**Supplementary Table S1.** Grain/seed yield of the crops

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment combination | Wheat grain yield (t/ha) | Mungbean seed yield (t/ha) | T. Aman rice grain yield (t/ha) |
| Location (L)×Treatment (T) | | | |
| L₁×T₁ | 1.42 h | 0.93 f | 2.37 l |
| L₁×T₂ | 4.58 cde | 1.89 cd | 5.31 c |
| L₁×T₃ | 4.16 fg | 1.62 de | 4.55 k |
| L₁×T₄ | 4.70 abcde | 1.87 cd | 5.14 e |
| L₁×T₅ | 5.02 a | 2.51 a | 5.61 a |
| L₁×T₆ | 4.86 abc | 2.26 ab | 5.38 c |
| L₁×T₇ | 4.44 def | 1.77 de | 4.77 i |
| L₁×T₈ | 4.55 cde | 1.80 d | 4.95 g |
| L₂×T₁ | 1.24 h | 0.89 f | 2.01 m |
| L₂×T₂ | 4.65 bcde | 1.82 cd | 5.22 d |
| L₂×T₃ | 4.06 g | 1.49 e | 4.52 k |
| L₂×T₄ | 4.64 cde | 1.81 d | 5.04 f |
| L₂×T₅ | 4.99 ab | 2.33 ab | 5.46 b |
| L₂×T₆ | 4.76 abcd | 2.12 bc | 5.35 c |
| L₂×T₇ | 4.40 efg | 1.65 de | 4.65 j |
| L₂×T₈ | 4.51 de | 1.73 de | 4.85 h |
| Location (L)×Year (Y) | | | |
| L₁×Y₁ | 4.10 bc | 1.76 ab | 4.73 b |
| L₁×Y₂ | 4.33 a | 1.90 a | 4.78 a |
| L₂×Y₁ | 4.05 c | 1.68 b | 4.60 d |
| L₂×Y₂ | 4.27 ab | 1.78 ab | 4.67 c |
| Treatment (T)×Year (Y) | | | |
| T₁×Y₁ | 1.13 i | 0.89 f | 2.16 j |
| T₁×Y₂ | 1.52 h | 0.93 f | 2.22 j |
| T₂×Y₁ | 4.60 bcdef | 1.82 cd | 5.24 d |
| T₂×Y₂ | 4.63 bcde | 1.89 cd | 5.28 d |
| T₃×Y₁ | 3.92 g | 1.50 e | 4.52 i |
| T₃×Y₂ | 4.30 ef | 1.61 de | 4.55 i |
| T₄×Y₁ | 4.55 cdef | 1.81 cd | 5.05 e |
| T₄×Y₂ | 4.80 abcd | 1.87 cd | 5.12 e |
| T₅×Y₁ | 4.92 ab | 2.32 ab | 5.47 b |
| T₅×Y₂ | 5.09 a | 2.51 a | 5.60 a |
| T₆×Y₁ | 4.74 bcd | 2.06 bc | 5.36 c |
| T₆×Y₂ | 4.88 abc | 2.32 ab | 5.37 c |
| T₇×Y₁ | 4.28 f | 1.67 de | 4.67 h |
| T₇×Y₂ | 4.57 cdef | 1.76 de | 4.75 g |
| T₈×Y₁ | 4.45 def | 1.71 de | 4.88 f |
| T₈×Y₂ | 4.61 bcdef | 1.83 cd | 4.92 f |
| Location (L)×Treatment (T)×Year (Y) | | | |
| L₁×T₁×Y₁ | 1.13 k | 0.91 i | 2.34 p |
| L₁×T₁×Y₂ | 1.70 j | 0.95 i | 2.40 p |
| L₁×T₂×Y₁ | 4.63 abcdefg | 1.85 cdefgh | 5.29 def |
| L₁×T₂×Y₂ | 4.52 cdefg | 1.92 cdefg | 5.33 cde |
| L₁×T₃×Y₁ | 4.00 hi | 1.53 gh | 4.54 o |
| L₁×T₃×Y₂ | 4.31 efghi | 1.70 efggh | 4.56 o |
| L₁×T₄×Y₁ | 4.57 cdefg | 1.84 cdefgh | 5.10 hi |
| L₁×T₄×Y₂ | 4.83 abcd | 1.91 cdefg | 5.17 ghi |
| L₁×T₅×Y₁ | 4.93 abc | 2.39 ab | 5.52 b |
| L₁×T₅×Y₂ | 5.11 a | 2.62 a | 5.69 a |
| L₁×T₆×Y₁ | 4.77 abcdef | 2.11 bcde | 5.37 cd |
| L₁×T₆×Y₂ | 4.96 abc | 2.40 ab | 5.39 cd |
| L₁×T₇×Y₁ | 4.30 fghi | 1.72 efggh | 4.76 n |
| L₁×T₇×Y₂ | 4.58 cdefg | 1.81 defgh | 4.78 mn |
| L₁×T₈×Y₁ | 4.47 cdefgh | 1.76 efggh | 4.93 kl |
| L₁×T₈×Y₂ | 4.63 abcdefg | 1.84 cdefgh | 4.97 kl |
| L₂×T₁×Y₁ | 1.13 k | 0.87 i | 1.98 q |
| L₂×T₁×Y₂ | 1.34 jk | 0.92 i | 2.04 q |
| L₂×T₂×Y₁ | 4.57 cdefg | 1.80 efggh | 5.19 fgh |
| L₂×T₂×Y₂ | 4.74 abcdefg | 1.85 cdefgh | 5.24 efg |
| L₂×T₃×Y₁ | 3.83 i | 1.46 h | 4.50 o |
| L₂×T₃×Y₂ | 4.29 fghi | 1.51 gh | 4.53 o |
| L₂×T₄×Y₁ | 4.53 cdefg | 1.78 efggh | 5.00 jk |
| L₂×T₄×Y₂ | 4.76 abcdef | 1.84 cdefgh | 5.08 ij |
| L₂×T₅×Y₁ | 4.90 abcd | 2.25 abc | 5.42 bc |
| L₂×T₅×Y₂ | 5.08 ab | 2.40 ab | 5.51 b |
| L₂×T₆×Y₁ | 4.72 abcdefg | 2.00 bcdef | 5.34 cde |
| L₂×T₆×Y₂ | 4.80 abcde | 2.23 abcd | 5.35 cd |
| L₂×T₇×Y₁ | 4.25 ghi | 1.61 fgh | 4.58 o |
| L₂×T₇×Y₂ | 4.55 cdefg | 1.70 efggh | 4.72 n |
| L₂×T₈×Y₁ | 4.43 defgh | 1.66 fgh | 4.82 mn |
| L₂×T₈×Y₂ | 4.59 bcdefg | 1.81 efggh | 4.87 lm |
| L×T | \* | \* | \*\*\* |
| L×Y | \* | \* | \* |
| T×Y | \* | \* | \* |
| L×T×Y | \* | \* | \* |

