**Table 1.** Energy equivalents (MJ unit-1) used for energy input and output calculations.

|  |  |  |  |
| --- | --- | --- | --- |
| **Particulars** | **Unit** | **Energy equivalent**  **(MJ ha-1)** | **References** |
| 1. **Inputs** | | | |
| 1. Human labour | | | |
| Adult man | hr | 1.96 | Barut *et al.*24, Kumar *et al.*25, Shahin *et al.*26, Yadav *et al.*27 |
| Adult women | hr | 1.57 | Devi *et al.*28 |
| 2. Bullocks | Pair-hr | 10.1 | Binning *et al*.21, Gopalan *et al.*20, Mittal *et al*.19, Singh22 and Subbian *et al.*23 |
| 3. Fuel and machinery | | | |
| Diesel | 1 L | 56.31 | Barut *et al.*24, Kumar *et al.*25, Shahin *et al.*26, Singh *et al.*29, Yadav *et al.*27 |
| Tractor | hr | 62.7 | Singh *et al.*29 |
| 4. Manures and fertilizers | | | |
| Farm Yard Manure | 1 t | 303.1 | Avval Mousavi *et al*.30 |
| Nitrogen | kg | 60.6 | Singh *et al.*29 |
| Phosphorus | kg | 11.1 | Singh *et al.*29 |
| Potassium | kg | 6.7 | Singh *et al.*29 |
| Zinc sulphate | kg | 20.9 | Nassiri and Singh31 |
| 5. Maize seeds | kg | 15.2 | Rahman and Rahman32, Yadav *et al.*27 |
| 6. Insecticide | kg | 120 | Kumar *et al.*25, Shahin *et al.*26, Shahan *et al.*33 |
| 7. Irrigation water | M3 | 1.02 | Devasenapathy *et al.*34 |
| 1. **Outputs** | | | |
| Maize grains | kg | 14.7 | Barut *et al.*24, Kumar *et al.*25, Rahman and Rahman32, Shahin *et al.*26, Yadav *et al.*27, Zahedi *et al.*35 |
| Maize stover | kg | 12.5 | Barut *et al.*24, Kumar *et al.*25, Rahman and Rahman32, Shahin *et al.*26, Yadav *et al.*27 and Zahedi *et al.*35 |

**Table 2: Days to physiological maturity, growing degree days, photo thermal units and heliothermal units of wintermaize as influenced by sowing windows and fertility levels**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Days to physiological maturity** | **Growing degree days (0 C day)** | **Photo thermal units (0 C day hr)** | **Heliothermal units (0 C day hr)** |
| **Factor I: Sowing windows** | |  |  |  |
| W1: 1st week of October | 120.0a | 1530.1a | 17371.3a | 11758.5a |
| W2: 2nd week of October | 116.1ab | 1493.4a | 16578.0b | 11655.0b |
| W3: 3rd week of October | 114.2ab | 1466.9b | 16268.3c | 11597.4c |
| W4: 4th week of October | 112.0bc | 1444.9c | 15966.6d | 11381.6d |
| W5: 1st week of November | 108.9c | 1242.4d | 15416.5e | 11274.0e |
| **S.Em ±** | **1.26** | **2.53** | **19.33** | **12.83** |
| **Factor II: Fertility levels** | |  |  |  |
| F1: 100 % RDF | 110.5b | 1392.7c | 15602.8c | 11149.0c |
| F2: 150% RDF | 114.4a | 1421.0b | 16330.9b | 11373.3b |
| F3: 200% RDF | 118.0a | 1493.5a | 17026.7a | 12077.5a |
| **S.Em ±** | **1.63** | **3.27** | **24.95** | **16.56** |
| **Interaction (W×F)** | |  |  |  |
| W1F1: 1st week of Oct + 100 % RDF | 116.7a-d | 1471.4e | 16838.2d | 11409.2f |
| W1F2: 1st week of Oct + 150 % RDF | 120.5ab | 1527.8c | 17387.3b | 11558.9e |
| W1F3: 1st week of Oct + 200 % RDF | 122.9a | 1591.1a | 17888.3a | 12307.4a |
