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Effect of tillage, sowing time and irrigation on growth and yield of maize (*Zea mays* L.)

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Abstract
A field experiment was conducted at research farm of Bihar Agricultural College, Sabour, Bhagalpur during *rabi* season of 2016-17 to find out the effect of tillage, sowing time and irrigation on growth and yield of maize (*Zea mays* L.).The experiment comprised of two tillage methods *viz.* conventional tillage (CT) and zero tillage (ZT) in main plot, two sowing dates- 30th October and 10th November as sub-plot and three irrigation levels (I_2 - 2 irrigations at six-leaf stage and tasseling, I_4 - 4 irrigations at four-leaf stage, ten leaf stage, tasseling and milking and I_6 - 6 irrigations at four-leaf stage, eight leaf stage, ten leaf stage, tasseling, milking and dough stage) as sub-sub plot treatment. The results indicated that the growth and productivity of *rabi* maize is significantly influenced by management practices. However, maximum grain yield (11.1 t ha^{-1}) was recorded in zero tillage system with six irrigation. Delay in sowing of *rabi* maize reduced the grain yield considerably at a rate of 121 kg/ha/day. With increasing resource as well as crop management constraints, adoption of zero tillage along with residue retention and optimum water use has the potential of improving the growth and crop productivity of maize.

Keywords: Zero tillage, date of sowing, irrigation, growth and yield of maize

Introduction
Maize has been widely cultivated during *kharif* season in India but it can also be successfully grown during the *rabi* season as yield of *rabi* maize is considerably higher than that of *kharif* maize (Patel *et al.*, 2006) [14]. The *rabi* maize has been widely accepted by farmers of Bihar with a cultivated area of 0.65 million ha with total production of 2.01 million tonnes (Directorate of Economics & Statistics, 2019-20). Sowing of the crop at right time make sure better plant growth, boosting the maize yield by increasing the resource use efficiency and also by suppressing weed growth. Tillage system is an integral part of crop production and it has been confirmed by different scientists that conventional intensive tillage increases soil compaction, reduces soil aggregates stability, disrupts soil productivity, decreases retention and transportation of water and solutes and exacerbates losses due to run-off erosion (Goddard *et al.*, 2008) [6]. In contrast many beneficial effects of zero-till and minimum tillage have also been reported like increased porosity, organic carbon, water holding capacity and decreased bulk density. It is well documented that zero tillage and crop residues management improves soil health and quality by improving various soil properties like reduced penetration resistance as well as the apparent density of soil that checks the soil evaporation rate (Rivas *et al.*, 1998) [17]. Water infiltration and soil aeration that depend on bulk density are also modified (Rice *et al.*, 1987) [16]. Zero tillage affects water availability to plants, essentially through soil water capture and root uptake capacity (Gajri *et al.*, 1994; Ojeniyi, 1986) [4, 11]. Zero tillage has also been reported to increase total nitrogen and microbial biomass in various soils (McCarty *et al.*, 1995) [10]. Irrigation is another important management practice for higher crop production which is mainly dependent on both irrigation frequency and total water application affecting root distribution and total root length (Robertson *et al.*, 1980) [18]. This determines the vital plant physiological processes like cell elongation, cell division, cell wall synthesis, nitrate reductase activity and photosynthesis that are very sensitive to plant water status. Therefore, production of a plant in terms of its growth and yield is mainly dependent on plant water status. The present investigation was carried out to find out the effect of tillage, date of sowing and irrigation on growth and yield of maize.