**Supplementary Table S2.** Statistical analysis for biological yield

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatment combinations** | **Biological yield (t/ha)** | | |
| **Wheat** | **Mungbean** | **T. Aman rice** |
| L×T | \* | \* | \*\*\* |
| L×Y | \* | \* | \* |
| T×Y | \* | \* | \* |
| L×T×Y | \* | \* | \* |

**Supplementary Table S3.** Effect of treatment combinations on nutrient content of BARI Gom30 in 2022 and 23

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | %N | | %P | | %K | | %S | | |
| Treatment combination | Grain | Straw | Grain | Straw | Grain | Straw | Grain | Straw |
| Location (L)×Treatment (T) | | | | | | | | |
| L₁×T₁ | 1.21 n | 0.20 l | 0.31 ef | 0.05 hi | 0.53 g | 1.21 f | 0.14 i | 0.14 h |
| L₁×T₂ | 1.66 d | 0.32 e | 0.37 b | 0.07 d | 0.56 e | 1.31 bc | 0.17 e | 0.24 a |
| L₁×T₃ | 1.30 l | 0.24 j | 0.32 d | 0.06 fg | 0.54 f | 1.13 g | 0.16 fg | 0.15 g |
| L₁×T₄ | 1.58 f | 0.32 d | 0.35 c | 0.05 ghi | 0.59 c | 1.23 e | 0.17 de | 0.16 f |
| L₁×T₅ | 1.86 a | 0.41 a | 0.40 a | 0.16 a | 0.66 a | 1.52 a | 0.19 b | 0.20 b |
| L₁×T₆ | 1.77 c | 0.36 b | 0.37 b | 0.09 c | 0.61 b | 1.33 b | 0.18 c | 0.18 d |
| L₁×T₇ | 1.44 h | 0.25 h | 0.32 de | 0.05 ghi | 0.55 f | 1.24 e | 0.18 cd | 0.16 fg |
| L₁×T₈ | 1.52 g | 0.25 h | 0.32 d | 0.06 ef | 0.57 d | 1.26 d | 0.16 f | 0.15 g |
| L₂×T₁ | 1.25 m | 0.29 f | 0.22 j | 0.04 i | 0.42 l | 1.21 f | 0.12 k | 0.14 h |
| L₂×T₂ | 1.59 e | 0.33 c | 0.27 i | 0.07 d | 0.43 k | 1.31 c | 0.14 i | 0.19 c |
| L₂×T₃ | 1.20 o | 0.26 g | 0.27 i | 0.05 ghi | 0.44 k | 1.14 g | 0.23 a | 0.15 g |
| L₂×T₄ | 1.43 i | 0.32 d | 0.28 gh | 0.05 gh | 0.51 h | 1.24 e | 0.13 j | 0.17 e |
| L₂×T₅ | 1.86 a | 0.36 b | 0.31 f | 0.12 b | 0.50 h | 1.52 a | 0.16 f | 0.20 b |
| L₂×T₆ | 1.78 b | 0.32 e | 0.29 g | 0.10 c | 0.49 i | 1.33 b | 0.15 gh | 0.18 d |
| L₂×T₇ | 1.32 k | 0.22 k | 0.28 g | 0.06 efg | 0.46 j | 1.24 e | 0.17 de | 0.15 g |
| L₂×T₈ | 1.39 j | 0.24 i | 0.27 hi | 0.06 de | 0.45 j | 1.26 d | 0.15 hi | 0.15 g |
| Location (L)×Year (Y) | | | | | | | | |
| L₁×Y₁ | 1.51 c | 0.26 d | 0.32 b | 0.06 c | 0.55 c | 1.33 b | 0.15 c | 0.15 c |
| L₁×Y₂ | 1.56 a | 0.32 a | 0.37 a | 0.09 a | 0.60 a | 1.22 c | 0.19 a | 0.20 a |
| L₂×Y₁ | 1.43 d | 0.31 b | 0.23 d | 0.08 b | 0.37 d | 1.21 d | 0.18 b | 0.19 b |
| L₂×Y₂ | 1.52 b | 0.28 c | 0.31 c | 0.05 c | 0.55 b | 1.34 a | 0.14 d | 0.15 c |
| Treatment (T)×Year (Y) | | | | | | | | |
| T₁×Y₁ | 1.25 n | 0.20 p | 0.23 m | 0.04 j | 0.42 k | 1.21 i | 0.13 h | 0.13 i |
| T₁×Y₂ | 1.21 o | 0.30 i | 0.30 g | 0.05 hij | 0.42 k | 1.22 hi | 0.13 h | 0.15 h |
| T₂×Y₁ | 1.58 f | 0.31 h | 0.27 kl | 0.07 ef | 0.43 j | 1.31 c | 0.15 g | 0.24 a |
| T₂×Y₂ | 1.66 e | 0.34 d | 0.37 b | 0.07 d | 0.45 i | 1.32 c | 0.16 f | 0.20 c |
| T₃×Y₁ | 1.20 p | 0.23 o | 0.26 l | 0.06 gh | 0.46 i | 1.13 j | 0.23 a | 0.15 h |
| T₃×Y₂ | 1.30 m | 0.27 j | 0.33 d | 0.05 ghi | 0.49 h | 1.14 j | 0.16 fg | 0.16 g |
| T₄×Y₁ | 1.43 j | 0.32 g | 0.28 ij | 0.05 ij | 0.50 g | 1.23 gh | 0.15 g | 0.16 g |
| T₄×Y₂ | 1.58 g | 0.33 e | 0.35 c | 0.06 g | 0.51 g | 1.24 efg | 0.16 fg | 0.17 f |
| T₅×Y₁ | 1.85 b | 0.40 a | 0.31 ef | 0.15 a | 0.53 f | 1.51 a | 0.17 e | 0.20 c |
| T₅×Y₂ | 1.86 a | 0.36 b | 0.40 a | 0.12 b | 0.55 e | 1.52 a | 0.19 b | 0.21 b |
| T₆×Y₁ | 1.78 c | 0.35 c | 0.29 hi | 0.09 c | 0.55 e | 1.32 bc | 0.16 f | 0.18 e |
| T₆×Y₂ | 1.77 d | 0.32 f | 0.37 b | 0.10 c | 0.57 d | 1.33 b | 0.18 cd | 0.19 d |
| T₇×Y₁ | 1.32 l | 0.24 m | 0.29 h | 0.05 ghi | 0.57 d | 1.23 fg | 0.17 de | 0.15 h |