| W2F1: 2nd week of Oct + 100 % RDF | 111.8b-e | 1444.4f | 15849.2g | 11156.4g |
| W2F2: 2nd week of Oct + 150% RDF | 116.3a-d | 1474.4e | 16550.3e | 11652.6d |
| W2F3: 2nd week of Oct + 200 % RDF | 120.2ab | 1561.3b | 17334.6b | 12155.9b |
| W3F1: 3rd week of Oct + 100 % RDF | 110.4c-e | 1433.4f | 15594.6h | 11351.9f |
| W3F2: 3rd week of Oct + 150 % RDF | 114.2a-e | 1445.0f | 16193.0f | 11365.4f |
| W3F3: 3rd week of Oct + 200 % RDF | 118.2a-c | 1522.4c | 17017.2c | 12074.7b |
| W4F1: 4th week of Oct + 100 % RDF | 108.2de | 1397.8g | 15175.1i | 11012.7h |
| W4F2: 4th week of Oct + 150 % RDF | 112.0b-e | 1440.0f | 15928.3g | 11170.6g |
| W4F3: 4th week of Oct + 200 % RDF | 116.5a-d | 1497.0d | 16796.5d | 11961.3c |
| W5F1: 1st week of Nov + 100 % RDF | 105.3e | 1213.9i | 14556.9j | 10814.6i |
| W5F2: 1st week of Nov + 150 % RDF | 109.2c-e | 1218.0i | 15595.6h | 11119.0g |
| W5F3: 1st week of Nov + 200 % RDF | 112.3b-e | 1295.5h | 16097.0f | 11888.3c |
| **S.Em ±** | **2.82** | **6.67** | **43.21** | **28.6** |

**Table 3: Grain yield, stover yield and harvest index of wintermaize as influenced by sowing windows and fertility levels**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatment** | **Grain yield (q ha-1)** | **Stover yield (q ha-1)** | **Harvest index (%)** |
| **Factor I: Sowing windows** | | | |
| W1: 1st week of October | 87.87a | 122.0a | 41.99a |
| W2: 2nd week of October | 86.44ab | 119.8ab | 41.86a |
| W3: 3rd week of October | 81.33b | 113.2bc | 41.83a |
| W4: 4th week of October | 74.36c | 107.5cd | 41.03a |
| W5: 1st week of November | 67.32d | 103.3d | 39.54a |
| **S.Em ±** | **1.54** | **2.09** | **0.62** |
| **Factor II: Fertility levels** | | | |
| F1: 100 % RDF | 74.97b | 105.9b | 41.34a |
| F2: 150% RDF | 80.22a | 114.1a | 41.34a |
| F3: 200% RDF | 83.20a | 119.5a | 41.06a |
| **S.Em ±** | **1.99** | **2.69** | **0.80** |
| **Interaction (W×F)** | | | |
| W1F1: 1st week of Oct + 100 % RDF | 84.03a-c | 112.8b-g | 42.86a |
| W1F2: 1st week of Oct + 150 % RDF | 88.14ab | 122.7a-c | 41.83a |
| W1F3: 1st week of Oct + 200 % RDF | 91.42a | 130.5a | 41.26a |
| W2F1: 2nd week of Oct + 100 % RDF | 81.41a-d | 110.0c-g | 42.23a |
| W2F2: 2nd week of Oct + 150% RDF | 87.83ab | 121.7a-d | 41.93a |
| W2F3: 2nd week of Oct + 200 % RDF | 90.07ab | 127.8ab | 41.40a |
| W3F1: 3rd week of Oct + 100 % RDF | 78.59b-e | 106.9d-g | 42.33a |
| W3F2: 3rd week of Oct + 150 % RDF | 82.17a-d | 114.8b-f | 41.76a |
| W3F3: 3rd week of Oct + 200 % RDF | 83.21a-c | 118.0a-e | 41.40a |
| W4F1: 4th week of Oct + 100 % RDF | 69.13ef | 101.9fg | 40.53a |
| W4F2: 4th week of Oct + 150 % RDF | 74.44c-e | 107.8c-g | 41.23a |
| W4F3: 4th week of Oct + 200 % RDF | 79.48b-e | 112.9b-g | 41.33a |
| W5F1: 1st week of Nov + 100 % RDF | 61.64f | 97.8g | 38.76a |
| W5F2: 1st week of Nov + 150 % RDF | 68.50ef | 103.8e-g | 39.96a |
| W5F3: 1st week of Nov + 200 % RDF | 71.80d-f | 108.4c-g | 39.9a |
| **S.Em ±** | **3.45** | **4.66** | **1.37** |

