# Effect of climate smart nitrogen and water management approaches on growth and yield of sweet corn

## ABSTRACT

A field experiment was carried out for two consecutive years during 2020-21 and 2021-22 in the research farm of OUAT, Bhubaneswar. The experiment was conducted in a strip plot design having four each of climate smart water and nutrient management approaches replicated four times. All the growth attributes like plant height, LAI, dry matter production as well as the yield attributing characters were superior under EFI with mulch and INM treatments in water and nitrogen management approaches, respectively. Optimal irrigation practice *i.e*. each furrow irrigation (EFI) with mulch in sweet corn resulted in higher cob yield (27.64 t/ha) followed by EFI alone. Similarly, INM practices comprising of 75% STBNR + 25% N through FYM produced higher cob yield (30.91 t/ha) as compared to other N-management options and was closely followed by STBNR.

*Key words:* EFI, AFI, BBF, RTNM, STBNR, INM, LAI

## 1. INTRODUCTION

Climate change poses an existential threat on agriculture. Fertilization effect of increased $CO_2$ concentration due to climate change is negated by corresponding increase in ambient atmospheric temperature which differs from plant to plant. Maize a $C_4$ plant due to its kranz anatomy and dimorphic chloroplast can adapt better to changing climate.The crop in Odisha is grown in about 254.14 thousand hectares with production of 733.41 thousand tonnes and productivity of 2886 kg/ha (Odisha Agricultural Statistics, 2020). Being a commercial crop and for its high consumer preference, sweet corn fetches high net returns to the farmers and thereby gaining importance among the farming community in recent years. The higher productivity of sweet corn is closely related with the nutrient and water management strategy. Sweet corn is an exhaustive crop like normal maize crop and removes greater amount of plant nutrients from soil after harvest. It requires to replenish such nutrients to soil in an integrated manner for sustaining crop production. Again under the climate change scenario, use of real time nutrient management (RTNM) option is a way to enhance the use efficiency by maintaining the soil health. The judicious application of nitrogenous fertilizer in conjunction with organic manures from different sources is the most feasible option to increase the crop and soil productivity, maintain the environment sustainability and improve the economic stability of farmers (Wailare 2014). Water, too much of it and especially not enough of it, embodies the climate threat to maize production. There is need for sustainable irrigation method particularly in the areas where water resources are limited. Generally, water-deficit stress reduces nitrogen availability and hasten leaf senescence, decreasing the leaf expansion as well as leaf area, and duration of grain filling (Brevedan and Egli, 2003). Under this situation mulching and alternate furrow irrigation could be a good substitute means of irrigation to save soil moisture.The judicious use of nutrients in suitable combination of organic and inorganic sources (INM) as well as water saving approaches like broad bed and furrow (BBF) method, alternate furrow irrigation (AFI), mulching are beneficial to achieve the higher yield with increasing the use efficiency and maintain soil heath under changing climatic condition.

## 2. MATERIALS AND METHODS

A field experiment was carried out for two consecutive years during 2020-21 and 2021-22 in the research farm of OUAT, Bhubaneswar ($20^0$15'N latitude, $85^0$52'E longitude with an elevation of 25.9 m above MSL). The climate of Bhubaneswar is characterized by hot, moist and sub-humid with hot summer and mild winter. The temperature during the growing period ranges between 18.2 to 33.6ºCand 18.3 to 30.7 ºCfor the year 2020-21and 2021-22, respectively. The crop received total amount of 7.5 and 70.2 mm rainfall during the year 2020-21 and 2021-22, respectively. The soil of the experimental site was sandy loam in texture.

