**Supplementary**

**Supplementary Table 1.** L9 ($3^4$).

| Numerical order | Factors | | | |
|---|---|---|---|---|
| | plastic covering method (A) | Drip irrigation pipe density (B) | Lower limit of irrigation (C) | |
| | Levels | | | |
| 1 | F (1) | $T_1$ (1) | $L_{60}$ (1) | 1 |
| 2 | F (1) | $T_{3/4}$ (2) | $L_{70}$ (2) | 2 |
| 3 | F (1) | $T_{1/2}$ (3) | $L_{80}$ (3) | 3 |
| 4 | H (2) | $T_1$ (1) | $L_{70}$ (2) | 3 |
| 5 | H (2) | $T_{3/4}$ (2) | $L_{80}$ (3) | 1 |
| 6 | H (2) | $T_{1/2}$ (3) | $L_{60}$ (1) | 2 |
| 7 | N (3) | $T_1$ (1) | $L_{80}$ (3) | 2 |
| 8 | N (3) | $T_{3/4}$ (2) | $L_{60}$ (1) | 3 |
| 9 | N (3) | $T_{1/2}$ (3) | $L_{70}$ (2) | 1 |

Note: L9 ($3^4$) includes up to four experimental factors. In this study, we included three factors: plastic covering method (A), Drip irrigation pipe density (B) and Lower limit of irrigation (C). Plastic covering method includes three levels of full, half and no plastic plastic covering, i.e. F, H and N. Drip irrigation pipe density includes three levels of one pipe for one row ($T_1$), three pipes for four rows ($T_{3/4}$) and one pipe for two rows ($T_{1/2}$). Lower limit of irrigation includes three levels of 60%, 70% and 80% field water capacity, i.e. $L_{60}$, $L_{70}$ and $L_{80}$. F (1), F means the plastic covering method level of F, and (1) is the number in the L9 ($3^4$).

**Supplementary Table 2.** Irrigation amount and water use efficiency.

| Factors | P | | | T | | | L | | |
|---|---|---|---|---|---|---|---|---|---|
| | F | H | N | $T_1$ | $T_{3/4}$ | $T_{1/2}$ | $L_{60}$ | $L_{70}$ | $L_{80}$ |
| Irrigation amount (mm) | 92.51c | 100.41b | 121.51a | 102.38a | 107.36a | 104.7a | 58.03c | 100.66b | 155.74a |
| Irrigation water use efficiency ($kg \cdot m^{-3}$) | 31.52a | 31.36a | 20.05b | 26.48b | 27.42a | 27.28a | 42.80a | 30.25b | 19.09c |

Note: P is plastic covering method (full, half and no plastic plastic covering, i.e. F, H and N); T is drip irrigation pipe density (one pipe for one row ($T_1$), three pipes for four rows ($T_{3/4}$) and one pipe for two rows ($T_{1/2}$)); L is and lower limit of irrigation (60%, 70% and 80% field capacity, i.e. $L_{60}$, $L_{70}$ and $L_{80}$). The different lowercase letters show significant difference ($p < 0.05$) in different level of the same factor.

**Supplementary Table 3.** Effect of plastic covering method, drip irrigation pipe density and lower limit of irrigation on transpiration rate ($T_r$) (μmol$CO_2$·$m^{-2}$·$s^{-1}$) and intercellular $CO_2$ concentration ($C_i$) (μmol·$mol^{-1}$).

| | Growth periods | | Single experimental factors | | |
|---|---|---|---|---|---|
| | | P* | F:7.19c | H:8.99b | N:11.32a |
| | Flowering period (FP) | T* | $T_1$:10.69a | $T_{3/4}$:8.46b | $T_{1/2}$:8.35b |
| | | L* | $L_{60}$:13.27a | $L_{70}$:7.34b | $L_{80}$:6.90b |
| | | $P^{ns}$ | F:23.52a | H:24.71a | N:23.87a |
| *Tr* | Fruit swelling period (FSP) | T* | $T_1$:24.73a | $T_{3/4}$:21.93b | $T_{1/2}$:25.20a |
| | | L* | $L_{60}$:22.04b | $L_{70}$:25.17a | $L_{80}$:24.60a |
| | | P* | F:23.52b | H:25.25a | N:23.16b |
| | Mature period (MP) | $T^{ns}$ | $T_1$:24.32a | $T_{3/4}$:23.88a | $T_{1/2}$:23.20a |
| | | L* | $L_{60}$:23.97b | $L_{70}$:24.98a | $L_{80}$:22.46c |
| | | P* | F:268.15b | H:236.16c | N:279.23a |
| | Flowering period (FP) | T* | $T_1$:234.83a | $T_{3/4}$:254.90b | $T_{1/2}$:293.80a |
| | | L* | $L_{60}$:263.96b | $L_{70}$:244.30c | $L_{80}$:275.28a |
| | | $P^{ns}$ | F:182.09a | H:185.13a | N:188.46a |
| *Ci* | Fruit swelling period (FSP) | T* | $T_1$:197.46a | $T_{3/4}$:194.27a | $T_{1/2}$:162.44b |
| | | L* | $L_{60}$:208.77a | $L_{70}$:187.67b | $L_{80}$:158.96c |
| | | P* | F:261.77a | H:225.01b | N:254.55a |
| | Mature period (MP) | T* | $T_1$:232.51b | $T_{3/4}$:255.59a | $T_{1/2}$:261.11a |
| | | L* | $L_{60}$:232.64c | $L_{70}$:243.47b | $L_{80}$:268.39a |

