The Andhra Agric. J 63 (4): 758-762, 2016

Response of Zero Tillage Maize to Sub Surface Drip Fertigation

V Prasada Rao, B Venkateswarlu, A S Rao, Balkrishna Yadav, K L N Rao and P Prasuna Rani
Department of Agronomy, Agricultural College, Bapatla 522 101, Andhra Pradesh

ABSTRACT

A field experiment was carried out for two consecutive years (2012-13 and 2013-14) on sandy loam soils of Jain Hi-tech Agri institute, Jalgaon, Maharashtra with the objective to study the response of zero tillage to subsurface drip fertigation. The experiment was laid out in split-plot design with four replications. The cultivars used for the study 'Dekalb' (Private hybrid) in maize. The growth parameters viz. plant height, drymatter accumulation and kernel yield, of zero till maize increased with increase in irrigation schedule from 75% Epan to 150% Epan irrigation schedule in drip irrigation. Increase in the level of N application from 120 to 240 kg N ha^{-1} resulted in the increase of all the growth parameters, kernel yield were higher with the irrigation schedule of 150% Epan and nitrogen dose of 240 kg N ha^{-1} applied through fertigation.

Key words : Fertigation, Sub surface drip, Zero tillage maize.

Maize is the third most important cereal crop next to rice and wheat in the world. In India, maize is grown in an area of 8.26 m ha with a production of 16.72 m t with a productivity of 2024 kg ha^{-1}. In Andhra Pradesh, it is grown in an area of 0.783 m ha with a production and productivity of 2.762 m t and 3527 kg ha^{-1} respectively (Indiastat, 2010). Judicious use of irrigation water coupled with efficient nutrient management is more important to enhance total food grain production. During vegetative growth, plants have a high demand for nitrogen that is required for efficient root system, leaf and stem development and dry matter production. Nitrogen is the main plant nutrient that limits plant growth and affects yield and quality of the kernel. Escalating prices of nitrogen fertilizers coupled with reduction in subsidy on fertilizers have forced crop growers to use fertilizers efficiently. Better plant nutrient management is necessary for achieving self-reliance in agriculture (Oktem *et al*., 2010).

Fertigation is the precise application of water soluble fertilizers (Nitrogen) through drip irrigation. It is an efficient and economically viable method of providing soluble plant nutrients directly to the active plant root zone. The increase in area under micro- irrigation in different crops provides an excellent opportunity to explore fertigation technique that provides complete and balanced plant nutrient management and have the potential to improve plant growth and maximum yield with less/ equal quantity of nitrogen. Though many studies were reported on effect of drip irrigation and N fertigation levels on grain maize, only few have been reported on maize with drip irrigation and N fertigation

MATERIAL AND METHODS

A field experiment was carried out for two consecutive years (2012-13 and 2013-14) at sandy loam soils of Jain Hi-tech Agri institute, Jalgaon, Maharashtra with the objective to study the response of zero tillage to subsurface drip fertigation. The experimental soil was sandy loam soils which had pH of 7.3 and soil was low in organic carbon (0.37%), available nitrogen (184.4 kg ha^{-1}), available phosphorus (11 kg ha^{-1}) and available potassium (257.3 kg ha^{-1}) experiment was laid out in split-plot design with four replications. Four irrigation schedules were taken in main plots and four nitrogen levels in sub plots in drip system Irrigation treatments included I_1: SDI at 75% Epan, I_2: SDI at 100% Epan, I_3: SDI at 125% Epan and I_4: SDI at 150% Epan with four nitrogen levels i.e., N_1:120; N_2: 160; N_3: 200 and N_3: 240 kg ha^{-1} in fertigation. In maize crop, the check tested was surface irrigation at IW/CPE ratio of 1.2 with 160 kg N ha^{-1}. The cultivars used for the study 'Dekalb' (Private hybrid) in maize. The growth parameters viz. plant height, drymatter accumulation and kernel yield, of zero till maize increased with increase in irrigation schedule from 75% Epan to 150% Epan irrigation schedule in drip irrigation. Increase in the level of N application from 120 to 240 kg N ha^{-1} resulted in the increase of all the growth parameters, kernel yield were higher with the irrigation schedule of 150% Epan and nitrogen dose of 240 kg N ha^{-1} applied through fertigation. N was supplied as per the treatments through fertigation commencing from 10 days after sowing upto 80 days after sowing using water soluble fertilizers (urea phosphate and urea) through a ventury fitted to the drip system at weekly interval. For check treatment, N was applied in three equal splits as basal, at knee high and tasseling stages. P_2O_5 was supplied @ 60 kg ha^{-1} as mono ammonium phosphate (MAP) during first fertigation uniformly to all the treatments. For check it was applied as Single super phosphate as basal dose. Uniform dose of K_2O @ 50 kg ha^{-1} was applied for all the treatments including checks as basal through MOP.

