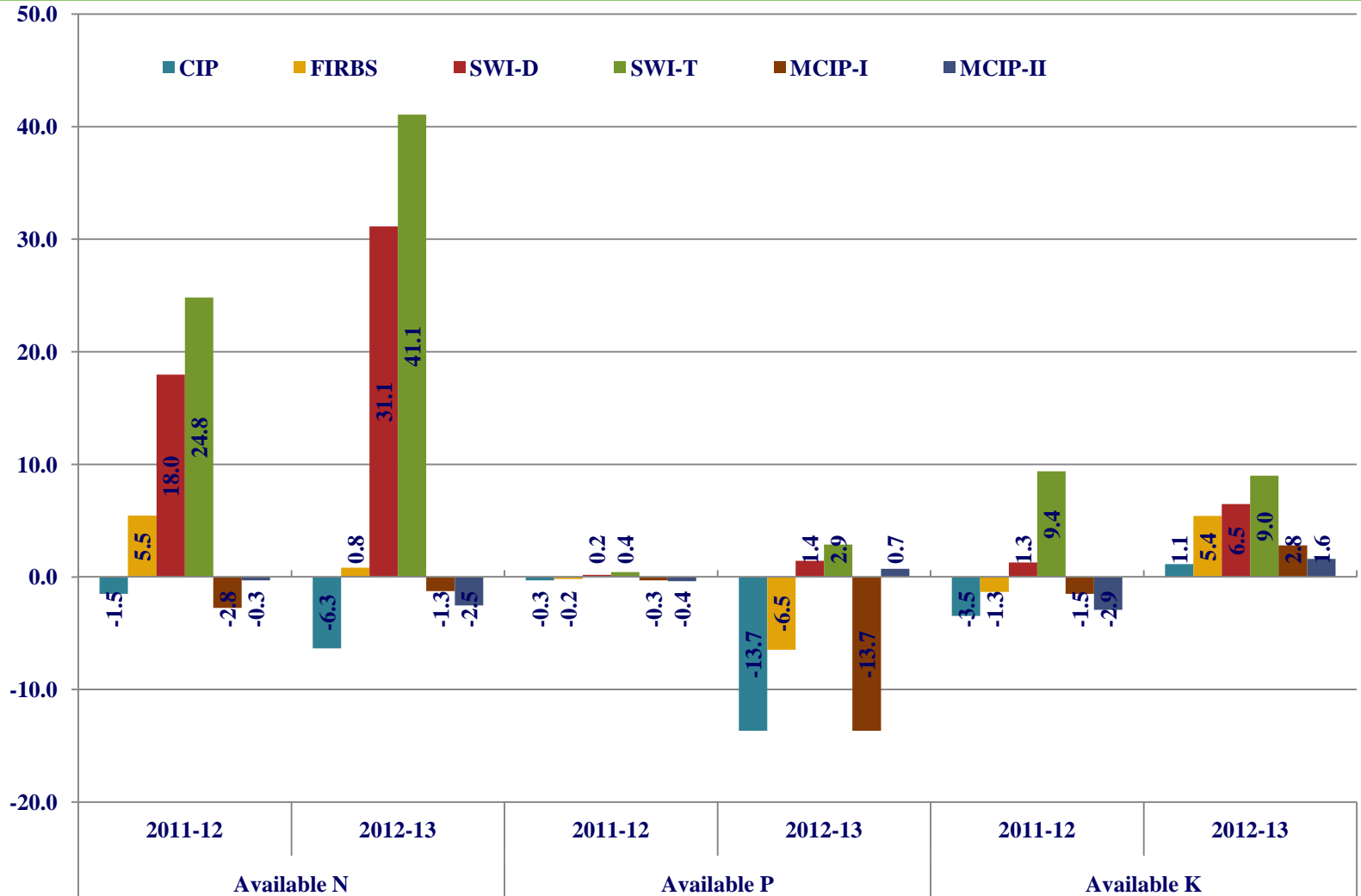