Note: After comprehensive analysis, the effect of plastic covering method on *Tr* was N = H > F. The effect of drip irrigation pipe density on *Tr* was $T_1$ > $T_{1/2}$ > $T_{3/4}$. And, the effect of lower limit of irrigation on *Tr* was $L_{70}$ > $L_{80}$ > $L_{60}$. H, $T_{1/2}$ and $L_{80}$ could form the best combination for increasing $G_s$, and the second combination was H, $T_{3/4}$ and $L_{80}$.

**Supplementary Table 4.** Nitrogen uptake of different organs of muskmelon (g·$kg^{-1}$).

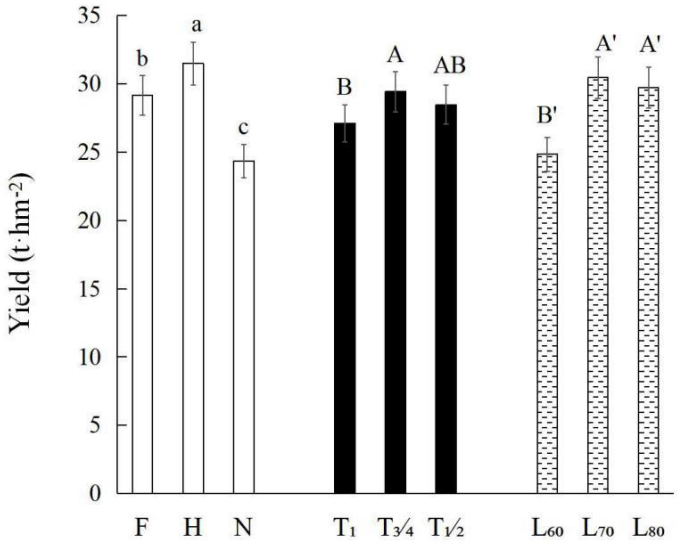
| Factors | P | | | T | | | L | | |
|---|---|---|---|---|---|---|---|---|---|
| | F | H | N | $T_1$ | $T_{3/4}$ | $T_{1/2}$ | $L_{60}$ | $L_{70}$ | $L_{80}$ |
| Nitrogen of stem | 22.51b | 26.3a | 19.51c | 25.21b | 27.10a | 27.81a | 21.07b | 27.66a | 27.74a |
| Nitrogen of leaf | 26.52b | 31.24a | 24.05c | 28.08b | 27.42b | 30.12a | 24.68c | 33.22a | 30.09b |
| Nitrogen of fruit | 16.07b | 18.52a | 14.11c | 15.21a | 15.89a | 16.31a | 12.73b | 17.25a | 16.92a |

Note: The different lowercase letters show significant difference ($p < 0.05$) in different level of the same factor.

**Supplementary Table 5.** Correlation analysis of biomass and yield.

| | Yield | Fruit fresh biomass | Root fresh biomass | Total biomass |
|---|---|---|---|---|
| Yield | 1 | 0.98** | 0.48** | 0.87** |
| Fruit fresh biomass | | 1 | 0.51** | 0.86** |
| Root fresh biomass | | | 1 | 0.75** |
| Total biomass | | | | 1 |

Note: ** stands for extremely significant correlation. *Pn* is net photosynthetic rate.




**Supplementary Figure 1.** Influence of experimental factor on muskmelon yield. **Note:** a (b, c), a′ (b′, c′) and A′ (B′, C′) mean the significant difference ($P < 0.05$) of the effect of plastic covering method, drip irrigation pipe density and lower limit of irrigation on muskmelon yield, respectively.