Effect of normal and saline water irrigation on yield and yield attributes of maize cultivar district Kannauj, Uttar Pradesh

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Abstract
The field experiment was conducted during the year 2016 and 2017 at village Jasaura district Kannauj, Uttar Pradesh. Grain yield was ranged from 43.85-70.32 q ha\(^{-1}\) and 40.50-73.92 q ha\(^{-1}\). Stover yield was ranged from 116.65-142.87 q ha\(^{-1}\) and 114.25-143.15 q ha\(^{-1}\). Biological yield was ranged from 178.00-230.57 q ha\(^{-1}\) and 171.82-233.57 q ha\(^{-1}\). The weight of 100 seeds was ranged from 20.88-28.40 gram and 20.75-29.78 gram. Shelling percentage was ranged from 71.15-80.22\% and 70.20-80.44\%. Harvest Index was ranged from 0.24-0.30\% and 0.23-0.30\%. Gross returns or output, net return and benefit cost ratio were ranged from Rs. 69766-107461, Rs. 3342-41037 and 0.05-0.62 and Rs. 67849-116647, Rs. (+) 1222-47576 and (-) 0.02-0.69. The highest and lowest growth and reduction on grain and stover yield was achieved from T:\(+\) 4.87\% to (+) 0.19\% and T:\(-\) 7.64\% to (-) 2.06\%. All the parameters were obtained from 2016 to 2017 year respectively.

Keywords: Longitude, latitude, benefit cost ratio, maize, GPS, harvest index, shelling percentage

Introduction
Maize (Zea mays L) or corn is a cereal grain belonging to the family gramineae/poaceae and is known as 'Queen of Cereals' because of its several uses. In addition to staple food for human being and quality feed for animals, maize serves as a basic raw material as an ingredient to thousands of industrial products that includes starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceutical, cosmetic, film, textile, gum, package and paper industries etc. It is used worldwide for about 3500 products of different uses as feed (61\%), food (17\%) and also serves as a source of basic raw material of number of industries (22\%) viz., starch, ethanol, oil, alcoholic beverages, food sweeteners, pharma, cosmetics etc. No other cereal can be used in such many ways as maize. Every part of the maize plant has economic value the grains, leaves, stalk, tassel, and cob can all be used to produce a variety of food and non-food products. In India not only production and consumption of maize have been rising consistently, the consumption pattern has also changed over the years Kumar et al. (2012a) [8].

Materials and Methods
Location of study area
The field experiment was conducted in Jasaura village of Jalalabad block, Kannauj district situated in the western region of Uttar Pradesh with latitude of 270 05’ North and longitude of 0790 49’ East.

Survey of ground irrigation water
First of all 10 surveys were conducted within the Kannauj district. The 10 water samples were randomly collected with the help of Global Positioning System from surveyed area in labeled plastic bottle within the district. The collected water samples brought in laboratory for further desired chemical constituents examination.
Selection of study area
After chemical analysis of water samples the Jasaura village was found good and saline water. The most dominant crop in summer season was maize of this village. Therefore, Jasaura village was selected for conducted experiment purpose.

Fig 1: Map of study area

Table 1: Description of treatments combination with irrigations application.

| Treatments       | Irrigations pattern |
|------------------|---------------------|
| T1-Normal Water (GW) | Regular             |
| T2-Saline Water (SW) | Regular             |
| T3-NW: SW        | 3 NW: 3 SW          |
| T4-SW: NW        | 3SW: 3 NW           |
| T5-NW: SW        | 4 NW: 2 SW          |
| T6-SW: NW        | 4SW: 2 NW           |
| T7-NW:SW        | 5 NW: 1 SW          |
| T8-SW: NW        | 5SW: 1 NW           |

