**Cereal Systems Initaitive for South Asia (CSISA)-Taraori**

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A medium term (4 yrs) farmer’s participatory strategic research trial was conducted at Taraori (Haryana), India to evaluate the effects conservation agriculture (CA) based management practices such as zero tillage (ZT), direct dry seeding of rice (DSR), residue recycling and grain legume integration on crop yields, water productivity, profitability and protein yield of scented RW system. Six treatments included; T1- CT puddled transplanted rice- CT wheat without residue {PTR-CTW (-*R*)}; T2-PTR- CTW- CT mungbean (mungbean residue incorporated) {PTR-CTW-CTM (+M*Ri*)}; T3- Zero till direct seeded rice rice-zero till wheat (no residue) {ZTDSR-ZTW (-*R*)}; T4- ZTDSR- ZTW-relay seeded mungbean with mungbean residue retained {ZTDSR-ZTW-RM (+M*Rr*)}; T5- ZTDSR-ZTW with both rice and wheat residues retained {ZTDSR-ZTW (+RW*Rr*)} and T6- ZTDSR-ZTW- relay seeded mungbean with all three residues retained {ZTDSR-ZTW-RM (+RWM*Rr*)}.

**Table. Total residue recycled (Mg ha-1) and carbon load (Mg ha-1) from all the crops under different treatments over the years.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Residue recycled and total carbon load (Mg ha-1)** | | | | | | | | | | | | | | | | |
| **2011-12** | | | | **2012-13** | | | | **2013-14** | | | | **2014-15** | | | | **Total** |
| **Rice** | **Wheat** | **MBa** | **Total** | **Rice** | **Wheat** | **MB** | **Total** | **Rice** | **Wheat** | **MB** | **Total** | **Rice** | **Wheat** | **MB** | **Total** |  |
| T1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| T2 | 0.00 | 0.00 | 1.37 (0.37)b | 1.37 (0.37) | 0.00 | 0.00 | 1.42 (0.37) | 1.42 (0.37) | 0.00 | 0.00 | 1.29 (0.34) | 1.29 (0.34) | 0.00 | 0.00 | 1.43 (0.37) | 1.43 (0.37) | 5.51 (1.45) |
| T3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| T4 | 0.00 | 0.00 | 1.42 (0.38) | 1.42 (0.38) | 0.00 | 0.00 | 1.48 (0.39) | 1.48 (0.39) | 0.00 | 0.00 | 1.49 (0.39) | 1.49 (0.39) | 0.00 | 0.00 | 1.54 (0.40) | 1.54 (0.40) | 5.93 (1.56) |
| T5 | 6.89 (2.55) | 6.77 (2.71) | 0.00 | 13.66 (5.26) | 7.83 (2.90) | 6.69 (2.68) | 0.00 | 14.52 (5.58) | 7.38 (2.73) | 7.16 (2.87) | 0.00 | 14.54 (5.60) | 7.66 (2.84) | 6.95 (2.85) | 0.00 | 14.61 (5.69) | 57.33 (22.13) |
| T6 | 7.08 (2.62) | 6.71 (2.69) | 1.43 (0.39) | 15.22 (5.70) | 7.98 (2.95) | 6.79 (2.72) | 1.49 (0.39) | 16.26 (6.06) | 7.60 (2.81) | 6.99 (2.80) | 1.51 (0.39) | 16.10 (6.00) | 8.02 (2.97) | 6.94 (2.85) | 1.5 7 (0.41) | 16.53 (6.23) | 64.11 (23.99) |

a MB-Mungbean

bFigures in parenthesis indicates the carbon load (Mg ha-1)

**Table. Cost of key inputs and outputs used for economic analysis during the different years**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item/Commodity** | **Cost of key inputs and outputs (INR)** | | | |
| **2011-12** | **2012-13** | **2013-14** | **2014-15** |
| Scented rice grain (Mg-1) | 18000 | 25000 | 36000 | 28100 |
| Scented rice loose residue (ha-1) | 1750 | 1500 | 3250 | 2500 |
| Scented rice seed (Kg-1) | 55 | 60 | 65 | 65 |
| Wheat grain (Mg-1) | 12850 | 13500 | 14000 | 14500 |
| Wheat loose residue (ha-1) | 2750 | 3250 | 6750 | 3750 |
| Wheat seed (kg-1) | 30 | 30 | 37.5 | 37.5 |
| Mungbean grain (kg-1) | 50 | 55 | 65 | 68 |
| Mungbean seed (kg-1) | 80 | 100 | 100 | 125 |
| Urea (kg-1) | 4.94 | 5.37 | 5.37 | 5.50 |
| Di-ammonium-phosphate (DAP) (kg-1) | 13.20 | 22.50 | 23.10 | 23.70 |
| Muriate of potash (MoP) (kg-1) | 8.80 | 13.40 | 18.00 | 16.00 |
| Diesel (l-1) | 40.18 | 51.20 | 52.38 | 51.55 |
| Wages Rate (person-1 day-1) | 270 | 300 | 300 | 350 |
| USD to INR Conversation rate | 47 | 54 | 58 | 61 |