| T₇×Y₂ | 1.44 i | 0.23 n | 0.31 fg | 0.06 fg | 0.59 c | 1.25 ef | 0.18 bc | 0.16 fg |
| T₈×Y₁ | 1.39 k | 0.24 l | 0.28 jk | 0.06 gh | 0.61 b | 1.25 de | 0.15 g | 0.15 h |
| T₈×Y₂ | 1.52 h | 0.25 k | 0.32 e | 0.07 de | 0.66 a | 1.27 d | 0.16 fg | 0.16 g |
| Location (L)×Treatment (T)×Year (Y) | | | | | | | | |
| L₁×T₁×Y₁ | 1.18 y | 0.18 t | 0.29 gh | 0.04 hi | 0.51 hi | 1.30 f | 0.13 kl | 0.13 mn |
| L₁×T₁×Y₂ | 1.23 w | 0.22 q | 0.33 ef | 0.05 efgh | 0.55 f | 1.12 mn | 0.16 hi | 0.15 j |
| L₁×T₂×Y₁ | 1.63 j | 0.28 l | 0.34 de | 0.04 hi | 0.53 g | 1.35 e | 0.15 i | 0.27 a |
| L₁×T₂×Y₂ | 1.68 h | 0.35 f | 0.39 b | 0.10 c | 0.58 cd | 1.28 g | 0.19 de | 0.22 d |
| L₁×T₃×Y₁ | 1.27 v | 0.23 p | 0.29 gh | 0.06 def | 0.52 gh | 1.14 lm | 0.14 jk | 0.13 mn |
| L₁×T₃×Y₂ | 1.32 r | 0.24 o | 0.35 d | 0.05 efgh | 0.56 ef | 1.13 m | 0.18 f | 0.17 h |
| L₁×T₄×Y₁ | 1.55 l | 0.29 k | 0.32 f | 0.03 i | 0.59 c | 1.35 e | 0.16 gh | 0.20 f |
| L₁×T₄×Y₂ | 1.60 k | 0.35 f | 0.37 c | 0.07 d | 0.58 cd | 1.12 mn | 0.19 de | 0.16 i |
| L₁×T₅×Y₁ | 1.83 d | 0.35 f | 0.38 bc | 0.14 b | 0.63 b | 1.58 a | 0.18 f | 0.24 b |
| L₁×T₅×Y₂ | 1.88 a | 0.46 a | 0.42 a | 0.17 a | 0.68 a | 1.45 b | 0.21 b | 0.14 lm |
| L₁×T₆×Y₁ | 1.74 g | 0.31 i | 0.34 de | 0.05 efgh | 0.58 cd | 1.25 i | 0.17 g | 0.23 c |
| L₁×T₆×Y₂ | 1.79 f | 0.40 c | 0.39 b | 0.13 b | 0.63 b | 1.40 c | 0.20 c | 0.13 mn |
| L₁×T₇×Y₁ | 1.41 q | 0.25 n | 0.30 g | 0.04 hi | 0.52 gh | 1.36 de | 0.15 i | 0.18 g |
| L₁×T₇×Y₂ | 1.46 p | 0.24 o | 0.33 ef | 0.06 def | 0.57 de | 1.12 mn | 0.21 bc | 0.13 no |
| L₁×T₈×Y₁ | 1.49 o | 0.20 s | 0.30 g | 0.05 efgh | 0.50 i | 1.35 e | 0.14 j | 0.18 g |
| L₁×T₈×Y₂ | 1.54 m | 0.29 k | 0.34 de | 0.07 d | 0.64 b | 1.17 j | 0.18 ef | 0.14 kl |
| L₂×T₁×Y₁ | 1.31 s | 0.21 r | 0.17 m | 0.04 hi | 0.33 m | 1.11 n | 0.13 kl | 0.15 jk |
| L₂×T₁×Y₂ | 1.18 y | 0.37 e | 0.27 i | 0.04 gh | 0.51 hi | 1.31 f | 0.11 m | 0.21 e |
| L₂×T₂×Y₁ | 1.53 n | 0.34 g | 0.20 l | 0.09 c | 0.31 n | 1.27 gh | 0.15 i | 0.18 gh |
| L₂×T₂×Y₂ | 1.64 i | 0.32 h | 0.34 de | 0.05 fgh | 0.55 f | 1.35 e | 0.14 jk | 0.16 i |
| L₂×T₃×Y₁ | 1.13 z | 0.22 q | 0.24 k | 0.05 efgh | 0.34 m | 1.12 mn | 0.32 a | 0.15 jk |
| L₂×T₃×Y₂ | 1.27 v | 0.30 j | 0.30 g | 0.05 efgh | 0.53 g | 1.15 kl | 0.14 jk | 0.20 f |
| L₂×T₄×Y₁ | 1.30 t | 0.34 g | 0.24 k | 0.06 def | 0.42 j | 1.11 n | 0.14 j | 0.14 lm |
| L₂×T₄×Y₂ | 1.55 l | 0.30 j | 0.32 f | 0.04 hi | 0.59 c | 1.36 de | 0.13 l | 0.23 c |
| L₂×T₅×Y₁ | 1.87 b | 0.45 b | 0.24 jk | 0.16 a | 0.37 l | 1.44 b | 0.16 gh | 0.17 h |
| L₂×T₅×Y₂ | 1.84 c | 0.26 m | 0.37 c | 0.07 d | 0.63 b | 1.59 a | 0.16 gh | 0.22 d |
| L₂×T₆×Y₁ | 1.81 e | 0.39 d | 0.23 k | 0.13 b | 0.39 k | 1.39 c | 0.15 i | 0.15 jk |
| L₂×T₆×Y₂ | 1.74 g | 0.24 o | 0.34 de | 0.06 de | 0.58 cd | 1.26 hi | 0.15 i | 0.16 i |
| L₂×T₇×Y₁ | 1.22 x | 0.22 q | 0.28 hi | 0.06 def | 0.39 k | 1.11 n | 0.19 d | 0.15 jk |
| L₂×T₇×Y₂ | 1.41 q | 0.22 q | 0.28 hi | 0.06 efg | 0.52 gh | 1.37 d | 0.16 hi | 0.17 h |
| L₂×T₈×Y₁ | 1.28 u | 0.28 l | 0.25 j | 0.06 def | 0.40 k | 1.16 jk | 0.16 gh | 0.14 lm |
| L₂×T₈×Y₂ | 1.49 o | 0.20 s | 0.29 gh | 0.07 d | 0.50 i | 1.36 de | 0.13 kl | 0.12 o |
| L×T | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \* | \*\*\* | \*\*\* |
| L×Y | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* |
| T×Y | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \* | \*\*\* | \*\*\* |
| L×T×Y | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* |