Table 2: Description of experimental layout

| S. No. | Particulars                  | Descriptions                                      |
|--------|------------------------------|----------------------------------------------------|
| 1.     | Year of commencement         | 5 March 2016 and 5 March 2017                      |
| 2.     | Location                     | Village: Jasaura district Kannauj                  |
| 3.     | Recommended dose of fertilizers | 150: 60:40 (N: P: K) Kg ha\(^{-1}\) + 20Kg ZnSO\(_4\) 7H\(_2\)O + 10 tonne FYM |
| 4.     | Variety                      | Hybrid Maize variety DeKalb 9108 plus              |
| 5.     | Spacing                      | 60 x 30cm                                          |
| 6.     | No. of irrigations-          | 6                                                  |
| 7.     | Design                       | RBD                                                |
| 8.     | Replication:                 | 4                                                  |
| 9.     | Plot size                    | 2.5 x 2=5 M\(^2\)                                  |
| 10.    | Net area                     | 160 M\(^2\)                                        |

Result and Discussion

Grain yield
As depicted in Table 1.3 the maximum and minimum grain yield was found in treatment T\(_1\)-73.92q ha\(^{-1}\) and T\(_2\)-40.50q ha\(^{-1}\). The grain yield increasing in T\(_1\)-87.45 to 91.82q ha\(^{-1}\) and reducing trends were observed in remaining treatments from previous year 2016 to final year 2017. Similar trends were observed by Aechra (2017)\(^{[1]}\), Chaudhary, (2017)\(^{[2]}\), Feng et al., (2017)\(^{[3]}\), Leogrande et al., (2016)\(^{[4]}\), Liu et al., (2016)\(^{[5]}\), Wang et al., (2016)\(^{[6]}\), Zhang et al., (2016)\(^{[7]}\), Awad et al., (2014)\(^{[8]}\), Faria and Mansouri (2014)\(^{[9]}\), Azizian and Sepaskhah (2014)\(^{[10]}\), Mojid (2013)\(^{[11]}\).

Table 3: Grain yield (q ha\(^{-1}\)) at harvest of maize crop in 2016 and 2017

| Treatments | Grain yield (q ha\(^{-1}\)) |
|------------|-----------------------------|
|            | Mean | Mean |
| T\(_1\)    | 70.32 | 73.92 |
| T\(_2\)    | 43.85 | 40.50 |
| T\(_3\)    | 52.87 | 51.45 |
| T\(_4\)    | 51.90 | 50.52 |
| T\(_5\)    | 56.97 | 53.82 |
| T\(_6\)    | 53.55 | 50.25 |
| T\(_7\)    | 69.80 | 69.77 |
| T\(_8\)    | 44.97 | 41.95 |
| S. Ed (±)  | 1.420 | 1.122 |
| C.D at 5%  | 4.178 | 3.299 |
Stover yield

As depicted in Table 1.4 the maximum and minimum stover yield was found in treatment T₁-143.15 q ha⁻¹ and T₂-114.25 q ha⁻¹. The stover yield increasing in T₁-142.87 to 143.15 q ha⁻¹ and reducing trends were observed in remaining treatments from previous year 2016 to final year 2017. Similar trends were reported by Aechra (2017) [1], Chaudhary, (2017) [4], Feng et al., (2017) [6], Liu et al., (2016) [10], Zhang et al., (2016) [13], Awad et al., (2014) [2], Mojid (2013) [11].

### Table 4: Stover yield (q ha⁻¹) at harvest of maize crop in 2016 and 2017

| Treatments | Mean | Mean |
|------------|------|------|
| T₁         | 142.87 | 143.15 |
| T₂         | 116.65 | 114.25 |
| T₃         | 119.35 | 118.57 |
| T₄         | 118.17 | 118.05 |
| T₅         | 120.47 | 120.42 |
| T₆         | 118.00 | 117.72 |
| T₇         | 142.42 | 140.50 |
| T₈         | 116.57 | 116.30 |
| S. Ed (±)  | 1.296  | 1.212  |
| C.D at 5%  | 3.811  | 3.563  |

Biological Yield

As depicted in Table 1.5 the highest and lowest biological yield was found in treatment T₁-233.57 q ha⁻¹ and T₂-171.82 q ha⁻¹. The biological yield increasing in T₁-230.57 to 233.57q ha⁻¹ and reducing trends were observed in remaining treatments from previous year 2016 to final year 2017. Similar trends were investigated by Aechra (2017) [1], Chaudhary, (2017) [4], Feng et al., (2017) [6], Liu et al., (2016) [10], Zhang et al., (2016) [13], Awad et al., (2014) [2], Mojid (2013) [11].