Materials and Methods

A field experiment was conducted at Research farm of Bihar Agricultural University, Sabour (25º15′40″ N, 87º2′42″ E; 37 m above mean sea level), Bhagalpur, Bihar, India during *rabi* season of 2016-17. The soil of the experimental field was sandy loam with neutral in reaction, medium in organic carbon (0.6%) and available phosphorus (35.2 kg P_2O_5 ha^{-1}), while low in available soil nitrogen (220.1 kg ha^{-1}), and rich in soil potassium (327 kg K_2O ha^{-1}). The experiment comprised of twelve treatment combinations laid out in split-split design with three replications. The two tillage methods *viz*. zero tillage (T_1 - ZT) and conventional tillage (T_2 - CT) were kept as main plots, while in sub-plot it was two sowing dates (D_1 - 30 October and D_2 - 10 November), and in sub-sub plot there were three irrigation levels i.e. I_2 (2 irrigations at six-leaf stage and tasseling), I_4 (4 irrigations at four-leaf stage, ten leaf stage, tasseling and milking) and I_6(6 irrigations at four-leaf stage, eight leaf stage, ten leaf stage, tasseling, milking and dough stage). The maize crop was sown on 30 October and 10 November in the year 2016 with a spacing of 60×20 cm and harvested on 7 April and 20 April 2017, respectively. Plant height was recorded from the randomly tagged plants at different intervals *viz*. 30, 60, 90, 120 DAS and at harvest by measuring from the base of the stem (ground level) to the growing tip of the top most leaf and the mean plant height was calculated which is expressed in cm. The leaf area index (LAI) was estimated by area – weight relationship method. Leaf area index was measured non-destructively at 30, 60, 90, 120 DAS and at harvest by using LP-80 Ceptometer. For biomass production plant samples from an earmarked portion in each plot were collected at 30, 60, 90, 120 and at harvest. After collection, the aboveground plant samples were cleaned and washed in water to remove surface contamination and separated into green leaves and stover. There after the plant parts were kept in separate paper packets which in turn were placed in an oven for drying at 70°C for about 72 hours till constant weights were obtained. Dry biomass of leaves and stover were noted. The sum of the dry weights of these plant parts were taken as the total above ground biomass production. The cob length was measured from the blunt end to the shank tip of five randomly selected cobs and the average cob length was recorded for each treatment and expressed in cm. The cob girth of five randomly selected cobs was measured at three places of the cob (at one fourth, half and three fourth distance from the top) and their mean girth was recorded in cm. The seeds from two randomly selected cobs were weighed and total weight of seeds was recorded and the average seed weight cob^{-1} was worked out and presented in g. Hundred seeds were counted at random from each treatment and the weight was recorded and expressed in g. Grain and Stone yield in each net plot was weighed and expressed in kg ha^{-1}. Harvest index was calculated by using the following formula.

$$\text{Harvest Index (\%)} = \frac{\text{Economic Yield}}{\text{Biological Yield}} \times 100$$

Economic yield indicates the grain yield, whereas, the biological yield represents the total yields of grain and straw recorded in this experiment. The experimental data recorded were analyzed statistically in split-split plot design to test the significance of the overall differences among treatments by using the F test and conclusions were drawn at 5% probability level.

Results and Discussion

Growth parameters of maize as influenced by different tillage method, date of sowing and irrigation levels

Plant height of maize measured at different growth stages i.e., 30, 60, 90, 120 DAS and at harvest continuously increased up to 120 DAS and thereafter declined at the time of harvest (table 1). In main plot due to tillage, plant height was significantly higher with T_2 (ZT) over T_1 (CT) at different growth stages i.e., 30, 60, 90, 120 DAS and at the time of harvest. In main plot maximum height was observed at 120 DAS with ZT (203.3cm) which was significantly higher over CT (191.9 cm). In sub plot due to date of sowing, plant height was significantly higher with D_1 (30th October) sowing over D_2 (10th November) sowing from 30 days to 90 DAS while it remained non-significant for the rest of the period. In sub plot maximum height of 184.8 cm was observed at 90 DAS with D_1 sowing which was significantly higher over D_2 sowing (145.5 cm). In sub-sub plot due to irrigation, there was no significant effect on plant height during the initial phase of the crop growth. However, the plant height was significantly influenced with differences in irrigation application and recorded higher value with I_6 (six irrigations) followed by I_4 (four irrigations) and I_2 (two irrigations) from 60 DAS to harvest. In sub subplot maximum plant height was recorded at 120 DAS (204.3 cm) with I_6 which was at par with I_4 (199.9 cm) and significantly higher over I_2 (188.6 cm).

LAI measured at different growth stages i.e. 30, 60, 90, 120 DAS and at harvest continuously increased up to 90 DAS and there after which declined from 120 DAS to the time of harvest (table 2). In main plot due to tillage, LAI was significantly higher in T_2 (ZT) over T_1 (CT) at different growth stages i.e., 30, 60, 90, 120 DAS and at the time of harvest. In main plot maximum LAI was recorded at 90 DAS with ZT (4.5) which was significantly higher over CT (4.3). In sub plot due to date of sowing LAI was significantly higher with D_1 (30th October) sowing over D_2 (10th November) sowing from 30 to 120 DAS while it remained non-significant for the rest of the period. In sub plot maximum LAI of 4.5 was recorded at 90 DAS with D_1 sowing which is significantly higher over D_2 sowing (4.3). In sub-sub plot due to irrigation, there was no significant effect on LAI during the initial phase of the crop growth. However, the LAI was significantly influenced with differences in irrigation application and recorded higher values with I_6 (six irrigations) followed by I_4 (four irrigations) and I_2 (two irrigations) from 90 DAS to harvest .In sub- sub plot maximum LAI was recorded at 90 DAS (4.6) with I_6 which was at par with I_4 (4.5) and significantly higher over I_2 (3.9).