**Supplementary Table S4.** Effect of treatment combinations on nutrient content of Binamoog-8 in 2022 and 23

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | %N | | %P | | %K | | %S | |
| Treatment combination | Grain | Straw | Grain | Straw | Grain | Straw | Grain | Straw |
| Location (L)×Treatment (T) | | | | | | | | |
| L₁×T₁ | 3.14 o | 0.66 n | 0.45 k | 0.27 j | 0.84 k | 0.31 n | 0.24 m | 0.26 l |
| L₁×T₂ | 4.80 e | 0.85 g | 0.52 b | 0.31 d | 0.94 e | 0.53 f | 0.30 e | 0.33 g |
| L₁×T₃ | 3.18 m | 0.68 m | 0.49 h | 0.29 g | 0.90 h | 0.44 l | 0.25 k | 0.28 k |
| L₁×T₄ | 4.58 g | 0.88 e | 0.52 b | 0.32 c | 0.92 f | 0.55 d | 0.30 e | 0.36 e |
| L₁×T₅ | 5.20 a | 1.02 a | 0.53 a | 0.35 a | 1.04 a | 0.63 a | 0.35 a | 0.43 a |
| L₁×T₆ | 5.00 c | 0.96 c | 0.53 a | 0.32 b | 0.99 c | 0.56 c | 0.33 b | 0.39 c |
| L₁×T₇ | 3.68 k | 0.71 k | 0.51 d | 0.30 f | 0.91 g | 0.48 j | 0.27 i | 0.30 i |
| L₁×T₈ | 4.28 i | 0.74 i | 0.52 c | 0.31 e | 0.90 h | 0.52 g | 0.29 f | 0.31 h |
| L₂×T₁ | 3.12 p | 0.63 o | 0.43 l | 0.25 l | 0.81 l | 0.29 o | 0.21 o | 0.24 m |
| L₂×T₂ | 4.78 f | 0.83 h | 0.50 e | 0.29 g | 0.92 f | 0.51 h | 0.28 g | 0.31 hi |
| L₂×T₃ | 3.16 n | 0.66 n | 0.46 j | 0.26 k | 0.88 j | 0.41 m | 0.23 n | 0.26 l |
| L₂×T₄ | 4.56 h | 0.86 f | 0.50 f | 0.29 g | 0.89 i | 0.52 g | 0.28 h | 0.34 f |
| L₂×T₅ | 5.17 b | 1.00 b | 0.51 d | 0.32 b | 1.02 b | 0.61 b | 0.32 c | 0.40 b |
| L₂×T₆ | 4.98 d | 0.94 d | 0.50 e | 0.30 f | 0.97 d | 0.54 e | 0.31 d | 0.37 d |
| L₂×T₇ | 3.66 l | 0.69 l | 0.48 i | 0.28 i | 0.88 j | 0.46 k | 0.24 l | 0.28 k |
| L₂×T₈ | 4.26 j | 0.72 j | 0.49 g | 0.28 h | 0.88 j | 0.50 i | 0.26 j | 0.29 j |
| Location (L)×Year (Y) | | | | | | | | |
| L₁×Y₁ | 4.22 b | 0.80 b | 0.49 b | 0.30 b | 0.92 b | 0.49 b | 0.28 b | 0.32 b |
| L₁×Y₂ | 4.24 a | 0.82 a | 0.52 a | 0.32 a | 0.94 a | 0.51 a | 0.30 a | 0.34 a |
| L₂×Y₁ | 4.20 c | 0.78 c | 0.47 c | 0.27 d | 0.89 c | 0.47 c | 0.26 c | 0.30 c |
| L₂×Y₂ | 4.22 b | 0.80 b | 0.49 b | 0.29 c | 0.92 b | 0.49 b | 0.28 b | 0.32 b |
| Treatment (T)×Year (Y) | | | | | | | | |
| T₁×Y₁ | 3.12 p | 0.64 o | 0.43 m | 0.25 n | 0.83 l | 0.29 p | 0.21 o | 0.24 m |
| T₁×Y₂ | 3.14 o | 0.66 n | 0.45 l | 0.27 l | 0.84 k | 0.31 o | 0.24 m | 0.26 l |
| T₂×Y₁ | 4.78 f | 0.83 h | 0.50 f | 0.29 h | 0.92 f | 0.51 i | 0.28 g | 0.31 hi |
| T₂×Y₂ | 4.80 e | 0.85 g | 0.52 c | 0.31 e | 0.94 e | 0.53 f | 0.30 e | 0.33 g |
| T₃×Y₁ | 3.16 n | 0.66 n | 0.46 k | 0.27 m | 0.88 j | 0.41 n | 0.23 n | 0.26 l |
| T₃×Y₂ | 3.18 m | 0.68 m | 0.49 i | 0.29 i | 0.90 h | 0.44 m | 0.25 k | 0.28 k |
| T₄×Y₁ | 4.56 h | 0.86 f | 0.50 g | 0.29 h | 0.89 i | 0.53 g | 0.28 h | 0.34 f |
| T₄×Y₂ | 4.58 g | 0.88 e | 0.52 c | 0.32 d | 0.92 f | 0.55 d | 0.30 e | 0.36 e |
| T₅×Y₁ | 5.17 b | 1.00 b | 0.50 f | 0.33 b | 1.02 b | 0.61 b | 0.32 c | 0.40 b |
| T₅×Y₂ | 5.20 a | 1.02 a | 0.53 a | 0.34 a | 1.04 a | 0.63 a | 0.35 a | 0.43 a |
| T₆×Y₁ | 4.98 d | 0.94 d | 0.50 f | 0.30 g | 0.97 d | 0.54 e | 0.31 d | 0.37 d |
| T₆×Y₂ | 5.00 c | 0.96 c | 0.53 b | 0.32 c | 0.99 c | 0.56 c | 0.33 b | 0.39 c |
| T₇×Y₁ | 3.66 l | 0.69 l | 0.48 j | 0.28 k | 0.88 j | 0.46 l | 0.24 l | 0.28 k |
| T₇×Y₂ | 3.68 k | 0.71 k | 0.51 e | 0.30 g | 0.91 g | 0.48 k | 0.27 i | 0.30 i |