### Table 5: Biological yield (q ha⁻¹) at harvest of maize crop in 2016 and 2017

| Treatments | Stover yield (q ha⁻¹) |
|------------|-----------------------|
| T₁         | Mean 230.57, Mean 233.57 |
| T₂         | Mean 178.00, Mean 171.82 |
| T₃         | Mean 190.02, Mean 187.47 |
| T₄         | Mean 188.50, Mean 186.92 |
| T₅         | Mean 194.97, Mean 193.87 |
| T₆         | Mean 189.65, Mean 185.60 |
| T₇         | Mean 229.37, Mean 227.75 |
| T₈         | Mean 179.02, Mean 174.95 |
| S. Ed (±)  | Mean 2.170, Mean 2.063 |
| C.D at 5%  | Mean 6.383, Mean 6.066 |
Graph 3: Biological yield (q ha⁻¹) of maize crop in 2016 and 2017

**Weight of 100 seeds**

As depicted in Table 1.6 the highest and lowest weight of 100 seeds was found in treatment T₁-29.78 gram and T₂-20.75 gram. The weight of 100 seeds increasing in T₁-28.40 to 29.78 gram and reducing trends were observed in remaining treatments from previous year 2016 to final year 2017. Similar trends were examined by Aechra (2017) [1], Chaudhary, (2017) [4], Feng et al., (2017) [6], Liu et al., (2016) [10], Zhang et al., (2016) [13], Awad et al., (2014) [2], Mojid (2013) [11].

**Table 6: Weight of 100 seeds (gram) of maize crop in 2016 and 2017**

| Treatments | Weight of 100 seeds (gram) | Mean | Mean |
|------------|----------------------------|------|------|
| T₁         | 28.40                      | 29.78|
| T₂         | 20.88                      | 20.75|
| T₃         | 21.81                      | 21.29|
| T₄         | 21.43                      | 21.19|
| T₅         | 21.75                      | 21.58|
| T₆         | 21.60                      | 21.07|
| T₇         | 27.84                      | 27.97|
| T₈         | 21.39                      | 21.15|
| S. Ed (±)  | 0.265                      | 0.226|
| C.D at 5%  | 0.780                      | 0.664|

**Shelling percentage**

As depicted in Table 1.7 the highest and lowest shelling percentage was found in treatment T₁-80.44% and T₂-70.20%. The shelling percentage increasing in T₁-79.98 to 80.44% and reducing trends were observed in remaining treatments from previous year 2016 to final year 2017. Similar trends were determined by Aechra (2017) [1], Chaudhary, (2017) [4], Feng et al., (2017) [6], Liu et al., (2016) [10], Zhang et al., (2016) [13], Awad et al., (2014) [2], Mojid (2013) [11].

**Table 7: Shelling percentage of maize crop in 2016 and 2017**

| Treatments | Shelling percentage | Mean | Mean |
|------------|---------------------|------|------|
| T₁         | 79.98               | 80.44|
| T₂         | 71.15               | 70.20|
| T₃         | 74.81               | 74.21|
| T₄         | 73.98               | 73.28|
| T₅         | 76.46               | 74.05|
| T₆         | 74.74               | 74.01|
| T₇         | 80.22               | 80.26|
| T₈         | 71.67               | 71.33|
| S. Ed (±)  | 0.515               | 0.322|
| C.D at 5%  | 1.516               | 0.946|

**Harvest index (H.I)**

As depicted in Table 1.8 the highest and lowest harvest index was found in treatment T₁-0.30% T₇-0.2% and T₆-0.23% T₈-0.23% The harvest index increasing in T₁-0.29 to 0.30%, invariability in treatments T₅,T₇ and reducing trends were observed in remaining treatments from previous year 2016 to final year 2017. Similar trends were determined by Aechra (2017) [1], Chaudhary, (2017) [4], Feng et al., (2017) [6], Liu et al., (2016) [10], Zhang et al., (2016) [13], Awad et al., (2014) [2], Mojid (2013) [11].