**Table. Grain yield (Mg ha-1) of scented rice, wheat, mungbean and wheat equivalent system yield as affected by management protocols in rice-wheat- mungbean system**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **Grain yield (Mg ha-1)** | | | | |
| **2011-12** | **2012-13** | **2013-14** | **2014-15** | **Pooled average** |
| *Scented rice* | | | | | |
| T1 | 5.10aa | 4.90ab | 4.69a | 4.95a | 4.91ab |
| T2 | 5.15a | 5.02a | 4.74a | 4.94a | 4.96a |
| T3 | 4.79b | 4.68cd | 4.76a | 4.88a | 4.78c |
| T4 | 4.78b | 4.58d | 4.74a | 4.51b | 4.65d |
| T5 | 4.76b | 4.71cd | 4.70a | 4.47b | 4.66d |
| T6 | 4.79b | 4.81bc | 4.85a | 4.92a | 4.84bc |
| *Wheat* | | | | | |
| T1 | 5.81c | 5.15c | 5.44bc | 5.34b | 5.44c |
| T2 | 5.86c | 5.44b | 5.39c | 5.24b | 5.48c |
| T3 | 6.39b | 5.66b | 5.67b | 5.52b | 5.81b |
| T4 | 6.99a | 5.66b | 6.36a | 6.07a | 6.27a |
| T5 | 6.42b | 6.10a | 6.40a | 6.12a | 6.26a |
| T6 | 6.88a | 6.15a | 6.40a | 6.14a | 6.39a |
| *Mungbean* | | | | | |
| T1 | NAb | NA | NA | NA | NA |
| T2 | 0.77b | 0.80a | 0.76b | 0.81a | 0.79a |
| T3 | NA | NA | NA | NA | NA |
| T4 | 0.79b | 0.82a | 0.81a | 0.84a | 0.82a |
| T5 | NA | NA | NA | NA | NA |
| T6 | 0.82a | 0.83a | 0.80a | 0.83a | 0.82a |
| *System yield (wheat equivalent)* | | | | | |
| T1 | 12.95c | 14.23d | 17.53e | 14.94c | 14.91d |
| T2 | 16.11b | 18.03a | 21.13b | 18.64b | 18.48b |
| T3 | 13.12c | 14.34d | 17.93d | 14.98c | 15.09cd |
| T4 | 16.79a | 17.50b | 22.33a | 18.78b | 18.85ab |
| T5 | 13.09c | 14.82c | 18.51c | 14.80c | 15.31c |
| T6 | 16.80a | 18.44a | 22.63a | 19.57a | 19.36a |

aMeans followed by a similar lowercase letters within a column are not significantly different (p=0.05).

bNot applicable

**Table. Total irrigation water use (mm ha-1) and water productivity (kg grain m-3) applied to scented rice-wheat-mungbean system as influenced by different management protocols.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatments** | **Total irrigation water use (mm ha-1)** | | | | | **Irrigation water productivity (WPI; kg grain m-3)** | | | | | **Total water productivity (irrigation + rainfall) (WPI+R; kg grain m-3)** | | | | |
| **2011-12** | **2012-13** | **2013-14** | **2014-15** | **Pooled average** | **2011-12** | **2012-13** | **2013-14** | **2014-15** | **Pooled average** | **2011-12** | **2012-13** | **2013-14** | **2014-15** | **Pooled average** |
| T1 | 1737ba | 3014b | 1671b | 2249b | 2168b | 0.75c | 0.47c | 1.05c | 0.66d | 0.69d | 0.59b | 0.39c | 0.74b | 0.53c | 0.54d |
| T2 | 1999a | 3174a | 1871a | 2465a | 2378a | 0.81c | 0.57c | 1.13c | 0.76c | 0.78cd | 0.63b | 0.47c | 0.76b | 0.59c | 0.60cd |
| T3 | 1449cd | 1940d | 1259d | 1663d | 1578d | 0.88c | 0.74b | 1.42b | 0.90bc | 0.96bc | 0.67b | 0.56bc | 0.92a | 0.66bc | 0.70bc |
| T4 | 1562c | 2041c | 1403c | 1843c | 1713c | 1.07b | 0.86b | 1.59b | 1.02b | 1.10b | 0.79a | 0.65b | 0.97a | 0.74b | 0.78b |
| T5 | 1293d | 1579f | 1147e | 1438e | 1365f | 1.01b | 0.94b | 1.61b | 1.03b | 1.12b | 0.75a | 0.67b | 1.01a | 0.73b | 0.78b |
| T6 | 1340d | 1699e | 1199de | 1539e | 1445e | 1.25a | 1.09a | 1.89a | 1.27a | 1.34a | 0.88a | 0.79a | 1.08a | 0.87a | 0.90a |