| T₈×Y₁ | 4.26 j | 0.72 j | 0.49 h | 0.28 j | 0.88 j | 0.50 j | 0.26 j | 0.29 j |
| T₈×Y₂ | 4.28 i | 0.74 i | 0.52 d | 0.31 f | 0.90 h | 0.52 h | 0.29 f | 0.31 h |
| Location (L)×Treatment (T)×Year (Y) | | | | | | | | |
| L₁×T₁×Y₁ | 3.13 v | 0.65 s | 0.44 k | 0.26 j | 0.83 o | 0.30 t | 0.22 n | 0.25 q |
| L₁×T₁×Y₂ | 3.15 u | 0.67 r | 0.46 i | 0.28 h | 0.85 n | 0.32 s | 0.25 k | 0.27 op |
| L₁×T₂×Y₁ | 5.21 a | 0.84 j | 0.51 d | 0.30 f | 0.93 g | 0.52 i | 0.29 g | 0.32 jk |
| L₁×T₂×Y₂ | 4.79 h | 0.86 i | 0.53 b | 0.32 d | 0.95 f | 0.54 g | 0.31 e | 0.34 hi |
| L₁×T₃×Y₁ | 4.81 g | 0.67 r | 0.47 h | 0.28 h | 0.89 k | 0.42 q | 0.24 l | 0.27 op |
| L₁×T₃×Y₂ | 3.17 t | 0.69 p | 0.50 e | 0.30 f | 0.91 i | 0.45 o | 0.26 j | 0.29 mn |
| L₁×T₄×Y₁ | 3.19 s | 0.87 h | 0.51 d | 0.30 f | 0.90 j | 0.54 g | 0.29 g | 0.35 gh |
| L₁×T₄×Y₂ | 4.57 k | 0.89 g | 0.53 b | 0.33 c | 0.93 g | 0.56 e | 0.31 e | 0.37 ef |
| L₁×T₅×Y₁ | 4.59 j | 1.01 b | 0.51 d | 0.34 b | 1.03 b | 0.62 b | 0.33 c | 0.41 b |
| L₁×T₅×Y₂ | 5.18 b | 1.03 a | 0.54 a | 0.35 a | 1.05 a | 0.64 a | 0.36 a | 0.44 a |
| L₁×T₆×Y₁ | 4.99 e | 0.95 e | 0.51 d | 0.31 e | 0.98 e | 0.55 f | 0.32 d | 0.38 de |
| L₁×T₆×Y₂ | 5.01 d | 0.97 d | 0.54 a | 0.33 c | 1.00 d | 0.57 d | 0.35 b | 0.40 bc |
| L₁×T₇×Y₁ | 3.67 q | 0.70 o | 0.49 f | 0.29 g | 0.89 k | 0.47 n | 0.25 k | 0.29 mn |
| L₁×T₇×Y₂ | 3.69 p | 0.72 n | 0.52 c | 0.31 e | 0.92 h | 0.49 l | 0.28 h | 0.31 kl |
| L₁×T₈×Y₁ | 4.27 n | 0.73 m | 0.50 e | 0.29 g | 0.89 k | 0.51 j | 0.27 i | 0.30 lm |
| L₁×T₈×Y₂ | 4.29 m | 0.75 l | 0.53 b | 0.32 d | 0.91 i | 0.53 h | 0.30 f | 0.32 jk |
| L₂×T₁×Y₁ | 4.77 i | 0.64 t | 0.44 k | 0.24 l | 0.80 p | 0.30 t | 0.20 o | 0.23 r |
| L₂×T₁×Y₂ | 4.79 h | 0.82 k | 0.49 f | 0.26 j | 0.83 o | 0.50 k | 0.22 n | 0.25 q |
| L₂×T₂×Y₁ | 3.14 uv | 0.84 j | 0.51 d | 0.28 h | 0.90 j | 0.52 i | 0.27 i | 0.29 mn |
| L₂×T₂×Y₂ | 3.17 t | 0.65 s | 0.45 j | 0.30 f | 0.93 g | 0.40 r | 0.29 g | 0.32 jk |
| L₂×T₃×Y₁ | 4.55 l | 0.67 r | 0.47 h | 0.25 k | 0.87 m | 0.42 q | 0.22 n | 0.25 q |
| L₂×T₃×Y₂ | 4.57 k | 0.84 j | 0.48 g | 0.27 i | 0.89 k | 0.51 j | 0.24 l | 0.27 op |
| L₂×T₄×Y₁ | 5.16 c | 0.87 h | 0.51 d | 0.28 h | 0.88 l | 0.53 h | 0.26 j | 0.33 ij |
| L₂×T₄×Y₂ | 5.18 b | 0.98 c | 0.49 f | 0.30 f | 0.90 j | 0.59 c | 0.29 g | 0.35 gh |
| L₂×T₅×Y₁ | 4.96 f | 1.01 b | 0.52 c | 0.31 e | 1.01 c | 0.62 b | 0.31 e | 0.39 cd |
| L₂×T₅×Y₂ | 4.99 e | 0.93 f | 0.49 f | 0.33 c | 1.03 b | 0.53 h | 0.33 c | 0.41 b |
| L₂×T₆×Y₁ | 3.65 r | 0.95 e | 0.51 d | 0.29 g | 0.95 f | 0.55 f | 0.30 f | 0.36 fg |
| L₂×T₆×Y₂ | 3.67 q | 0.68 q | 0.47 h | 0.31 e | 0.98 e | 0.44 p | 0.32 d | 0.38 de |
| L₂×T₇×Y₁ | 4.25 o | 0.70 o | 0.49 f | 0.26 j | 0.87 m | 0.47 n | 0.23 m | 0.26 pq |
| L₂×T₇×Y₂ | 4.27 n | 0.70 o | 0.48 g | 0.29 g | 0.89 k | 0.48 m | 0.25 k | 0.29 mn |
| L₂×T₈×Y₁ | 3.13 v | 0.73 m | 0.50 e | 0.27 i | 0.87 m | 0.51 j | 0.25 k | 0.28 no |
| L₂×T₈×Y₂ | 3.10 w | 0.62 u | 0.41 l | 0.29 g | 0.89 k | 0.28 u | 0.27 i | 0.30 lm |
| L×T | \* | \*\* | \* | \*\* | \*\* | \*\* | \* | \* |
| L×Y | \* | \*\* | \* | \* | \* | \* | \*\*\* | \* |
| T×Y | \* | \* | \* | \*\* | \* | \* | \* | \* |
| L×T×Y | \* | \* | \*\*\* | \*\* | \*\*\* | \*\* | \*\* | \* |