Highest values were denoted with ‘a’ followed by the next alphabets for lower values (b, c, d *etc*.). Value denoted by same small letter in the column does not differ significantly at 0.05 level of significance.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **AEN (kg kg-1)** | **AEP (kg kg-1)** | **AEK (kg kg-1)** | **PEN (kg ha-1)** | **PEP (kg ha-1)** | **PEK (kg ha-1)** | **REN (%)** | **REP (%)** | **REK (%)** |
| **Factor I: Sowing windows** | | | | | | | | | |
| W1: 1st week of October | 22.80a | 52.63a | 52.63a | 49.01ab | 184.24a | 68.57a | 47.92a | 29.32a | 78.99a |
| W2: 2nd week of October | 21.80a | 48.72ab | 48.72ab | 47.94b | 181.72a | 68.65a | 44.36a | 27.70a | 73.04ab |
| W3: 3rd week of October | 19.80a | 45.69b | 45.69b | 48.37b | 184.45a | 66.42a | 41.59a | 26.19a | 69.09b |
| W4: 4th week of October | 16.14b | 37.25c | 37.25c | 48.74ab | 194.31a | 69.50a | 33.92b | 21.97b | 56.01c |
| W5: 1st week of November | 12.74c | 29.40d | 29.40d | 53.80a | 209.01a | 69.58a | 26.78c | 18.04c | 44.04d |
| **S.Em ±** | **0.75** | **1.74** | **1.74** | **1.31** | **17.76** | **4.28** | **1.70** | **0.81** | **1.98** |
| **Factor II: Fertility levels** | | | | | | | | | |
| F1: 100 % RDF | 23.41a | 53.93a | 53.93a | 50.67a | 196.68a | 69.65a | 49.12a | 31.52a | 81.23a |
| F2: 150% RDF | 18.03b | 41.06b | 41.06b | 49.73a | 187.26a | 68.28a | 37.39b | 23.48b | 61.65b |
| F3: 200% RDF | 14.51c | 33.19c | 33.19c | 48.32a | 188.29a | 67.69a | 30.23c | 18.91c | 49.82c |
| **S.Em ±** | **0.97** | **2.25** | **2.25** | **1.69** | **22.93** | **5.53** | **2.20** | **1.04** | **2.56** |
| **Interaction (W×F)** | | | | | | | | | |
| W1F1: 1st week of Oct + 100 % RDF | 29.59a | 68.29a | 68.29a | 47.54b | 185.96a | 66.47a | 62.19a | 38.43a | 102.52a |
| W1F2: 1st week of Oct + 150 % RDF | 21.55bc | 49.74bc | 49.74bc | 49.54b | 185.99a | 72.13a | 45.29bc | 27.28b | 74.66b |
| W1F3: 1st week of Oct + 200 % RDF | 17.26c-f | 39.83c-f | 39.83c-f | 49.95b | 180.76a | 67.10a | 36.27c-f | 22.22b-e | 59.79c-e |
| W2F1: 2nd week of Oct + 100 % RDF | 27.17a | 62.20a | 62.20a | 47.55b | 174.68a | 70.35a | 56.64ab | 35.73a | 93.13a |
| W2F2: 2nd week of Oct + 150% RDF | 21.41bc | 46.68cd | 46.68cd | 48.66b | 184.99a | 66.97a | 42.51cd | 26.43bc | 70.08bc |
| W2F3: 2nd week of Oct + 200 % RDF | 16.81c-f | 37.25c-g | 37.25c-g | 47.61b | 185.48a | 68.63a | 33.92c-g | 20.93c-e | 55.92c-f |
| W3F1: 3rd week of Oct + 100 % RDF | 25.96ab | 59.92ab | 59.92ab | 49.71b | 190.37a | 65.86a | 54.57ab | 34.58a | 91.49a |
| W3F2: 3rd week of Oct + 150 % RDF | 18.90c-e | 43.62c-e | 43.62c-e | 47.89b | 176.39a | 66.52a | 39.67c-e | 24.89b-d | 65.47b-d |
| W3F3: 3rd week of Oct + 200 % RDF | 14.52d-g | 33.51e-g | 33.51e-g | 47.51b | 186.58a | 66.88a | 30.52d-g | 19.09d-f | 50.30e-g |
| W4F1: 4th week of Oct + 100 % RDF | 19.67cd | 45.41c-e | 45.41c-e | 49.04b | 166.28a | 72.02a | 41.35cd | 27.33b | 68.18bc |