The experiment was carried out in a strip plot design having 16 treatments and 4 replications. The nitrogen management approaches areorganics ($N_1$), INM ($N_2$), STBNR ($N_3$) and RTNM ($N_4$), respectively. The organic treatment (N1) composed of 1/3rd N each by FYM, NOC (Neem oil cake) and PM (Poultry manure). Similarly, INM (N2) treatment comprised of 75% N through STBNR + 25% N through FYM. All the organic manures were applied in line at sowing. The state recommended dose of fertilizers for hybrid maize was 120-60-60 kg $N-P_2O_5-K_2O$/ha. As nitrogen status of the soil was low, keeping 25% extra N dose, the STBFR for maize crop was 150-60-60 kg $N-P_2O_5-K_2O$/ha. The inorganic fertilizers were applied in three splits i.e., 25%N, all P and 50% K as basal; 50% N and50% K at three week stage and rest 25% N at six week stage under STBNR and INM treatments. In Real Time Nitrogen Management (RTNM) approach Nitrogen was applied based on the SPAD value of 42 @ 20 kg N/ha each time.

Similarly, four water management approaches in sweet corn are. W1:Each furrow irrigation (EFI), W2: Each furrow irrigation with mulching, W3: Alternate furrow irrigation (AFI) and W4: Broad bed and furrow (BBF). Two common irrigations were given one after sowing for germination and another at 21 DAS following intercultural operation, first topdressing, earthing up and mulching. Differential irrigations were imposed thereafter as per the treatments.Under every furrow irrigation (EFI), irrigation was applied to each furrow up to 2/3rd height of the ridge. While for Every furrow irrigation with mulching (EFI with mulch), mulches (rice straw) were applied manually on furrows 21 days after sowing following earthing up. Irrigation was given to each furrow covered with straw mulch. In case of alternate furrow irrigation (AFI), only selective irrigation of every other furrow was done, *i.e*., each row of plants received water only on one side each time. Odd furrows (1, 3, 5, *etc*) were irrigated in the first irrigation followed by the even furrows (2, 4, 6, *etc*) in the next and so on. For broad bed and furrow (BBF) method, beds of 1.0 m and 15 cm height were prepared and channels of 25 cm width were provided between two beds for irrigation/drainage. Each plot under BBF accommodated 3beds. Treated seeds (var. sugar75) with vitavax powder were sown at a spacing of 50 cm x 20 cm using seed rate of 8 kg/ha. Gap filling was done at 5-7 DAS to ensure uniform plant population.

Biometric observations were on randomly selected and peg marked five sample plants at 20, 40, 60 DAS and harvest. Destructive samples for determining dry matter accumulation were taken from second row. The length of five cobs selected from each plot at harvest for recording fresh cob weight was measured from base to tip of the cob and the mean value was expressed in cm. The circumference of the same five cobs was measured at the middle of the cob using thread and averaged to express the girth in cm. Kernels from five dehusked cob were counted after separation from cob and the average values were obtained. Cobs were separately harvested from the plants leaving the border area of 0.5 m from each end and two rows (1 border +1 for destructive sampling) from each side. Fresh cob and green fodder yields from the net plot were recorded.

Data collected on various characters of sweet corn, were analyzed statistically by following standard analysis of variance technique (ANOVA) for strip-plot design (Gomez and Gomez, 1984).The treatment variations were tested for significance by ‘F’ test. The standard error of mean SE (m)± and critical difference (CD) at 5% probability level were calculated to interpret the results.

**Table 1. Initial soil physico-chemical characteristics of the experimental site**

| Particular | Value | Method employed |
|---|---|---|
| I. Mechanical composition of the soil (%) | | |
| Sand | 75.2 | Bouyoucos Hydrometer Method (Piper, 1950) |
| Silt | 11.5 | |
| Clay | 13.3 | |
| Textural class | Sandy loam | |
| II. Physical characteristic | | |
| Bulk density (Mg/m$^3$) | 1.31 | Core method (Black, 1965) |
| III. Chemical properties | | |
| pH ((1:2.5:: soil:water)) | 6.1 | Glass electrode pH meter (Jackson, 1973) |
| EC (dS/m) at 25$^{o}$C | 0.51 | Digital Electrical Conductivity meter (Jackson, 1973) |
| Organic carbon (%) | 0.39 | Modified Walkley and Black (Jackson, 1973) |
| Available N (kg/ha) | 183.1 (Low) | Alkaline potassium permanganate (Subbiah and Asija, 1956) |
| Available P (kg/ha) | 11.8 (Medium) | Bray’s method (Jackson, 1973) |
| Available K (kg/ha) | 181.0 (Medium) | Ammonium acetate extraction method (Jackson, 1973) |