**Supplementary Table S5.** Effect of treatment combinations on nutrient content of BRRI dhan71 in 2022 and 23

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | %N | | %P | | %K | | %S | |
| Treatment combination | Grain | Straw | Grain | Straw | Grain | Straw | Grain | Straw |
| Location (L)×Treatment (T) | | | | | | | | |
| L₁×T₁ | 0.95 o | 0.34 o | 0.11 j | 0.06 k | 0.29 l | 1.19 n | 0.16 j | 0.08 n |
| L₁×T₂ | 1.20 f | 0.58 e | 0.18 c | 0.10 e | 0.40 c | 1.40 f | 0.22 c | 0.15 e |
| L₁×T₃ | 1.07 l | 0.46 k | 0.14 i | 0.07 i | 0.33 i | 1.27 l | 0.18 h | 0.10 l |
| L₁×T₄ | 1.18 g | 0.64 d | 0.17 de | 0.09 f | 0.37 e | 1.41 e | 0.21 d | 0.15 e |
| L₁×T₅ | 1.39 a | 0.78 a | 0.20 a | 0.11 b | 0.43 a | 1.56 a | 0.28 a | 0.18 a |
| L₁×T₆ | 1.32 c | 0.71 c | 0.18 c | 0.10 d | 0.42 b | 1.50 c | 0.24 b | 0.17 b |
| L₁×T₇ | 1.09 k | 0.49 i | 0.15 h | 0.07 i | 0.35 h | 1.31 j | 0.19 g | 0.12 i |
| L₁×T₈ | 1.14 i | 0.54 g | 0.16 fg | 0.08 h | 0.36 g | 1.36 h | 0.21 e | 0.13 g |
| L₂×T₁ | 0.90 p | 0.34 n | 0.11 j | 0.07 j | 0.26 n | 1.14 o | 0.13 l | 0.08 o |
| L₂×T₂ | 1.21 e | 0.56 f | 0.18 c | 0.11 c | 0.39 d | 1.39 g | 0.20 f | 0.14 f |
| L₂×T₃ | 0.97 n | 0.43 m | 0.13 i | 0.07 i | 0.29 m | 1.23 m | 0.16 k | 0.09 m |
| L₂×T₄ | 1.17 h | 0.50 h | 0.17 cd | 0.09 f | 0.36 f | 1.36 h | 0.19 g | 0.12 h |
| L₂×T₅ | 1.37 b | 0.71 b | 0.20 a | 0.12 a | 0.43 a | 1.54 b | 0.24 b | 0.17 c |
| L₂×T₆ | 1.30 d | 0.64 d | 0.19 b | 0.11 b | 0.40 c | 1.45 d | 0.22 c | 0.15 d |
| L₂×T₇ | 1.07 m | 0.45 l | 0.15 gh | 0.08 g | 0.31 k | 1.28 k | 0.17 i | 0.10 k |
| L₂×T₈ | 1.10 j | 0.46 j | 0.16 ef | 0.08 g | 0.32 j | 1.32 i | 0.18 h | 0.11 j |
| Location (L)×Year (Y) | | | | | | | | |
| L₁×Y₁ | 1.21 a | 0.65 a | 0.16 b | 0.09 b | 0.36 c | 1.27 c | 0.21 a | 0.14 a |
| L₁×Y₂ | 1.12 c | 0.48 c | 0.15 c | 0.08 c | 0.37 a | 1.47 a | 0.21 b | 0.13 b |
| L₂×Y₁ | 1.18 b | 0.55 b | 0.17 a | 0.11 a | 0.32 d | 1.21 d | 0.17 d | 0.12 c |
| L₂×Y₂ | 1.09 d | 0.47 d | 0.15 c | 0.07 d | 0.37 b | 1.46 b | 0.20 c | 0.12 c |
| Treatment (T)×Year (Y) | | | | | | | | |
| T₁×Y₁ | 1.06 l | 0.47 k | 0.11 l | 0.07 j | 0.28 n | 1.15 n | 0.15 m | 0.07 m |
| T₁×Y₂ | 0.78 p | 0.21 o | 0.11 l | 0.06 k | 0.27 o | 1.18 m | 0.15 m | 0.09 k |
| T₂×Y₁ | 1.23 e | 0.63 e | 0.19 bc | 0.12 c | 0.37 f | 1.27 i | 0.22 e | 0.15 d |
| T₂×Y₂ | 1.18 h | 0.51 j | 0.17 fg | 0.08 g | 0.42 c | 1.52 c | 0.20 f | 0.13 g |
| T₃×Y₁ | 1.12 k | 0.51 j | 0.14 jk | 0.08 h | 0.30 m | 1.19 m | 0.16 l | 0.08 l |
| T₃×Y₂ | 0.92 o | 0.37 n | 0.13 k | 0.07 j | 0.31 l | 1.31 g | 0.18 j | 0.11 j |
| T₄×Y₁ | 1.22 f | 0.61 f | 0.18 de | 0.10 d | 0.36 g | 1.25 j | 0.20 f | 0.14 f |
| T₄×Y₂ | 1.13 j | 0.53 i | 0.16 gh | 0.08 h | 0.37 f | 1.52 c | 0.20 f | 0.13 g |
| T₅×Y₁ | 1.32 c | 0.75 a | 0.22 a | 0.14 a | 0.40 d | 1.35 f | 0.24 b | 0.18 a |
| T₅×Y₂ | 1.44 a | 0.74 b | 0.18 cd | 0.09 e | 0.46 a | 1.75 a | 0.28 a | 0.17 c |
| T₆×Y₁ | 1.25 d | 0.69 c | 0.19 b | 0.13 b | 0.38 e | 1.29 h | 0.23 c | 0.18 b |
| T₆×Y₂ | 1.37 b | 0.66 d | 0.17 ef | 0.08 g | 0.44 b | 1.66 b | 0.23 d | 0.15 e |
| T₇×Y₁ | 1.17 i | 0.54 h | 0.16 hi | 0.08 g | 0.32 k | 1.21 l | 0.17 k | 0.11 j |
| T₇×Y₂ | 0.99 n | 0.40 m | 0.14 j | 0.07 i | 0.34 i | 1.37 e | 0.19 i | 0.12 i |