**Table 8: Harvest index of maize crop in 2016 and 2017**

| Treatments | Harvest index | Mean | Mean |
|------------|---------------|------|------|
| T₁         | 0.29          | 0.30 |
| T₂         | 0.24          | 0.23 |
| T₃         | 0.28          | 0.27 |
| T₄         | 0.27          | 0.26 |
| T₅         | 0.27          | 0.27 |
| T₆         | 0.28          | 0.27 |
| T₇         | 0.30          | 0.30 |
| T₈         | 0.24          | 0.23 |
| S. Ed (±)  | 0.005         | 0.003|
| C.D at 5%  | 0.016         | 0.010|

**Gross returns or output**

As depicted in Table 1.9 and 1.10 the highest gross return was obtained from
from previous year to final year due to percentage growth and reduction in these treatments gross return was decreased. The lowest gross return was achieved from treatment T2 in previous year whereas; negatively gross return was obtained during second year from treatment T3. Similar trends were observed by Faria and Mansouri (2014) [5].

Input, net return and benefit cost ratio
As depicted in Table 1.11 and 1.12 the input was change Rs. 66424=00 to 69071 from previous year to final year due to increasing cost of input components. The highest net return and B.C Ratio were achieved from treatment T7 followed by T5, T3, T4, T6, T8, T2 in previous year 2016 and final year 2017 respectively. The gross return was increased from previous to final year except treatments T2, T3, T6 and T4 in these treatments gross return was decreased.

The gross returns or output in 2016

| Treatments | Gross return or Output (Grain @ Rs. 1325 and Stover @ Rs. 100 per quintal) | Gross return or Output (Grain @ Rs. 1325 and Stover @ Rs. 100 per quintal) |
|------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|
| T1         | 70.32                                                                     | 93174                                                                     |
| T2         | 43.85                                                                     | 58101                                                                     |
| T3         | 52.87                                                                     | 70053                                                                     |
| T4         | 51.90                                                                     | 68767                                                                     |
| T5         | 56.97                                                                     | 75485                                                                     |
| T6         | 53.55                                                                     | 70954                                                                     |
| T7         | 69.80                                                                     | 92485                                                                     |
| T8         | 44.97                                                                     | 59585                                                                     |

Table 10: Gross returns or output in 2017

| Treatments | Gross return or Output (Grain @ Rs. 1325 and Stover @ Rs. 100 per quintal) | Gross return or Output (Grain @ Rs. 1325 and Stover @ Rs. 100 per quintal) |
|------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|
| T1         | 73.92                                                                     | 100901                                                                    |
| T2         | 40.50                                                                     | 55282                                                                     |
| T3         | 51.45                                                                     | 70229                                                                     |
| T4         | 50.52                                                                     | 68960                                                                     |
| T5         | 53.82                                                                     | 73464                                                                     |
| T6         | 50.25                                                                     | 68591                                                                     |
| T7         | 69.77                                                                     | 95236                                                                     |
| T8         | 41.95                                                                     | 57262                                                                     |

Treatment T1 followed by T7, T3, T5, T6, T8, T2 in previous year 2016 and second year 2017 respectively. The gross return was increased from previous to final year except treatments T2, T3, T6 and T4 in these treatments gross return was decreased. The lowest gross return was achieved from treatment T2 in previous year whereas; negatively gross return was obtained during second year from treatment T3. Similar trends were observed by Faria and Mansouri (2014) [5].