## 3. RESULTS AND DISCUSSION

### 3.1 PLANT HEIGHT

Plant height was significantly affected by both nitrogen and irrigation management practices (Table 2)**.**The average plant height at 20, 40, 60 DAS and at harvest were 34, 96.7, 173.7 and 186.6 cm, respectively. Under different water management options, EFI with mulching (W2) registered the highest plant height at all the stages (36.1, 186.0 and 200.0 cm at 20, 60 DAS and at harvest, respectively). During all the growth stages, plant height was lowest under AFI treated plot and being at par with BBF method.Significantly higher plant height under EFI with mulching might be attributed to the greater soil moisture content in the root zone, which leads to optimal growth conditions. Thider *et al*. (2020) and (Abebe *et al*., 2020)also reported that the different mulching conditions along with conventional furrow irrigation had a substantial impact on plant growth parameters of the maize crop than AFI. Conventional furrow irrigation method along with wheat straw mulching leads to the highest plant height of maize followed by alternate furrow.

Among the different nitrogen management approaches, INM treated plots exhibitedtaller plantsat all the stages (39.0, 110.2, 207.1 and 222.3 cm at 20, 40, 60 DAS and at harvest, respectively) and was followed by STBNR and RTNM treated plots. The plants were the shortest in organic treatments (*i.e.* 1/3rd N each through FYM, PM and NOC). Taller plant height under INM treatment might be due to slow and continuously nutrient supply by NPK and organic matter *i.e.* FYM throughout the period of crop growth. Nutrients were responsible for increased cell division, cell enlargement, growth, and photosynthesis which are being the reason for quantitative increase in plant growth. The results of present study are in agreement with the findings of Lahay *et al*. (2019), Raman and Suganya (2018) who reported that plant growth was significantly increased by the combination of 100% RDF and presumed compost @ 5 t/ha as compared to other treatments.

## 3.2 LEAF AREA INDEX

Leaf area index increased progressively up to 60 DAS in both the years and decreased towards maturity (Table 3.). Amongst the different water management practices, EFI with mulch recorded significantly higher LAI at all the growth stages (1.41, 4.02, 6.22 and 4.43 at 20, 40, 60 DAS and at harvest, respectively) and followed by EFI, BBF, AFI in sequence. The rice straw mulch reported to greatly improve the soil moisture at the depth of 0-40 cm there by helps in better uptake of nutrients which contributed for increased leaf area (Deng *et al*., 2006). The results are in line with (Yaseen *et al*., 2014) who reported that, leaf area and plant height weresignificantly affected by the mulching treatments.

The INM treatment recorded higher LAI of 1.47, 4.35, 6.74 and 4.78 at 20, 40, 60 and at harvest, respectively, closely followed by STBNR (1.46, 4.28, 4.76 and 4.69 at 20, 40, 60 DAS and at harvest, respectively). As compared to STBNR, application of nitrogen based on SPAD values (RTNM) resulted in lower LAI at all the stages while it was significantly higher than organic treatment.The higher LAI under INMmight be due to integrated application of inorganic and organic manure which resulted in better uptake of nutrients during the growth stages leading to rapid cell division as well as elongation. Similar results were obtained by Dharaiya *et al*. (2018).

## 3.3 DRY MATTER PRODUCTION

Dry matter production has followed an increasing trend throughout the crop growth period with the average of 16.8, 72.8, 126.1 and 176.8 34.8 g/plant at 20, 40, 60 DAS and at harvest, respectively (Table 4). Amongst the water management approaches, EFI with mulch (W2) produced significantly higher dry matter of 19.0, 82.1, 134.2 and 190.5 g/plant at 20, 40, 60 DAS and at harvest, respectively, which was at par with W1 but 29.2, 28.2, 14.9 and 16.0 per cent higher than W3 as well as 22.5, 25.5, 11.5 and 14.0 per cent higher than W4 at respective stages. The higher dry matter production might be due to increased root proliferation, higher content of chlorophyll associated with better nitrogen uptake as well as adequate and appropriate moisture under each furrow irrigation (Singh *et al*., 2015).