aMeans followed by a similar lowercase letters within a column are not significantly different (p=0.05).

**Table. Net returns (USD ha-1) of scented rice, wheat, mungbean and on system basis as affected by different management protocols in rice-wheat- mungbean system.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **Net returns (USD ha-1)** | | | | |
| **2011-12** | **2012-13** | **2013-14** | **2014-15** | **Pooled average** |
| *Scented rice* | | | | | |
| T1 | 1189ca | 1602b | 2233d | 1595ab | 1655b |
| T2 | 1198c | 1607b | 2303c | 1575b | 1671b |
| T3 | 1278a | 1513c | 2480a | 1785ab | 1764a |
| T4 | 1285a | 1567bc | 2408b | 1799ab | 1765a |
| T5 | 1256b | 1775a | 2291c | 1654ab | 1744a |
| T6 | 1269ab | 1716a | 2310c | 1838a | 1784a |
| *Wheat* | | | | | |
| T1 | 971d | 817c | 978c | 893c | 915d |
| T2 | 986d | 883b | 965c | 864c | 925d |
| T3 | 1176bc | 983a | 1081b | 990b | 1058c |
| T4 | 1318a | 985a | 1242a | 1115a | 1166a |
| T5 | 1117c | 1015a | 1121b | 1048ab | 1076bc |
| T6 | 1230ab | 1029a | 1119b | 1052ab | 1108b |
| *Mungbean* | | | | | |
| T1 | NA | NA | NA | NA | NA |
| T2 | 659b | 628b | 688b | 744b | 658b |
| T3 | NA | NA | NA | NA | NA |
| T4 | 764a | 712a | 806a | 842a | 756a |
| T5 | NA | NA | NA | NA | NA |
| T6 | 791a | 719a | 803a | 827a | 759a |
| *System* | | | | | |
| T1 | 2160d | 2419c | 3211f | 2489d | 2570d |
| T2 | 2759b | 3119c | 3957c | 3184b | 3255b |
| T3 | 2455c | 2496c | 3562d | 2775c | 2822c |
| T4 | 3269a | 3265a | 4457a | 3757a | 3687a |
| T5 | 2373c | 2790b | 3412e | 2702cd | 2820c |
| T6 | 3188a | 3466a | 4233b | 3718a | 3652a |

aMeans followed by a similar lowercase letters within a column are not significantly different (p=0.05).

**Table. System based protein yield (kg ha-1) and adults protein demand equivalents as affected by as affected by management protocols in rice-wheat-mungbean cropping system.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **Protein yield and adult equivalents** | | | | **Pooled average** |
| **2011-12** | **2012-13** | **2013-14** | **2014-15** |
| *System protein yield (kg ha-1)* | | | | | |
| T1 | 840ca | 769e | 782e | 789e | 795f |
| T2 | 1007b | 968b | 936d | 946c | 964c |
| T3 | 873c | 801d | 807c | 801de | 820e |
| T4 | 1086a | 962b | 1032a | 998b | 1019b |
| T5 | 872c | 841c | 867b | 828d | 852d |
| T6 | 1083a | 1021a | 1041a | 1026a | 1043a |
| *Yearly protein demand (based on 60g d-1 adult-1) equivalents for adults* | | | | | |
| T1 | 35c | 32e | 33e | 33e | 34f |
| T2 | 42b | 41b | 39b | 40c | 41c |
| T3 | 37c | 34d | 34d | 34de | 35e |
| T4 | 46a | 41b | 43a | 42b | 43b |
| T5 | 37c | 35c | 37c | 35d | 36d |
| T6 | 46a | 43a | 44a | 43a | 44a |

aMeans followed by a similar lowercase letters within a column are not significantly different (p=0.05).