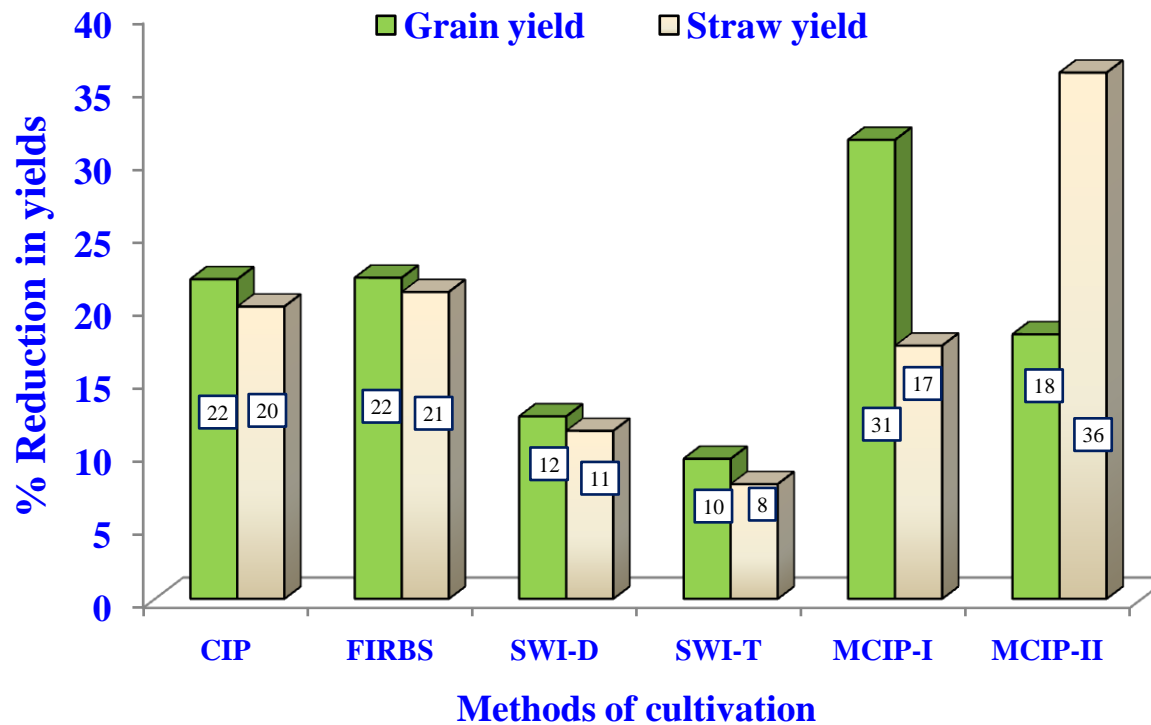