Dry matter production was significantly higher under INM practice (19.0, 85.1, 146.8 and 209.4 g/plant at 20, 40, 60 DAS and at harvest, respectively) and it was on par with STBNR. Application of fertilizer based on the SPAD values resulted in lower dry matter production as compared to INM and STBNR while it was significantly higher than organic practice. The proper utilization of NPK along with FYM by the plant might be ascribed to increased carbohydrate production. These results are in agreement with those of Bisht *et al*. (2015).

## 3.4 YIELD ATTRIBUTES

### 3.4.1 Kernels per row

Each furrow irrigation with mulch resulted in significantly higher number of kernels/row closely followed by STBNR. But, the water deficit practices like AFI and BBF reduced kernel/row to 32 and 33, respectively. In source-sink relationships, water deficit markedly reduced the flow of assimilates from source to sink (Li et al., 2018). The limited sucrose levels under water stress decrease the number of endosperm cells and starch granules, thereby, reducing sink capacity (Ober *et al*., 1991; Setter and Flanningan, 2001).

Combined application of 75 % N through STBNR and 25 % N through FYM resulted in significantly higher number of kernels/ row (39.6) and was at par with STBNR (38.9). This might be due to the combined application of organic and inorganic nutrient sources which improved synergism and synchronization between nutrient release and plant recovery thus resulted in better crop growth and yield attributes (Huang *et al.,* 2010).

### 3.4.2 Cob length and cob girth

The lengthiest (19.7) and shortest (17.4 cm) cob were recorded under EFI with mulch and AFI method. Again, each furrow irrigation with mulching resulted in significantly higher cob girth (17.3 cm) and was followed by EFI, BBF and AFI in a sequence. The increase in cob length as well as in girth under each furrow irrigation with straw mulch could be due to high availability of soil moisture to the crop that allowed the plants to accumulate more biomass with higher capacity to convert more photosynthesis into sink resulting in higher cob length and girth in conformity with Jehan *et al*. (2007) and Ali and Raouf (2012).

The cobs under INM practices were the lengthiest (21.1 cm) but were at par with STBNR (20.6 cm). The cobs were the shortest in organic treatment. Higher and balanced availability of nutrients under INM practice helps in continuous filling of kernels with sufficient photosynthates which led to increase in length and size of the cob. Similar findings were obtained by Mohsin *et al*. (2012) and Chan *et al*. (2008).

### 3.4.3 100 kernel weight

The EFI with mulch recorded higher 100 kernel weight (31.9 g) followed by EFI alone. The lowest kernel weight (29.3 g) was observed under AFI treatment. Furrow irrigation along with plastic mulch had highest grain number, grain weight per cob, and 1000-grain weight, followed by sand mulching and without mulch (Wang *et al*., 2011). Water stress results in poor source sink relation, poor crop growth rate and poor metabolic processes that result in poor grain weight (Kapoor *et al*., 2020).

Among the nitrogen management options, significantly higher kernel weight (35.5 g) was observed under INM practices followed by STBNR, Whereas, the organic practice resulted in lowest kernel weight (22.7 g). The increase in kernel weight under INM was mainly due to the balanced supply of nutrients from both urea and FYM throughout the kernel filling and development period. Similar findings were reported by Panchal *et al*. (2018).

## 3.5 YIELD and HI

Each furrow irrigation with mulch resulted in significantly higher cob yield (27.64 t/ha) which was 7.7, 38.2 and 33.0 per cent more than that of EFI, AFI and BBF method, respectively. Both fresh and dry stalk yield of sweet corn followed the same trend as that of cob yield under different water management options.This might be due to the higher soil moisture content in the root zone due to high irrigation water depth applied in continuous furrow irrigation technique and increasing plant water use efficiency due to the mulching effect which leads to make a favorable condition to improve yield of sweet corn. The current finding is in line with Meskelu *et al*. (2018), Mebrahtu and Mehamed (2019) and Jemal and Berhanu

(2020) who obtained maximum maize yield from conventional furrow irrigation technique as compared to fixed and alternate furrow.