| T₈×Y₁ | 1.20 g | 0.59 g | 0.17 fg | 0.09 f | 0.33 j | 1.23 k | 0.19 h | 0.12 h |
| T₈×Y₂ | 1.04 m | 0.41 l | 0.15 i | 0.07 i | 0.35 h | 1.44 d | 0.20 g | 0.12 i |
| Location (L)×Treatment (T)×Year (Y) | | | | | | | | |
| L₁×T₁×Y₁ | 1.11 n | 0.46 s | 0.11 j | 0.06 j | 0.31 l | 1.19 pq | 0.17 j | 0.07 l |
| L₁×T₁×Y₂ | 0.78 v | 0.21 x | 0.11 j | 0.06 j | 0.27 o | 1.19 pq | 0.15 k | 0.09 j |
| L₁×T₂×Y₁ | 1.23 g | 0.70 e | 0.18 de | 0.11 e | 0.38 f | 1.29 jk | 0.23 d | 0.16 c |
| L₁×T₂×Y₂ | 1.17 j | 0.46 s | 0.17 ef | 0.08 h | 0.42 c | 1.50 e | 0.20 g | 0.13 f |
| L₁×T₃×Y₁ | 1.14 l | 0.54 n | 0.14 hi | 0.07 i | 0.34 j | 1.21 no | 0.18 i | 0.08 k |
| L₁×T₃×Y₂ | 1.00 s | 0.37 w | 0.13 i | 0.07 i | 0.31 l | 1.32 i | 0.18 i | 0.11 h |
| L₁×T₄×Y₁ | 1.23 g | 0.68 g | 0.17 ef | 0.09 g | 0.36 h | 1.28 k | 0.21 f | 0.15 d |
| L₁×T₄×Y₂ | 1.13 m | 0.60 k | 0.16 fg | 0.08 h | 0.37 g | 1.54 d | 0.21 f | 0.14 e |
| L₁×T₅×Y₁ | 1.32 e | 0.81 a | 0.21 ab | 0.13 c | 0.40 d | 1.37 h | 0.27 b | 0.19 a |
| L₁×T₅×Y₂ | 1.45 a | 0.74 c | 0.18 de | 0.09 g | 0.46 a | 1.75 a | 0.28 a | 0.17 b |
| L₁×T₆×Y₁ | 1.25 f | 0.75 b | 0.18 de | 0.12 d | 0.39 e | 1.33 i | 0.25 c | 0.19 a |
| L₁×T₆×Y₂ | 1.39 c | 0.66 h | 0.17 ef | 0.08 h | 0.44 b | 1.67 b | 0.23 d | 0.15 d |
| L₁×T₇×Y₁ | 1.17 j | 0.57 l | 0.15 gh | 0.07 i | 0.35 i | 1.24 m | 0.19 h | 0.11 h |
| L₁×T₇×Y₂ | 1.01 r | 0.40 u | 0.14 hi | 0.07 i | 0.34 j | 1.37 h | 0.19 h | 0.12 g |
| L₁×T₈×Y₁ | 1.21 h | 0.66 h | 0.16 fg | 0.08 h | 0.36 h | 1.26 l | 0.21 f | 0.13 f |
| L₁×T₈×Y₂ | 1.06 p | 0.41 t | 0.15 gh | 0.07 i | 0.35 i | 1.45 f | 0.20 g | 0.12 g |
| L₂×T₁×Y₁ | 1.01 r | 0.47 r | 0.10 j | 0.07 i | 0.25 q | 1.11 t | 0.12 m | 0.07 l |
| L₂×T₁×Y₂ | 0.78 v | 0.56 m | 0.11 j | 0.06 j | 0.27 o | 1.17 rs | 0.14 l | 0.08 k |
| L₂×T₂×Y₁ | 1.23 g | 0.56 m | 0.19 cd | 0.13 c | 0.36 h | 1.24 m | 0.20 g | 0.14 e |
| L₂×T₂×Y₂ | 1.18 i | 0.48 q | 0.16 fg | 0.08 h | 0.42 c | 1.53 d | 0.20 g | 0.13 f |
| L₂×T₃×Y₁ | 1.10 o | 0.37 w | 0.13 i | 0.08 h | 0.26 p | 1.16 s | 0.14 l | 0.08 k |
| L₂×T₃×Y₂ | 0.84 u | 0.54 n | 0.13 i | 0.06 j | 0.31 l | 1.30 j | 0.17 j | 0.10 i |
| L₂×T₄×Y₁ | 1.21 h | 0.46 s | 0.18 de | 0.10 f | 0.35 i | 1.22 n | 0.19 h | 0.12 g |
| L₂×T₄×Y₂ | 1.13 m | 0.69 f | 0.16 fg | 0.07 i | 0.37 g | 1.50 e | 0.19 h | 0.12 g |
| L₂×T₅×Y₁ | 1.32 e | 0.73 d | 0.22 a | 0.15 a | 0.40 d | 1.32 i | 0.21 f | 0.17 b |
| L₂×T₅×Y₂ | 1.42 b | 0.63 j | 0.18 de | 0.09 g | 0.46 a | 1.75 a | 0.27 b | 0.16 c |
| L₂×T₆×Y₁ | 1.25 f | 0.65 i | 0.20 bc | 0.14 b | 0.36 h | 1.25 lm | 0.21 f | 0.16 c |
| L₂×T₆×Y₂ | 1.34 d | 0.50 p | 0.17 ef | 0.08 h | 0.44 b | 1.65 c | 0.22 e | 0.14 e |
| L₂×T₇×Y₁ | 1.16 k | 0.39 v | 0.16 fg | 0.09 g | 0.28 n | 1.18 qr | 0.15 k | 0.10 i |
| L₂×T₇×Y₂ | 0.97 t | 0.51 o | 0.14 hi | 0.07 i | 0.33 k | 1.37 h | 0.18 i | 0.11 h |
| L₂×T₈×Y₁ | 1.18 i | 0.41 t | 0.17 ef | 0.09 g | 0.30 m | 1.20 op | 0.17 j | 0.11 h |
| L₂×T₈×Y₂ | 1.02 q | 0.21 x | 0.15 gh | 0.07 i | 0.34 j | 1.43 g | 0.19 h | 0.11 h |
| L×T | \*\*\* | \*\*\* | \* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* |
| L×Y | \*\*\* | \*\*\* | \*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* |
| T×Y | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* |
| L×T×Y | \*\*\* | \*\*\* | \* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* |