The total biomass production of maize tended to increase progressively from 30 DAS to the harvest of the crop (table 3). In main plot due to tillage, total biomass production was significantly higher with T_2 (ZT) over T_1 (CT) at different growth stages i.e. 30, 60, 90, 120 DAS and at the time of harvest. In main plot maximum biomass was recorded at the time of harvest under ZT (19060.3 kg ha^{-1}) which was significantly higher over CT (17276.0 kg ha^{-1}). In sub plot due to date of sowing total biomass production was significantly higher with D_1 (30th October) sowing over D_2 (10th November) sowing from 30 DAS to the harvest. However maximum biomass was recorded at the time of harvest with D_1sowing (18713.6 kg ha^{-1}) which was significantly higher over D_2 sowing (17622.7 kg ha^{-1}). In sub-sub plot due to irrigation, there was no significant effect on biomass production during the initial growth stage of the crop up to 60

DAS. However, the total biomass production was significantly influenced with differences in irrigation application and recorded higher values with I_6 (six irrigations) followed by I_4 (four irrigations) and I_2 (two irrigations) from 90 DAS to harvest. During 120 DAS the biomass produced under I_4 and I_6 irrigation levels were found to be statistically at par but significantly higher over I_2 irrigation level. The maximum biomass production was recorded at the time of harvest under I_6 irrigation (21216.2 kg ha^{-1}) which was significantly higher over I_4 (19438.2 kg ha^{-1}) and I_2 (13850.0 kg ha^{-1}) irrigation levels.

Among the different growth parameters recorded in the present experiment plant height and LAI recorded significantly higher values due to zero tillage and early sowing of maize crop and the values consistently increased up to 90 DAS after which it declined. The effect of increasing irrigation levels on plant height and LAI was more prominent from 60 to 90 DAS. The crop receiving six irrigations produced significantly higher plant height and LAI compared to other treatments. Due to early sowing under zero tillage condition resulted in early establishment of the crop and consecutive higher dry matter accumulation. Among the various interaction effects tillage and different level of irrigation interaction significantly influenced biomass production from 90 DAS up to harvest. The reduction in tillage is expected to result in a progressive change in the total porosity of soil and also consecutive changes in bulk density. However due to increased porosity the water capacity of the soil is increased with ZT as a result the plant can utilise the major proportion of soil moisture for its growth and development.

Table 1: Plant height of maize (cm) as influenced by different tillage method, date of sowing and irrigation levels

Plant Height (cm)					
Treatment	**30 DAS**	**60 DAS**	**90 DAS**	**120 DAS**	**Harvest**
Tillage					
T_1	21.4	83.8	152.1	191.9	190.5
T_2	25.6	104.3	178.1	203.3	198.9
S.Em (±)	0.54	1.5	1.7	0.3	1.2
LSD (0.05)	3.27	9.3	10.2	1.6	7.0
Date of sowing					
D_1	32.5	105.2	184.8	200.1	196.8
D_2	14.5	82.9	145.5	195.2	192.6
S.Em (±)	0.65	1.8	2.6	1.8	1.9
LSD (0.05)	2.54	7.2	10.3	NS	NS
Irrigation					
I_2	24.4	89.8	154.2	188.6	186.7
I_4	23.4	95.4	166.9	199.9	195.1
I_6	22.6	97.1	174.2	204.3	202.2
S.Em (±)	0.5	1.3	1.4	1.9	1.6
LSD (0.05)	NS	4.0	4.2	5.7	4.9

T_1=Conventional Tillage; T_2-Zero Tillage; D_1=30 October; D_2-10 November; I_2=Irrigation at V_6 and tasseling; I_4-Irrigation at V_4, V_{10}, tasseling, milking; I_6-Irrigation at V_4, V_8, V_{10}, tasseling, milking, dough stage of the crop

Table 2: Leaf area index (LAI) of maize at different growth stages as influenced by different tillage method, date of sowing and irrigation levels