Application of 75 % N through STBNR along with 25 % of N through FYM (INM) resulted in only 2.5 per cent yield advantage over STBNR but32.0 percent over RTNM. Cob yield under INM practice was even 3.2 times of than in organic practice. With respect to stalk yield the nitrogen management treatments followed the sequence *i.e.* INM > STBNR > RTNM > Organic. Complete substitution of inorganic nutrient by organic sources resulted in heavy yield penalty in sweet corn possibly due to lowavailable nutrient content caused by the slow mineralization rate of organic manure, thus unable to match with the phasic nutrient demands of a relatively short duration sweet corn crop during its growing period (Masunga *et al*., 2016). The judicious use of inorganic nutrients and organic manure in INM practice had the synergistic effect on availability of applied nutrients in soluble form that favoured better utilization of it thus, increased sink capacity through better nutrient uptake by crop. Again, integrated use of nutrients influenced the soil physico-chemical and biological properties there by accomplished the better availability, absorption and utilization of nutrients thus, increased yield. This result of present experiment is in close harmony with the findings of Rathod *et al*. (2018) and Singh *et al*. (2018).

The EFI treated either with or without mulch resulted in higher HI than alternate furrow and bed irrigation method probably due to disproportionately lower sink (cob) yield as compared to the total biomass under the deficit irrigation practices in agreement with Bryant et al. (1992) and Farre and Faci (2009).

The organic nutrition practices in sweet corn also exhibited significantly the lowest HI of 34.23 per cent as compared to INM, STBNR or even RTNM practices because of the lowest cob yield in line with the findings of Bhatt *et al*. (2020).

## 4. CONCLUSION

Optimal irrigation to sweet corn *i.e.* EFI with mulch resulted in significantly higher cob yield (27.64 t/ha) followed by only EFI. The INM practice in sweet corn produced higher cob yield (30.91 t/ha) as compared to other nitrogen management options but it was at par with STBNR. Integrated nutrient management approach comprising of 75% N through STBNR (inorganic) + 25 % of N through FYM *along* with each furrow irrigation with mulching is the optimal combination for better growth and yield to sweet corn.

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**Table 2.Effect of climate smart nitrogen and water management approaches on plant height (cm) of sweet corn at different stages**

| Particular | 20 DAS | | | 40 DAS | | | 60 DAS | | | Harvest | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled |
| **Water management** | | | | | | | | | | | | |
| $W_1$ | 35.9 | 34.5 | 35.2 | 102.5 | 102.2 | 102.4 | 184.0 | 178.6 | 181.3 | 199.4 | 191.3 | 195.4 |
| $W_2$ | 37.7 | 34.4 | 36.1 | 104.5 | 99.6 | 102.1 | 188.8 | 183.2 | 186.0 | 203.8 | 196.3 | 200.0 |
| $W_3$ | 33.0 | 31.4 | 32.2 | 91.1 | 88.4 | 89.7 | 163.8 | 159.4 | 161.6 | 175.6 | 170.8 | 173.2 |
| $W_4$ | 33.8 | 30.9 | 32.3 | 93.8 | 91.0 | 92.4 | 168.1 | 163.8 | 166.0 | 180.4 | 175.5 | 178.0 |
| SEm (±) | 0.56 | 0.93 | 0.54 | 1.98 | 2.80 | 1.71 | 5.14 | 5.05 | 3.60 | 4.73 | 5.41 | 3.60 |
| CD (0.05) | 1.8 | 3.0 | 1.6 | 6.3 | 8.9 | 5.1 | 16.5 | 16.2 | 10.7 | 15.1 | 17.3 | 10.7 |
| **Nitrogen management** | | | | | | | | | | | | |
| Organic | 26.0 | 26.7 | 26.3 | 77.8 | 78.0 | 77.9 | 113.8 | 114.1 | 113.9 | 121.7 | 122.6 | 122.2 |
| INM | 41.1 | 37.0 | 39.0 | 112.1 | 108.2 | 110.2 | 210.6 | 203.6 | 207.1 | 226.6 | 218.0 | 222.3 |
| STBNR | 39.3 | 36.4 | 37.9 | 108.7 | 105.2 | 107.0 | 205.5 | 198.0 | 201.7 | 221.6 | 212.0 | 216.8 |
| RTNM | 34.1 | 31.1 | 32.6 | 93.2 | 89.9 | 91.6 | 175.0 | 169.2 | 172.1 | 189.4 | 181.2 | 185.3 |
| SEm (±) | 0.69 | 0.55 | 0.44 | 1.56 | 1.60 | 1.12 | 2.23 | 2.80 | 1.79 | 2.65 | 3.01 | 2.00 |
| CD (0.05) | 2.2 | 1.8 | 1.3 | 5.0 | 5.1 | 3.3 | 7.1 | 9.0 | 5.3 | 8.5 | 9.6 | 5.9 |