RESULTS AND DISCUSSION

The highest plant height observed with irrigation schedule at 150% Epan (335 cm and 339 cm) which was on a par with 125% Epan (330.7 and 322.4.3 cm). Surface irrigation at IW/CPE ratio of 1.2 registered closer plant height with sub surface drip irrigation at 150% Epan. (table.1)The increase in plant height might be due to the higher availability of water and increase in soil moisture regimes was used for the chemical and biochemical process supporting plant metabolism, deficit water limits the cell division and cell expansion. The results are confirmative with research findings of Ganesaraja *et al*. (2009) and Basava *et al*. (2012). Plant height increased with the level of sub surface nitrogen fertigation. The tallest plants (32.6 cm and 39.1 cm) were recorded with 240 kg N ha^{-1} which was superior to that of 120 kg N ha $^{-1}$ but it was on a par with that of 200 kg N ha^{-1} (31.2 cm) during 2012-13 and at significantly superior during 2013-14. The maximum plant height recorded with the application of 240 kg N ha^{-1} might be due to accelerated cell division and cell elongation as promoted by nitrogen. The results are in line with those of Bindhani *et al*. (2008), and Basava *et al*. (2012). Interaction between irrigation schedule and nitrogen fertigation levels was not significant.

Drymatter accumulation was significantly increased with increased irrigation levels from 75% Epan to 150% Epan. The highest (18245 and 19259 kg ha^{-1}) and the lowest (15482 and 14759 kg ha^{-1}) drymatter production observed with irrigation schedule at 150% of Epan and 75% Epan during 2012-13 and 2013-14 years of study respectively. Irrigation schedule of 100% Epan and 125% Epan were also comparable with one on another. Dry matter production was favorably influenced by drip irrigation and fertigation levels. Higher dry matter production might be due to better crop growth, more number of leaves and higher leaf area as a result of maintenance of favourable soil moisture in the root zone and effective absorption by plants. These results are in conformity with findings of Basava *et al*. (2012) and Padmaja (2014). At harvest there was increase in drymatter production with increase in nitrogen levels. Drymatter production was significantly increased with increasing N fertigation levels. Significantly, the highest (18245 and 19259 kg ha^{-1}) and the lowest (15482 and 14759 kg ha^{-1}) dry matter production in first and second years of experimentation was observed in 240 and 120 kg N ha^{-1}, respectively. Increased supply of nitrogen might have helped the maize plants to increase their growth which in turn put forth more photosynthetic surface, thus contributed to more drymatter accumulation. Enhanced drymatter accumulation with increased N application was also reported by Mallareddy *et al*. (2012) and Padmaja (2014).
The interaction effect between the irrigation schedules and nitrogen fertigation doses was not significant.

The kernel yield was significantly increased with increase in the quantity of water applied from the irrigation schedule 75% Epan to 150% Epan during both the years of study. During 2012, significantly the highest kernel yield (11067 kg ha^{-1}) was observed in the treatment which was irrigated at 150% Epan while significantly the lowest kernel yield (9152 kg ha^{-1}) was given by the irrigation schedule at 75% Epan. Kernel yield 10068 kg ha^{-1} was recorded with the irrigation schedule with the 125% Epan and 100% Epan were statically

Table 1. Plant height (cm) of zero tillage maize at maturity as influenced by irrigation schedule and N level through sub surface drip fertigation.