Leaf Area Index					
Treatment	**30 DAS**	**60 DAS**	**90 DAS**	**120 DAS**	**Harvest**
Tillage					
T_1	0.2	1.5	4.3	3.4	2.2
T_2	0.3	2.0	4.5	3.4	2.3
S.Em (±)	0.00	0.0	0.0	0.0	0.1
LSD (0.05)	0.03	0.1	0.1	0.1	NS
Date of sowing					
D_1	0.4	2.2	4.5	3.5	2.2
D_2	0.2	1.3	4.3	3.3	2.3
S.Em (±)	0.00	0.0	0.0	0.0	0.1
LSD (0.05)	0.01	0.1	0.1	0.1	NS
Irrigation					
I_2	0.3	1.7	3.9	3.1	1.8
I_4	0.3	1.8	4.5	3.5	2.5
I_6	0.3	1.7	4.6	3.6	2.5
S.Em (±)	0.0	0.0	0.1	0.0	0.1
LSD (0.05)	NS	NS	0.2	0.1	0.2

T_1=Conventional Tillage; T_2-Zero Tillage; D_1=30 October; D_2-10 November; I_2=Irrigation at V_6 and tasseling; I_4-Irrigation at V_4, V_{10}, tasseling, milking; I_6-Irrigation at V_4, V_8, V_{10}, tasseling, milking, dough stage of the crop

Table 3: Total Biomass production of maize at different growth stages as influenced by different tillage method, date of sowing and irrigation levels

Biomass (kg ha^{-1})					
Treatment	**30 DAS**	**60 DAS**	**90 DAS**	**120 DAS**	**Harvest**
Tillage					
T_1	325.2	2721.4	7034.4	13693.8	17276.0
T_2	401.1	3150.8	7592.8	15403.8	19060.3
S.Em (±)	4.02	52.9	85.3	47.7	269.0
LSD (0.05)	24.43	321.7	519.2	290.5	1636.7
Date of sowing					
D_1	401.2	3395.7	7592.6	14872.0	18713.6
D_2	325.0	2476.5	7034.6	14225.6	17622.7
S.Em (±)	9.32	101.6	80.4	98.3	205.6
LSD (0.05)	36.61	398.9	315.7	386.2	807.4
Irrigation					
I_2	353.8	2874.5	6162.7	11569.8	13850.0
I_4	364.7	2945.4	7666.6	15855.0	19438.2
I_6	370.9	2988.5	8111.6	16221.7	21216.2
S.Em (±)	7.9	35.1	88.7	182.1	251.9
LSD (0.05)	NS	NS	266.0	546.1	755.2

T_1=Conventional Tillage; T_2-Zero Tillage; D_1=30 October; D_2-10 November; I_2=Irrigation at V_6 and tasseling; I_4-Irrigation at V_4, V_{10}, tasseling, milking; I_6-Irrigation at V_4, V_8, V_{10}, tasseling, milking, dough stage of the crop

Yield attributes and yield of maize as influenced by different tillage methods, date of sowing and irrigation levels