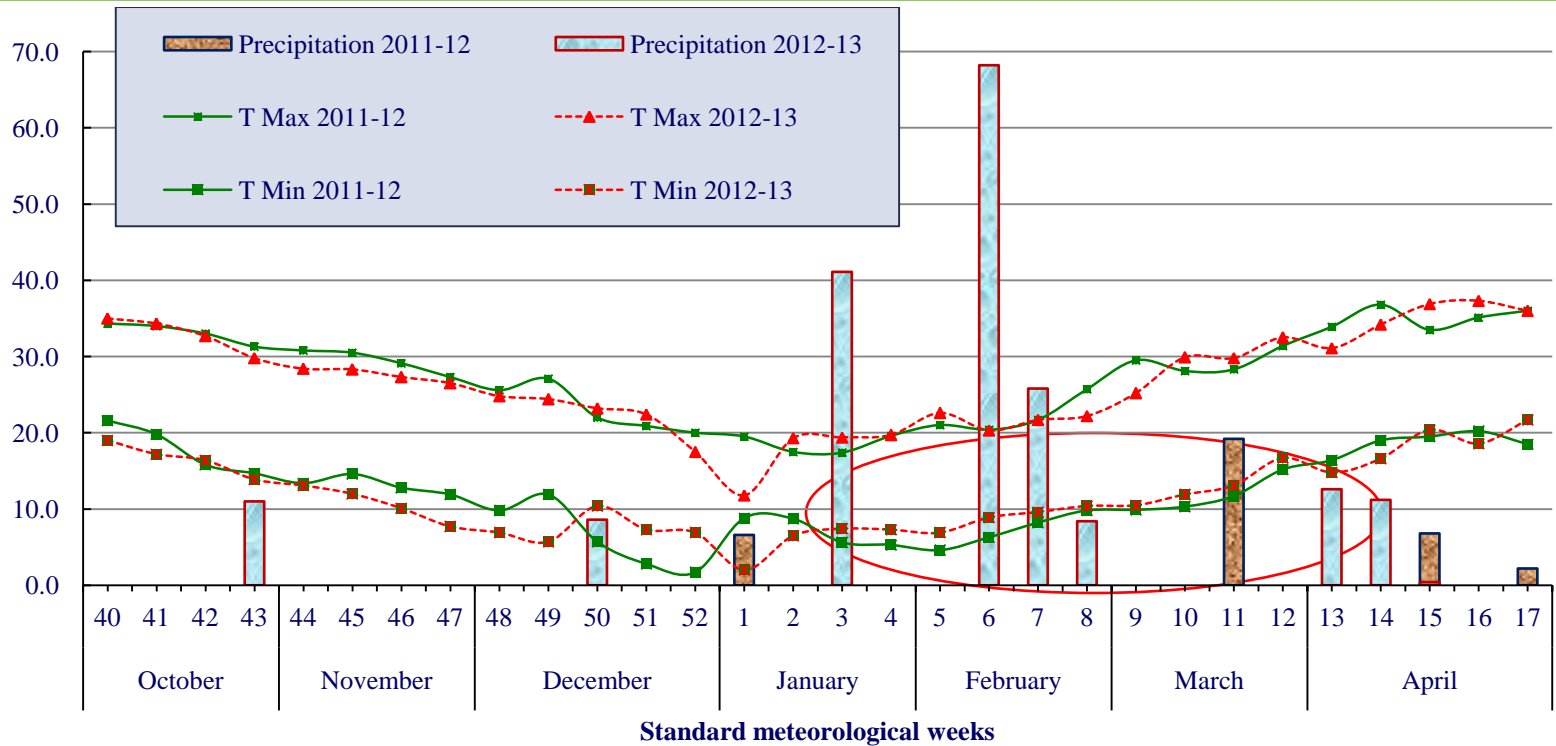