Table 9: Gross returns or output in 2016

Table 12: Input, Gross return, Net return and Benefit Cost Ratio in 2017

| Treatments | Input (Rs.) | Gross return (Rs.) | Net return (Rs.) | B.C Ratio |
|------------|-------------|--------------------|-----------------|-----------|
| T1         | 69071       | 116647             | (-) 47576       | (+) 0.69  |
| T2         | 69071       | 67849              | (-) 1222        | (-) 0.02  |
| T3         | 69071       | 83272              | (+) 14201       | (+) 0.20  |
| T4         | 69071       | 81945              | (+) 12874       | (+) 0.19  |
| T5         | 69071       | 86710              | (+) 17639       | (+) 0.25  |
| T6         | 69071       | 81540              | (+) 12469       | (+) 0.18  |
| T7         | 69071       | 110740             | (+) 41669       | (+) 0.00  |
| T8         | 69071       | 70055              | (+) 984         | (+) 0.01  |

The lowest net return and B.C Ratio were achieved from treatment T2 in previous year whereas; negatively net return and B.C Ratio were obtained during second year from treatment T3. Similar trends were reported by Faria and Mansouri (2014) [5].

Growth and reduction on grain and Stover yield
As depicted in Table 1.13 the highest and lowest growth and reduction on grain and Stover yield was received from T1-(+) 4.87% to (+) 0.19% and T2(-) 7.64% to (-) 2.06% from previous year 2016 to final year 2017 respectively. The stability was not found in any treatments previous to final year. Similar trends were observed by Azizian and Sepaskhah (2014) [5].

Table 11: Input, gross return, net return and benefit cost ratio in 2016

| Treatments | Input (Rs.) | Gross return (Rs.) | Net return (Rs.) | B.C Ratio |
|------------|-------------|--------------------|-----------------|-----------|
| T1         | 66424       | 107461             | (+) 41037       | (+) 0.62  |
| T2         | 66424       | 69766              | (+) 3342        | (+) 0.05  |
| T3         | 66424       | 81988              | (+) 15564       | (+) 0.23  |
| T4         | 66424       | 80584              | (+) 14160       | (+) 0.21  |
| T5         | 66424       | 87532              | (+) 21108       | (+) 0.32  |
| T6         | 66424       | 82754              | (+) 16330       | (+) 0.24  |
| T7         | 66424       | 106727             | (+) 40303       | (+) 0.61  |
| T8         | 66424       | 71242              | (+) 4818        | (+) 0.07  |

Table 13: Growth and reduction on grain and stover yield from 2016 to 2017

| Treatments | Grain yield (q ha⁻¹) | Stover yield (q ha⁻¹) | % age growth and reduction |
|------------|----------------------|-----------------------|---------------------------|
| 2016       | 2017                 | 2016                  | 2017                      |
| T1         | 70.32                | 73.92                 | (+) 4.87                  | 142.87 | 143.15 | (+) 0.19 |
| T2         | 43.85                | 40.50                 | (-) 7.64                  | 116.65 | 114.25 | (-) 2.06 |
| T3         | 52.87                | 51.45                 | (-) 2.68                  | 119.35 | 118.57 | (-) 0.65 |
| T4         | 51.90                | 50.52                 | (-) 2.66                  | 118.17 | 118.05 | (-) 0.10 |
| T5         | 56.97                | 53.82                 | (-) 5.53                  | 120.47 | 120.42 | (-) 0.04 |
| T6         | 53.55                | 50.25                 | (-) 6.16                  | 118.00 | 117.72 | (-) 0.24 |
| T7         | 69.80                | 69.77                 | (-) 0.04                  | 142.42 | 140.95 | (-) 1.03 |
| T8         | 44.97                | 41.95                 | (-) 6.71                  | 116.57 | 116.30 | (-) 0.23 |
Conclusion
Among the various studies was found that treatment first superior over all treatments. When number of saline irrigation water increasing and normal water irrigation applied in decreasing manner maize growth and yield was found reduced and physico-chemical properties of soil were going increasing order. The soil application of gypsum and phospho-gypsum will be best amendments for management practices to sustain productivity and avoid soil from degradation losses.

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