Tillage method and date of sowing did not influence the number of cobs plant^{-1} of maize. However, due to irrigation, number of cobs plant^{-1} was recorded significantly higher with I_6 (1.9) which was significantly higher over I_4 (1.5) and I_2 (1.3) irrigation levels (table 4). The data revealed that there was significant influence of tillage, date of sowing and irrigation levels on cob length of maize. Due to tillage, maximum cob length was recorded with T_2 (18.2 cm) which was significantly higher over T_1 (16.3 cm). Due to sowing date difference maximum cob length was recorded with earlier sowing (17.6 cm) which was significantly higher over the late sowing (16.8 cm). As a result of variation in irrigation levels maximum cob length was recorded with I_6 (18 cm) which was significantly higher over I_4 (17.8 cm) and I_2 (15.9 cm). The data on Cob girth of maize crop as presented in the table 4 revealed that tillage methods did not influence the cob girth significantly. However due to date of sowing maximum cob girth was recorded with D_1 sowing (13.5 cm) which was significantly higher over D_2 sowing (13.3 cm). Due to differential irrigation application maximum cob girth was recorded with I_6 (13.9 cm) which was significantly higher over I_4 (13.3 cm) and I_2 (13.1 cm). The maximum cob weight with T_2 (197.5g) which was significantly higher over T_1 (179.2 g) treatment. Due to difference in date of sowing statistically higher cob weight was recorded with D_1 sowing (193.5 g) over D_2 (183.2 g) sown crop. Irrigation application significantly influenced the cob weight recording maximum cob weight with I_6 (208.3 g) irrigation treatment which was significantly higher over I_4 (192.8 g) and I_2 (163.9 g) irrigation treatments respectively (table 4). The number of grains cob^{-1} was recorded significantly higher with T_2 (497.68) treatment over T_1 (423.28) with different tillage options. Due to date of sowing maximum number of grains cob^{-1} was recorded with D_1 sowing (467.14) which was significantly higher over D_2 sowing (453.81). Increasing irrigation levels plays an important role in improving the number of grains per cob with the maximum value being recorded with I_6 (495.86) which was significantly higher over I_4 (461.11) and I_2 (424.47). The data on number of rows cob^{-1} of maize crop recorded maximum number of rows cob^{-1} with zero tillage (14.9) which was significantly higher over conventional tillage (14.1). Although no significant influence of date of sowing on number of rows cob^{-1} of maize was observed but with the increasing irrigation levels maximum number of rows cob^{-1} was recorded with I_6 (15.8) which was significantly higher over I_4 (14.5) and I_2 (13.2). Due to tillage maximum number of grains row^{-1} of cob was recorded with T_2 (35.56) which was significantly higher over T_1 (33.28). In sub-sub plot maximum number of grains row^{-1} of cob was recorded with I_6 (36.92) irrigation levels which was significantly higher over I_4 (35.08) and I_2 (31.25) irrigation levels respectively (table 4). The 100 grain weight of maize was significantly influenced only due to date of sowing and irrigation levels (table 4). Due to date of sowing maximum100 grain weight of cob was recorded with D_1 sowing (36.66 g) which was significantly higher over D_2 sowing (35.55 g). In sub- sub plot due to irrigation levels maximum100 grain weight of cob was recorded with I_6 (38.31g) which was significantly higher over I_4 (36.84g) and I_2 (33.18g). Yield components like length of cob, girth of cob, cob weight, number of grains per cob, 100 grain weight was found to be significantly higher with ZT, early date of sowing (D_1) and six irrigations (I_6) which were ultimately significantly and positively related to the grain yield of the crop.

The data on the yield of maize crop has been presented in table 5. Grain yield differed significantly with tillage and recorded significantly higher grain yield under ZT (9164.9 kg ha^{-1}) as compared to CT (8043.2 kg ha^{-1}) which was 14 per cent more over CT. In sub-plot due to date of sowing, grain yield was significantly higher when sown on D_1-30th October (9270.6 kg ha^{-1}) than D_2-10th November (7937.4 kg ha^{-1}) sowing. Due to the early sowing of maize the yield was higher by 17 per cent and the yield decreased at a rate of 121 kg/ha/day over early sown crop. In sub-sub plot significantly higher, grain yield was recorded with I_6 (11077.4 kg ha^{-1}) which was significantly higher over I_4 (9565.5 kg ha^{-1}) and I_2 (5169.1 kg ha^{-1}) irrigation levels. The significant yield increase with four irrigations (I_4) over I_2 was 85 per cent while a further increase of two irrigations under I_6, a 16 per cent increase in yield was recorded over I_4 irrigation level. From the results, it can be concluded that zero tillage had a significant influence in increasing the crop yield followed by sowing time and irrigation levels. ZT in combination with earlier sowing and six irrigations produced the maximum yield. However, ZT of the early sown crop with four irrigations could also produce equivalent yield to that of CT plots under D_1 sowing receiving six irrigations and also ZT with late sowing receiving six irrigations. The stone yield of maize did not vary significantly due to tillage methods or date of sowing. Due to irrigation application, the stone yield recorded higher values with I_6 (six irrigations) (2920 kg ha^{-1}) which was statistically at par with I_4 (four irrigations) (2635.2 kg ha^{-1}) and significantly higher over I_2 (two irrigations) (1580.8 kg ha^{-1}). The data on harvest index of maize crop has been presented in the table 5 In main plot maximum harvest index recorded with T_2 (48%) which was significantly higher over T_1 (45%).In sub plot maximum grain yield was recorded with D_1 (48%) which was significantly higher over D_1 (44%).In sub-sub plot due to irrigation, harvest index was significantly influenced with differences in irrigation application and maximum harvest index was recorded with I_6 (52%) which was significantly higher over I_4 (49%) and I_2 (37%). The higher yield of maize in ZT plots could be attributed to the multiple effects of nutrients added (Blanco-Canqui *et al.*, 2009 and Kaschuk *et al.*, 2010) [11, 9], comparatively lower weed pressure due to maintenance of surface residue (Ozpinar, 2015 and Chauhan *et al.*, 2007) [12, 2], better water regimes promoting root growth and development (Govaerts *et al.*, 2009) [7] compared to CT. The findings of higher maize yield under ZT in close agreement with the findings of Yadav *et al* 2016 [19], Gathala *et al.*, 2013, Parihar *et al.*, 2016 [13]. The higher yield of maize under zero tillage system could be attributed to the compound effect of early establishment of the crop due to favorable moisture conditions in soil, additional nutrients (Blanco-Canqui *et al.*, 2009 and Kaschuk *et al.*, 2010) [11, 9], reduced competition for resources and improved bio-physicochemical soil health as observed by previous researchers (Jat *et al.*, 2013 and Govaerts *et al.*, 2009) [8, 7] over conventional tillage system.