| W4F2: 4th week of Oct + 150 % RDF | 15.46d-g | 35.69d-g | 35.69d-g | 49.33b | 215.34a | 69.45a | 32.50d-g | 20.92c-e | 53.57d-f |
| W4F3: 4th week of Oct + 200 % RDF | 13.28e-g | 30.64fg | 30.64fg | 47.83b | 201.29a | 67.01a | 27.90e-g | 17.63ef | 46.27e-g |
| W5F1: 1st week of Nov + 100 % RDF | 14.66d-g | 33.85d-g | 33.85d-g | 59.50a | 266.11a | 73.57a | 30.84d-g | 21.54b-e | 50.84e-g |
| W5F2: 1st week of Nov + 150 % RDF | 12.87fg | 29.60fg | 29.60fg | 53.22ab | 173.58a | 66.32a | 26.96fg | 17.88ef | 44.45fg |
| W5F3: 1st week of Nov + 200 % RDF | 10.72g | 24.73g | 24.73g | 48.68b | 187.33a | 68.84a | 22.53g | 14.68f | 36.82g |
| **S.Em ±** | **1.68** | **3.89** | **3.89** | **2.92** | **39.71** | **9.57** | **3.80** | **1.80** | **4.43** |

**Table 4: Nutrient use efficiency of nitrogen, phosphorus and potassium as influenced by sowing windows and fertility levels**

**Table 5: Energetics of winter maize as influenced by sowing windows and fertility levels**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Input energy (MJ ha-1)** | **Output energy (MJ ha-1)** | **Net energy (MJ ha-1)** | **Energy use efficiency** | **Energy productivity  (kg MJ-1)** | **Specific energy (MJ kg-1)** |
| **Factor I: Sowing windows** | | | | | | |
| W1: 1st week of October | 23141.7 | 281233.7a | 258121.4a | 12.40a | 0.39a | 2.62c |
| W2: 2nd week of October | 23141.7 | 276831.5a | 253719.2a | 12.19ab | 0.38ab | 2.65c |
| W3: 3rd week of October | 23147.6 | 260631.8b | 237519.5b | 11.72b | 0.36b | 2.85c |
| W4: 4th week of October | 23153.5 | 243285.6c | 220173.3c | 10.72c | 0.33c | 3.12b |
| W5: 1st week of November | 23153.5 | 227703.2d | 204085.9d | 10.03d | 0.30d | 3.43a |
| **S.Em ±** | - | 3552.1 | 3551.66 | 0.16 | 0.01 | 0.06 |
| **Factor II: Fertility levels** | | | | | | |
| F1: 100 % RDF | 18602.6 | 242543.1c | 223672.8b | 13.06a | 0.40a | 2.51c |
| F2: 150% RDF | 23147.6 | 259575.7b | 236463.4a | 11.23b | 0.34b | 2.92b |
| F3: 200% RDF | 27692.6 | 271692.2a | 244035.4a | 9.94c | 0.29c | 3.36a |
| **S.Em ±** | - | 4585.7 | 4585.1 | 0.21 | 0.01 | 0.08 |
| **Interaction (W×F)** | | | | | | |
| W1F1: 1st week of Oct + 100 % RDF | 18596.7 | 264510.1c-e | 245942.8a-c | 14.24a | 0.45a | 2.21h |
| W1F2: 1st week of Oct + 150 % RDF | 23141.6 | 281676.0a-c | 258563.8ab | 12.18b | 0.38bc | 2.62e-h |
| W1F3: 1st week of Oct + 200 % RDF | 27686.7 | 297515.0a | 269857.8a | 10.76cd | 0.32ef | 3.03c-e |
| W2F1: 2nd week of Oct + 100 % RDF | 18596.7 | 257193.0c-e | 238625.7b-d | 13.85a | 0.44a | 2.28gh |
| W2F2: 2nd week of Oct + 150% RDF | 23141.6 | 281176.0a-c | 258063.7ab | 12.17b | 0.38bc | 2.64e-h |
| W2F3: 2nd week of Oct + 200 % RDF | 27686.7 | 292125.6ab | 264468.4ab | 10.56cd | 0.32ef | 3.03c-e |
| W3F1: 3rd week of Oct + 100 % RDF | 18602.6 | 249111.3d-f | 230544.0c-e | 13.41a | 0.42ab | 2.38f-h |
| W3F2: 3rd week of Oct + 150 % RDF | 23147.6 | 262982.0c-e | 239869.7bc | 11.38bc | 0.35c-e | 2.82d-f |