**Table 3.Effect of climate smart nitrogen and water management approaches on leaf area index of sweet corn at different stages**

| Particular | 20 DAS | | | 40 DAS | | | 60 DAS | | | Harvest | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled |
| **Water management** | | | | | | | | | | | | |
| $W_1$ | 1.38 | 1.37 | 1.37 | 4.01 | 3.96 | 3.98 | 6.20 | 6.15 | 6.18 | 4.41 | 4.30 | 4.36 |
| $W_2$ | 1.43 | 1.39 | 1.41 | 4.04 | 3.99 | 4.02 | 6.25 | 6.20 | 6.22 | 4.52 | 4.34 | 4.43 |
| $W_3$ | 1.22 | 1.18 | 1.20 | 3.42 | 3.37 | 3.39 | 5.28 | 5.24 | 5.26 | 3.75 | 3.67 | 3.71 |
| $W_4$ | 1.26 | 1.22 | 1.24 | 3.52 | 3.47 | 3.50 | 5.44 | 5.40 | 5.42 | 3.88 | 3.78 | 3.83 |
| SEm (±) | 0.038 | 0.041 | 0.028 | 0.08 | 0.083 | 0.059 | 0.132 | 0.130 | 0.092 | 0.100 | 0.091 | 0.068 |
| CD (0.05) | 0.12 | 0.13 | 0.08 | 0.27 | 0.27 | 0.18 | 0.42 | 0.41 | 0.27 | 0.32 | 0.29 | 0.20 |
| **Nitrogen management** | | | | | | | | | | | | |
| Organic | 0.99 | 0.97 | 0.98 | 2.45 | 2.41 | 2.43 | 3.78 | 3.75 | 3.77 | 2.70 | 2.63 | 2.66 |
| INM | 1.49 | 1.45 | 1.47 | 4.38 | 4.32 | 4.35 | 6.77 | 6.72 | 6.74 | 4.87 | 4.70 | 4.78 |
| STBNR | 1.47 | 1.44 | 1.46 | 4.31 | 4.25 | 4.28 | 6.66 | 6.61 | 6.64 | 4.76 | 4.63 | 4.69 |
| RTNM | 1.34 | 1.29 | 1.31 | 3.85 | 3.80 | 3.83 | 5.95 | 5.91 | 5.93 | 4.23 | 4.14 | 4.18 |
| SEm (±) | 0.027 | 0.027 | 0.019 | 0.08 | 0.082 | 0.058 | 0.134 | 0.127 | 0.090 | 0.116 | 0.089 | 0.073 |
| CD (0.05) | 0.09 | 0.09 | 0.06 | 0.26 | 0.26 | 0.17 | 0.41 | 0.41 | 0.27 | 0.37 | 0.28 | 0.22 |