Irrigation Schedule	2012-13 Nitrogen level (kg ha^{-1})					2013-14 Nitrogen level (kg ha^{-1})				
	120	160	200	240	Mean	120	160	200	240	Mean
I_1 : 75 % Epan	292.2	304.6	311.9	313.5	305.5	291.9	302.8	306.8	310.9	303.1
I_2 : 100 % Epan	317.1	315.6	320.7	323.1	319.1	308.4	312.9	323.7	330.3	318.8
I_3 : 125 % Epan	325.1	328.3	331.7	337.9	330.7	310.5	317.1	328.5	333.4	322.4
I_4 : 150 % Epan	326.4	333.4	337.4	342.8	335.0	318.7	323.9	332.9	341.9	329.3
Mean	315.2	320.5	325.4	329.3		307.3	314.1	323.0	323.0	
		Sem±	CD (0.05)	CV (%)			Sem±	CD (0.05)	CV (%)	
I		5.2	16.5	6.4			6.8	21.8	8.6	
N		3.8	10.9	4.7			5.3	15.1	6.6	
IXN										
N at same level of I		7.6	NS				10.5	NS		
I at Same level of N		8.3	NS				11.4	NS		
Check : Maize with surface irrigation at IW/CPE ratio of 1.2 with 160 kg N ha^{-1}					302.8					300.8

Table 2. Drymatter production (kg ha^{-1}) of zero tillage maize at maturity as influenced by irrigation schedule and N level through sub surface drip fertigation.

Irrigation Schedule	2012-13 Nitrogen level (kg ha^{-1})					2013-14 Nitrogen level (kg ha^{-1})				
	120	160	200	240	Mean	120	160	200	240	Mean
I_1 : 75 % Epan	14740	15229	15500	16458	15482	13364	14068	15202	16402	14759
I_2 : 100 % Epan	15177	15750	16187	16656	15943	14811	16268	16664	17485	16307
I_3 : 125 % Epan	15719	16417	16760	17385	16570	16741	17308	17793	18558	17600
I_4 : 150 % Epan	17344	17833	18271	19531	18245	17230	18683	19579	21546	19259
Mean	15745	16307	16680	17508	16560	15537	16582	17310	18498	16981
		Sem	CD (0.05)	CV (%)			Sem	CD (0.05)	CV (%)	
I		477	1526	12			498	1592	12	
N		313	896	8			305	874	7	
IXN										
N at same level of I		625	NS				609	NS		
I at Same level of N		722	NS				725	NS		
Check : Maize with surface irrigation at IW/CPE ratio of 1.2 with 160 kg N ha^{-1}					15902					14020

Table 3. Kernel yield (kg ha^{-1}) of zero tillage maize at maturity as influenced by irrigation schedule and N level through sub surface drip fertigation

Irrigation Schedule	2012-13 Nitrogen level (kg ha^{-1})					2013-14 Nitrogen level (kg ha^{-1})				
	120	160	200	240	Mean	120	160	200	240	Mean
I_1 : 75 % Epan	8253	9047	9330	9980	9152	7867	8124	8533	8793	8329
I_2 : 100 % Epan	8698	9478	9811	10350	9584	8443	9246	9739	9931	9340
I_3 : 125 % Epan	8950	9714	10485	11124	10068	9530	9809	10212	10690	10060
I_4 : 150 % Epan	9599	10976	11753	11942	11067	10326.3	11234	11620	12256	11359
Mean	8875	9804	10344	10849		9042	9603	10026	10418	
		Sem±	CD (0.05)	CV (%)			Sem±	CD (0.05)	CV (%)	
I		258	826	10			258	758	10	
N		255	731	10			255	698	10	
IXN										
N at same level of I		510	NS				487	NS		
I at Same level of N		511	NS				484	NS		
Check : Maize with surface irrigation at IW/CPE ratio of 1.2 with 160 kg N ha^{-1}					8910					8052

comparable with one on other. During 2013 also, the same trend was followed. The kernel yield was 11359, 10060, 9340 and 8329 kg ha^{-1} with the irrigation schedule at 150%, 125%, 100% and 75% Epan, respectively. Increase in kernel yield under drip irrigation at higher levels of irrigation schedule could be attributed mainly to improved soil moisture status throughout the crop growth period. Consequently higher plant relative water content and less negative leaf water potential (Viswanatha *et al*., 2002). The research findings of several workers support the same (El-Hendawy *et al*., 2008 and Basava *et al*., 2012). Kernel yield obtained in the check treatment i.e. supplemental irrigation at 1.2 IW/CPE ratio with 160 kg N ha^{-1} 8910 and 8052 kg ha^{-1} in 2012-13 and 2013-14 respectively, it was lower than that of all the three drip schedules during both the years of study (table.3).