Fig. Reduction (%) in grain and straw yields due to unfavourable weather conditions during 2012-13 in comparison with favourable year 2011-12





Temperature (°C) and Precipitation (mm) during crop period of 2011-12 and 2012-13

Conclusion

- **Plant growth was highest in SWI among different methods of cultivation.**
- **Root length and root volume in SWI were significantly higher in SWI as compared to CIP.**
- **Significantly higher yield attributes were recorded from SWI than other methods.**
- **SWI produced 37 % more grain yield and 45% more straw yield over CIP.**
- **Highest net returns were obtained from SWI despite its highest cost of cultivation.**
- **Residual soil fertility was higher in SWI over all other methods.**
- **SWI is more resilient to environmental stress than other methods.**



Thanks for kind attention!



Treatment	Cultural operations
CIP	<ul style="list-style-type: none"> • Seed treatment with bavistin/ thiram, 100 kg ha⁻¹ seed, line sowing at 20 cm by seed drill • 150:60:60 kg NPK ha⁻¹ through fertilizers • 6 irrigations at crown root initiation (CRI), tillering (T), late jointing (LJ), boot stage (B), flowering (F) and at grain filling (GF) stage at 21, 45, 65, 85, 105 and 115 DAS, respectively. • One hand weeding (HW) or spray of 25g ha⁻¹ sulfosulfuron
FIRBS	<ul style="list-style-type: none"> • Seed treatment with bavistin/thiram, 60 kg ha⁻¹ seed, sowing with FIRBS planter, 3 lines on raised bed at 15 cm distance • 80 % recommended dose of NPK (120:48:48 kg NPK ha⁻¹) through fertilizers • 6 irrigations at CRI, T, LJ, B, F and GF stage at 21, 45, 65, 85, 105 and 115 DAS, respectively. • One HW or spray of 25g ha⁻¹ sulfosulfuron
SWI-D	<ul style="list-style-type: none"> • Seed treatment with mixture of jaggery, cow urine, compost and hot water, seed rate-25 kg ha⁻¹, sowing by dibbling of 2 sprouted seeds per hill at 20x20cm² • <i>Trichoderma</i> treated (2.5 kg t⁻¹) compost @ 2.0 t ha⁻¹ + 68 kg DAP + 33 kg ha⁻¹ MOP before sowing; 68 kg ha⁻¹ Urea on 16th day; Vermicompost @ 500 kg ha⁻¹ + PSB culture 6.25 kg ha⁻¹ on 20th day; 34 kg ha⁻¹ Urea+34 kg ha⁻¹ MOP on 36th day; Vermicompost@500 kg ha⁻¹ on 40th day • 6 irrigations as SWI protocol at 15, 25, 35, 60, 95 and at 105 DAS. • Three weeding using cono-weeder at 20, 30 and 40 DAS

SWI-T	<ul style="list-style-type: none"> • Seed treatment with mixture of jaggery, cow urine, compost and hot water Seed rate-25 kg/ha, transplanting of 11 days old nursery, 2 seedling per hill at 20x20cm • <i>Trichoderma</i> (2.5 kg t⁻¹) treated compost @ 2.0 t ha⁻¹ + 68 kg ha⁻¹ DAP + 33 kg ha⁻¹ MOP before sowing; 68 kg urea ha⁻¹ on 16th day; Vermicompost @ 500 kg ha⁻¹ + PSB culture 6.25 kg ha⁻¹ on 20th day; 34 kg Urea + 34 kg MOP on 36th day; Vermicompost @ 500 kg ha⁻¹ on 40th day • 6 irrigations as SWI protocol at 17, 27, 37, 60, 95 and at 105 DAS. • 3 weeding using cono-weeder at 22,32 and 42 DAS
MCIP-I	<ul style="list-style-type: none"> • Pre-treated seed with bavistin/thiram, seed rate-100 kg ha⁻¹, line sowing at 20 cm with seed drill/deshi plough, • 150:60:60 kg NPK ha⁻¹ through fertilizers • 6 irrigations as SWI protocol at 15, 25, 35, 60, 95 and at 105 DAS. • One HW or spray of 25g/ha sulfosulfuron
MCIP-II	<ul style="list-style-type: none"> • Seed treatment with bavistin/ thiram, 100 kg ha⁻¹ seed, line sowing at 20 cm by seed drill, thinning at 10 DAS for plant distance 10 cm • 150:60:60 kg NPK ha⁻¹ through fertilizers • 6 irrigations at CRI, T, LJ, B, F and GF stage at 21, 45, 65, 85, 105 and 115 DAS, respectively. • One HW or spray of 25g ha⁻¹ sulfosulfuron

Performance of modified conventional and SWI methods of wheat cultivation

Treatments: 10 methods of wheat cultivation

1. Conventional + all recommended practices
 2. Conventional + seed treatment as SWI
 3. Conventional + manure and fertilizer schedule as SWI
 4. Conventional + inter cultivation as SWI
 5. Conventional + seed treatment + inter cultivation + manure and fertilizer schedule as SWI
 6. System of Wheat Intensification – recommended protocol
 7. System of Wheat Intensification – seed treatment as conventional
 8. System of Wheat Intensification – fertilizer as conventional
 9. System of Wheat Intensification - no hoeing weed control by herbicides
 10. System of Wheat Intensification - Irrigation as conventional
- Design : RBD