**Table 4.Effect of climate smart nitrogen and water management approaches ondry matter production (g/plant) of sweet corn at different stages**

| Particular | 20 DAS | | | 40 DAS | | | 60 DAS | | | Harvest | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled |
| **Water management** | | | | | | | | | | | | |
| $W_1$ | 19.2 | 16.5 | 17.8 | 82.0 | 77.3 | 79.6 | 136.7 | 129.4 | 133.1 | 188.2 | 183.3 | 185.8 |
| $W_2$ | 20.7 | 17.4 | 19.0 | 85.3 | 78.8 | 82.1 | 137.3 | 131.0 | 134.2 | 193.2 | 187.8 | 190.5 |
| $W_3$ | 15.9 | 13.5 | 14.7 | 65.2 | 62.7 | 64.0 | 118.7 | 114.6 | 116.7 | 166.8 | 161.4 | 164.1 |
| $W_4$ | 17.0 | 13.9 | 15.5 | 67.3 | 63.5 | 65.4 | 123.8 | 116.8 | 120.3 | 169.7 | 164.2 | 167.0 |
| SEm (±) | 0.45 | 0.51 | 0.34 | 3.51 | 3.50 | 2.48 | 3.72 | 3.45 | 2.54 | 3.02 | 3.63 | 2.36 |
| CD (0.05) | 1.4 | 1.6 | 1.0 | 11.2 | 11.2 | 7.4 | 11.9 | 11.0 | 7.5 | 9.7 | 11.6 | 7.0 |
| **Nitrogen management** | | | | | | | | | | | | |
| Organic | 13.7 | 12.9 | 13.3 | 56.0 | 57.9 | 57.0 | 88.0 | 90.8 | 89.4 | 111.7 | 115.7 | 113.7 |
| INM | 21.0 | 17.0 | 19.0 | 88.3 | 81.9 | 85.1 | 151.4 | 142.2 | 146.8 | 214.5 | 204.3 | 209.4 |
| STBNR | 20.1 | 16.5 | 18.3 | 82.5 | 77.1 | 79.8 | 147.9 | 137.3 | 142.6 | 209.1 | 201.4 | 205.2 |
| RTNM | 17.9 | 14.9 | 16.4 | 73.0 | 65.5 | 69.2 | 129.3 | 121.5 | 125.4 | 182.7 | 175.4 | 179.1 |
| SEm (±) | 0.85 | 0.65 | 0.53 | 3.71 | 3.98 | 2.72 | 2.74 | 2.22 | 1.76 | 2.85 | 2.55 | 1.91 |
| CD (0.05) | 2.7 | 2.1 | 1.6 | 11.9 | 12.7 | 8.1 | 8.8 | 7.1 | 5.2 | 9.1 | 8.1 | 5.7 |

**Table 5. Effect of climate smart nitrogen and water management approaches on yield attributes of sweet corn**

| Particular | Kernels/row | | | Length of cob (cm) | | | Girth of cob (cm) | | | 100-kernel wt. (g) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled |
| **Water management** | | | | | | | | | | | | |
| $W_1$ | 37.0 | 35.1 | 36.0 | 19.2 | 19.2 | 19.2 | 17.1 | 16.1 | 16.6 | 32.7 | 30.9 | 31.8 |
| $W_2$ | 37.9 | 36.0 | 37.0 | 20.1 | 19.3 | 19.7 | 17.7 | 16.9 | 17.3 | 33.7 | 30.1 | 31.9 |
| $W_3$ | 31.8 | 32.3 | 32.0 | 17.2 | 17.7 | 17.4 | 14.8 | 15.5 | 15.1 | 28.9 | 29.7 | 29.3 |
| $W_4$ | 32.3 | 33.7 | 33.0 | 17.9 | 18.3 | 18.1 | 15.5 | 15.7 | 15.6 | 30.2 | 30.0 | 30.1 |
| SEm (±) | 0.92 | 0.84 | 0.62 | 0.65 | 0.33 | 0.37 | 0.33 | 0.27 | 0.21 | 1.02 | 0.50 | 0.57 |
| CD (0.05) | 2.9 | 2.5 | 1.8 | 2.1 | 1.0 | 1.1 | 1.0 | 0.9 | 0.6 | 3.2 | NS | 1.7 |
| **Nitrogen management** | | | | | | | | | | | | |
| Organic | 24.6 | 27.0 | 25.8 | 13.8 | 14.8 | 14.3 | 11.8 | 12.7 | 12.3 | 22.2 | 23.2 | 22.7 |
| INM | 41.0 | 38.3 | 39.6 | 21.0 | 21.1 | 21.1 | 18.2 | 17.5 | 17.8 | 35.9 | 35.0 | 35.5 |
| STBNR | 40.1 | 37.7 | 38.9 | 20.8 | 20.4 | 20.6 | 18.1 | 17.3 | 17.7 | 35.0 | 33.2 | 34.1 |
| RTNM | 33.3 | 34.1 | 33.7 | 18.7 | 18.2 | 18.4 | 16.8 | 16.6 | 16.7 | 32.4 | 29.2 | 30.8 |
| SEm (±) | 0.63 | 0.96 | 0.52 | 0.30 | 0.33 | 0.23 | 0.33 | 0.24 | 0.20 | 0.92 | 0.41 | 0.50 |
| CD (0.05) | 1.9 | 2.8 | 1.6 | 1.0 | 1.1 | 0.7 | 1.0 | 0.8 | 0.6 | 2.9 | 1.3 | 1.5 |