| W3F3: 3rd week of Oct + 200 % RDF | 27692.6 | 269802.0b-d | 242144.8bc | 10.36c-e | 0.30fg | 3.35bc |
| W4F1: 4th week of Oct + 100 % RDF | 18608.5 | 228993.6fg | 210426.3ef | 12.33b | 0.37cd | 2.70d-g |
| W4F2: 4th week of Oct + 150 % RDF | 23153.5 | 242888.5ef | 219776.2c-e | 10.51cd | 0.32ef | 3.11b-d |
| W4F3: 4th week of Oct + 200 % RDF | 27698.5 | 257974.8c-e | 230317.5c-e | 9.32ef | 0.28fg | 3.53ab |
| W5F1: 1st week of Nov + 100 % RDF | 18608.5 | 212907.3g | 192825.1f | 11.46bc | 0.33d-f | 3.02c-e |
| W5F2: 1st week of Nov + 150 % RDF | 23153.5 | 229156.2fg | 206044.0ef | 9.91de | 0.29fg | 3.40bc |
| W5F3: 1st week of Nov + 200 % RDF | 27698.5 | 241046.0ef | 213388.7d- f | 8.71f | 0.26g | 3.85a |
| **S.Em ±** | - | 7942.7 | 7941.8 | 0.37 | 0.01 | 0.14 |

**Table 6: Economics of winter maize as influenced by sowing windows and fertility levels**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Cost of cultivation (USD ha-1)** | **Gross return**  **(USD ha-1)** | **Net return (USD ha-1)** | **B-C ratio** |
| **Factor I: Sowing windows** | | | | |
| W1: 1st week of October | 922 | 2331a | 1409a | 2.53a |
| W2: 2nd week of October | 922 | 2293ab | 1371a | 2.49a |
| W3: 3rd week of October | 935 | 2158b | 1223b | 2.31b |
| W4: 4th week of October | 948 | 1977c | 1030c | 2.09c |
| W5: 1st week of November | 948 | 1795d | 848d | 1.89d |
| **S.Em ±** | - | 38.9 | 38.9 | 0.04 |
| **Factor II: Fertility levels** | | | | |
| F1: 100 % RDF | 889 | 1991b | 1102b | 2.24a |
| F2: 150% RDF | 935 | 2130a | 1196ab | 2.28a |
| F3: 200% RDF | 980 | 2211a | 1231a | 2.26a |
| **S.Em ±** | - | 50.3 | 50.3 | 0.05 |
| **Interaction (W×F)** | | | | |
| W1F1: 1st week of Oct + 100 % RDF | 876 | 2226a-d | 1350ab | 2.54a |
| W1F2: 1st week of Oct + 150 % RDF | 922 | 2338a-c | 1416a | 2.55a |
| W1F3: 1st week of Oct + 200 % RDF | 968 | 2429a | 1462a | 2.51a |
| W2F1: 2nd week of Oct + 100 % RDF | 876 | 2157a-e | 1281a-c | 2.46a |
| W2F2: 2nd week of Oct + 150% RDF | 922 | 2330a-c | 1408a | 2.53a |
| W2F3: 2nd week of Oct + 200 % RDF | 968 | 2392ab | 1425a | 2.47a |
| W3F1: 3rd week of Oct + 100 % RDF | 889 | 2083c-g | 1194a-d | 2.34ab |
| W3F2: 3rd week of Oct + 150 % RDF | 935 | 2180a-e | 1245a-c | 2.33a-c |
| W3F3:3rd week of Oct + 200 % RDF | 980 | 2210a-d | 1230a-c | 2.25a-c |
| W4F1: 4th week of Oct + 100 % RDF | 902 | 1841f-h | 940d-f | 2.04c-e |
| W4F2: 4th week of Oct + 150 % RDF | 948 | 1978d-g | 1031c-e | 2.09b-e |
| W4F3: 4th week of Oct + 200 % RDF | 993 | 2111b-f | 1118b-e | 2.12b-d |
| W5F1: 1st week of Nov + 100 % RDF | 902 | 1648h | 746f | 1.83e |
| W5F2: 1st week of Nov + 150 % RDF | 948 | 1825gh | 878ef | 1.93de |
| W5F3: 1st week of Nov + 200 % RDF | 993 | 1914e-h | 920d-f | 1.93de |
| **S.Em ±** | - | 87.1 | 87.1 | 0.10 |

Highest values were denoted with ‘a’ followed by the next alphabets for lower values (b, c, d *etc*.). Value denoted by same small letter in the column does not differ significantly at 0.05 level of significance. (1 USD = 70 INR)