In a column, the same letter(s) indicate statistically similar, and different letter(s) indicate significant differences at the 5% level of probability (p<0.05). \*\*\* = P<0.001, \*\* = P<0.01, \* = P<0.05, ns = Non-significant; L1= BAU field; L2= Farmer’s field; T1= Control; T2= 100% RFD; T3= 75% RFD, T4= 75% N from RFD + 25% N from cow dung (CD); T5= 75% N from RFD + 25% N from poultry manure (PM); T6= 75% N from RFD + 25% N from vermicompost (VC); T7= 75% N from RFD + 25% N from household compost (HC);T8= 75% N from RFD + 25% N from rice straw compost (RSC); Y1= Year 2022; Y2=Year 2023

**Supplementary Table S6.** Statistical analysis for nutrient uptake by the crops

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment combinations** | **Total nutrient uptake (kg/ha) in Wheat** | | | | **Total nutrient uptake (kg/ha) in Mungbean** | | | | | **Total nutrient uptake (kg/ha) in T. Aman rice** | | | |
| **N** | **P** | **K** | **S** | **N** | **P** | **K** | **S** | **N** | | **P** | **K** | **S** |
| L×T | \* | \* | \* | \* | \*\*\* | \*\*\* | \*\* | \*\*\* | \*\* | | \*\*\* | \* | \*\*\* |
| L×Y | \* | \* | \*\* | \*\* | ns | \*\*\* | ns | \*\*\* | \*\*\* | | \*\*\* | \*\*\* | \*\*\* |
| T×Y | \* | \* | \* | \* | \*\*\*\* | \*\*\* | \*\*\* | \*\*\* | \*\*\* | | \*\*\* | \*\*\* | \*\*\* |
| L×T×Y | \* | \* | \* | \* | ns | \*\*\* | ns | \*\* | \*\*\* | | \*\*\* | \* | \*\* |

**Supplementary Table S7.** Variable cost for each treatment

|  |  |
| --- | --- |
| Treatments | System variable cost for each year (Tk/ha) |
|
| T1 | 0.00 |
| T2 | 29337 |
| T3 | 22002.75 |
| T4 | 34002.75 |
| T5 | 31602.75 |
| T6 | 164802.8 |
| T7 | 34167.75 |
| T8 | 26842.75 |

**Supplementary Table S8.** A list of abbreviations used in this study

|  |  |
| --- | --- |
| RFD | Recommended dose of fertilizers |
| CD | Cow dung |
| PM | Poultry Manure |
| VC | Vermicompost |
| RSC | Rice straw compost |
| HC | Household compost |
| SOM | Soil organic matter |
| CEC | Cation exchange capacity |
| IPNS | Integrated Plant Nutrition System |
| CV | Coefficient of variation |
| LOS | Level of significance |

**Supplementary Figure S1.**

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Layout of experimental units