Table 4: Yield attributes of maize as influenced by different tillage methods, date of sowing and irrigation levels

Treatment	No. of Cobs/plan	Length of cob	Girth of cob	Cob wt (g)	No. of grains/cob	No. of rows/cob	No. of grains/row of cob	100 grain wt (g)
					Tillage			
T_1	1.6	16.3	13.3	179.2	423.28	14.1	33.28	36.16
T_2	1.6	18.2	13.5	197.5	497.68	14.9	35.56	36.05
S.Em (±)	0.0	0.2	0.1	1.5	6.93	0.08	0.31	0.50
LSD (0.05)	NS	1.2	NS	9.2	42.14	0.48	1.91	NS
					Date of sowing			
D_1	1.7	17.6	13.5	193.5	467.14	14.6	34.67	36.66
D_2	1.5	16.8	13.3	183.2	453.81	14.4	34.17	35.55
S.Em (±)	0.1	0.2	0.0	2.5	3.05	0.16	0.58	0.19
LSD (0.05)	NS	0.8	0.1	10.0	11.96	NS	NS	0.76
					Irrigation			
I_2	1.3	15.9	13.1	163.9	424.47	13.2	31.25	33.18
I_4	1.5	17.8	13.3	192.8	461.11	14.5	35.08	36.84
I_6	1.9	18.0	13.9	208.3	495.86	15.8	36.92	38.31
S.Em (±)	0.1	0.2	0.1	3.0	11.14	0.26	0.53	0.77
LSD (0.05)	0.4	0.7	0.4	9.0	33.39	0.79	1.59	2.32

T_1=Conventional Tillage; T_2-Zero Tillage; D_1=30 October; D_2-10 November; I_2=Irrigation at V_6 and tasseling; I_4-Irrigation at V_4, V_{10}, tasseling, milking; I_6-Irrigation at V_4, V_8, V_{10}, tasseling, milking, dough stage of the crop

Table 5: Yield of maize as influenced by different tillage methods, date of sowing and irrigation levels

Treatment	Grain yield (kg/ha)	Stone yield (kg/ha)	Harvest Index (%)
	Tillage		
T_1	8043.2	2107.2	45
T_2	9164.9	2650.1	48
S.Em (±)	55.4	105.6	1.0
LSD(0.05)	336.9	NS	3.0
	Date of sowing		
D_1	9270.6	2499.4	48
D_2	7937.4	2257.8	44
S.Em (±)	154.9	65.5	1.0
LSD(0.05)	608.3	NS	3.0
	Irrigation		
I_2	5169.1	1580.8	37
I_4	9565.5	2635.2	49
I_6	11077.4	2919.9	52
S.Em (±)	101.5	101.3	1.0
LSD(0.05)	304.3	303.6	3.0

T_1=Conventional Tillage; T_2-Zero Tillage; D_1=30 October; D_2-10 November; I_2=Irrigation at V_6 and tasseling; I_4-Irrigation at V_4, V_{10}, tasseling, milking; I_6-Irrigation at V_4, V_8, V_{10}, tasseling, milking, dough stage of the crop

Conclusion
ZT was found to be an advantageous tillage practice in improving soil environment, facilitating maximum crop production while conserving the soil health. In this finding the ZT in combination with earlier sowing and six irrigations produced the maximum yield. Other interaction effect again confirmed that early sown maize with 4 irrigations under zero tillage system also has the potential to produce similar or higher grain yield compared to early sown maize with six irrigations under CT. Early sowing ensures better crop establishment and ZT with higher irrigation level provides better bio-physicochemical soil health for improved root development ensuring better nutrient extraction.

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