Kernel yield increased with increasing Nitrogen fertigation level. Among the four nitrogen levels studied, higher kernel yield was recorded at 240 kg N ha^{-1} (10849 and 11359 kg ha^{-1}) and was superior to that of fertigation with 120 kg N ha^{-1} (8875 and 9042 kg ha^{-1}) during first year and at par with 200 kg N ha^{-1} during second year (table.3). Application of 160 kg was again superior to 120 kg N ha^{-1} during both the years. Nitrogen fertigation with more readily available form at more frequent intervals might have resulted in higher availability of nitrogen in the soil solution which led to higher growth, uptake and better translocation of assimilates from source to sink thus in turn might have increased the yield (Fanish and Muthukrishnan, 2011). These results are in line with those obtained by Mallareddy *et al*. (2012) and Pasha *et al*. (2012).

Acknowledgement

I acknowledge with great pleasure to Padmasri. Bhavarlal Jain, Chairperson and Founder of Jain Irrigation Systems Ltd. for providing fellowship and financial assistance to conduct the research under "Jain Irrigation Fellowship Programme" at Jalgaon.

LITERATURE CITED

Basava S 2012 Performance of sweet corn hybrid under different levels of irrigation and nitrogen applied through drip system. *M. Sc. Thesis*. Acharya N.G. Ranga Agricultural University, Hyderabad, India.

El-Hendawy S E, El-Lattief E A A, Ahmed M S and Schmidhalter V 2008 Irrigation rate and plant density effects on yield and water use efficiency of drip irrigated corn. *Agricultural Water Management*, 95 (7): 836-844.

Fanish S A and Muthukrishnan P 2011 Effect of drip fertigation and intercropping on growth, yield and water use efficiency of maize (*Zea mays* L.). *Madras Agricultural Journal*, 98 (7/9): 238-242.

Ganesaraja V, Rani S, Kavitha M P and Paulpandi V K 2009 Effect of drip irrigation regimes and fertilizer application methods on growth, yield and nutrient uptake of baby corn. *Journal of Maharastra Agricultural Universities,* 34 (1): 92-93.

Indiastat.com 2010.http://www.indiastat.com/agriculture/2/foodgrains/17180/maize/17199/stats.aspx

Mallareddy M, Padmaja B and Reddy D V V 2012 Response of maize (*Zea mays* L.) to irrigation scheduling and nitrogen doses under no till condition in rice fallows. *Journal of Research, ANGRAU*. 40 (1): 6-12.

Oktem A, Oktem A G and Emeklier H Y 2010 Effect of nitrogen on yield and some quality parameters of sweet corn. *Communications in Soil Science and Plant Analysis*, 41 (7): 832-847.

Padmaja B 2014 Fertigation studies in aerobic rice-zero tillage maize cropping system. Ph.D thesis submitted to Acharya N G Ranga Agricultural University.

Pasha Md L, Krishna L, Bhadru D and Naik R B M 2012 Response of zero tillage maize after *kharif* rice under different methods of establishment and N levels in Nagarjuna Sagar project left canal command area (Sri Lal Bahdur Shastri Canal) of Nalgonda district. C*rop Research*, 44 (1&2): 30-32.

Viswanatha G B, Ramachandrappa B K and Nanjappa H V 2002 Soil-plant water status and yield of sweet corn (*Zea mays* L. cv. *Saccharata*) as influenced by drip irrigation and planting methods. *Agricultural Water Management*, 55: 85-91.

(Received on 09.11.2015 and revised on 12.10.2016)