**Table 6. Effect of climate smart nitrogen and water management approaches on cob yield, stalk yield and harvest index of sweet corn**

| Particular | Cob yield (t/ha) | | | Fresh stalk yield (t/ha) | | | Dry stalk yield (t/ha) | | | HI (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled | 2020-21 | 2021-22 | Pooled |
| **Water management** | | | | | | | | | | | | |
| W1 | 27.15 | 24.15 | 25.65 | 30.12 | 29.05 | 29.58 | 13.25 | 12.78 | 13.02 | 46.20 | 44.48 | 45.34 |
| $W_2$ | 29.96 | 25.32 | 27.64 | 32.94 | 31.00 | 31.97 | 14.49 | 13.64 | 14.07 | 45.86 | 44.29 | 45.07 |
| $W_3$ | 19.57 | 20.42 | 20.00 | 27.43 | 27.34 | 27.39 | 12.07 | 12.03 | 12.05 | 39.16 | 41.71 | 40.44 |
| $W_4$ | 21.05 | 20.49 | 20.77 | 29.57 | 28.56 | 29.06 | 13.01 | 12.57 | 12.79 | 39.32 | 40.93 | 40.13 |
| SEm (±) | 0.792 | 0.448 | 0.455 | 0.719 | 0.741 | 0.516 | 0.316 | 0.326 | 0.227 | 0.969 | 0.990 | 0.693 |
| CD (0.05) | 2.53 | 1.43 | 1.35 | 2.30 | 2.37 | 1.53 | 1.01 | 1.04 | 0.67 | 3.10 | 3.17 | 2.06 |
| **Nitrogen management** | | | | | | | | | | | | |
| Organic | 8.59 | 10.60 | 9.60 | 17.50 | 18.86 | 18.18 | 7.70 | 8.30 | 8.00 | 32.49 | 35.96 | 34.23 |
| INM | 32.81 | 29.00 | 30.91 | 37.72 | 36.50 | 37.11 | 16.60 | 16.06 | 16.33 | 46.40 | 44.26 | 45.33 |
| STBNR | 32.14 | 28.15 | 30.14 | 35.98 | 34.08 | 35.03 | 15.83 | 14.99 | 15.41 | 47.07 | 45.22 | 46.14 |
| RTNM | 24.19 | 22.62 | 23.40 | 28.85 | 26.52 | 27.68 | 12.69 | 11.67 | 12.18 | 44.59 | 45.97 | 45.28 |
| SEm (±) | 0.497 | 0.492 | 0.350 | 0.613 | 0.802 | 0.505 | 0.270 | 0.353 | 0.222 | 0.746 | 0.938 | 0.599 |
| CD (0.05) | 1.59 | 1.57 | 1.04 | 1.96 | 2.56 | 1.50 | 0.86 | 1.13 | 0.66 | 2.38 | 3.00 | 1.78 |