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Growth and Yield of Maize affected by Irrigation Schedules and Fertigation Levels under Drip Irrigation

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ABSTRACT

A field experiment was conducted on clay soils of Advanced Post Graduate Centre, Guntur, during *rabi*, 2017-18 to study the effect of growth and yield parameters of maize under different irrigation schedules and fertigation levels. Results of the experiment revealed that growth parameters, yield attributes and yield were significantly influenced by irrigation schedules and fertigation levels. Irrigation at 3 days interval with 100% ETc recorded higher plant height (240.4 cm), dry matter accumulation (22357.3 kg ha^{-1}), number of kernels per cob (461.7), kernel (6008 kg ha^{-1}) and stover (9153 kg ha^{-1}) yields. Irrespective of irrigation, fertigation at 100% RDN recorded significantly higher plant height (238.0 cm), dry matter accumulation (21931.9 kg ha^{-1}), no of kernels per cob (467), kernel yield (5753 kg ha^{-1}) and stover yield (8672 kg ha^{-1}). Irrigation at 3 days interval with 100% ET_C along with and 100% RDN recorded significantly higher kernel yield compared with other irrigation and fertigation levels.

Key words: *Drip Irrigation schedule, Maize, Fertigation level.*

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 9.18 m.ha with a production of 24.17 m.t and productivity of 2632 kg ha^{-1}. In Andhra Pradesh it is grown in an area of 0.303 m.ha with a production of 1.93 m.t and productivity of 6396 kg ha^{-1}. (www.Indiastat.com 2014-2015).

Water is a prime natural resource which very often becomes costly and limiting inputs particularly in arid and semi arid tropics and needs to be judiciously used to reap the maximum benefit of other inputs. Hence drip irrigation provides the efficient use of limited water with increased water use efficiency and crop yields may be different under different irrigation frequencies, although the same quantity of water is applied.

Fertigation through drip alter the application rates and frequency to suit the crop requirement at different growth stages, which in-turn increases the fertilizer use efficiency. Fertigation provides optimum nutrients required for the crop to get optimum yield as well as better quality produce through uniform distribution of nutrients in the field. When fertilizer is applied through drip, it was observed that beside the yield increase, about 30 per cent of the fertilizer can be saved (Sivanappan and Ranghaswami, 2005).

MATERIAL AND METHODS

A field trail to study the effect of irrigation schedules and fertigation levels on growth and yield of maize was conducted at Advanced Post Graduate Centre, Lam, Guntur, during *rabi*, 2017-18. Advanced Post Graduate Centre, Lam, Guntur, during *rabi*, 2017-18. The experiment was laid out in split-plot design with four irrigation schedules as main plots and three fertigation levels as sub plots with a total of twelve treatments and replicated thrice. Four irrigation schedules *i.e.*, I_1- Irrigation at 3 days interval with 100% ET_C, I_2- Irrigation at 3 days interval with 80% ET_C, I_3- Alternate irrigation at 3 days interval with 100 % ET_C and 50% ET_C, I_4- Alternate irrigation at 3 days interval with 80% ET_C and 40% ET_C are consisted as main plots and three fertigation levels *i.e* F_1 - 50% RDN , F_2 - 75% RDN , F_3 - 100% RDN (240 kg ha^{-1}) as subplots. The volume of water to be given for each treatment is calculated by multiplying the area with cumulative crop evapotranspiration for 3 days. Five plants were tagged in each net plot area for recording observations that did not involve destructive sampling. All the observations were recorded on these plants at 30, 60, 90 DAS and at harvest. Five plants in the second row from the border row in each plot were cut at each time for recording dry matter accumulation. The data recorded on various parameters of crop was subjected to statistical scrutiny by the method of analysis of variance outlined by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Effect of irrigation schedules and fertigation levels on growth parameters of maize

Irrigation schedules and fertigation levels had significant effect on different growth parameters *viz.,* plant height and dry matter accumulation at different

Table 1. Growth parameters of maize as influenced by different irrigation schedules and fertigation levels

Treatments	Plant height (cm)	Dry matter (kg ha^{-1})	Days to 50% tasseling	Days to 50% silking
Irrigation schedules				
I_1- Irrigation at 3 days interval with 100% ETc	240.40	22357.30	51.80	57.80
I_2- Irrigation at 3 days interval with 80% ETc	234.70	19604.10	53.80	60.80
I_3- Alternate irrigation at 3 days interval with 100% ETc and 50% ETc	226.90	17441.20	56.60	64.60
I_4- Alternate irrigation at 3 days interval with 80% ETc and 40% Etc	215.10	15548.20	59.10	66.10
SEm±	4.44	357.81	0.54	0.54
CD (p=0.05)	15.40	1238.20	1.90	1.90
CV %	5.80	5.70	2.90	2.60
Fertigation levels				
F_1- 50% RDN	218.50	15744.70	58.30	65.30
F_2- 75% RDN	231.30	18536.50	55.30	62.30
F_3- 100% RDN	238.00	21931.90	52.40	59.40
SEm±	3.39	331.43	0.32	0.32
CD (p=0.05)	10.20	993.70	0.90	0.90
CV%	5.10	6.10	2.00	1.80
Interaction (I×F)	NS	NS	NS	NS

Table 2. Yield parameters and yield of maize as influenced by different irrigation schedules and fertigation levels

Treatments	No of cobs plant^{-1}	Cob length (cm)	Test weight (g)	No of kernels per cob	Kernel yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index
Irrigation schedules							
I_1- Irrigation at 3 days interval with 100% Etc	1.12	19.14	24.73	461.7	6008	9153	39.2
I_2- Irrigation at 3 days interval with 80% Etc	1.11	18.26	24.02	427.5	5033	8285	37.6
I_3- Alternate irrigation at 3 days interval with 100% ETc and 50% Etc	1.07	17.91	23.29	391.8	4578	7906	36.4
I_4- Alternate irrigation at 3 days interval with 80% ETc and 40% ETc	1.07	16.72	21.13	356	4040	7202	35.9
SEm±	0.02	0.34	0.65	4.33	88.69	256.03	0.78
CD (p=0.05)	NS	1.18	2.24	15	307	886	NS
CV %	6.04	5.67	8.32	3.2	5	9	6.3
Fertigation levels							
F_1- 50% RDN	1	16.89	20.33	361.9	3677	7673	32.4
F_2- 75% RDN	1.11	17.97	23.83	398.9	5315	8064	39.6
F_3- 100% RDN	1.17	19.16	25.73	467	5753	8672	39.8
SEm±	0.02	0.31	0.62	5.79	78.06	191.44	0.57
CD (p=0.05)	0.07	0.92	1.85	17.4	307	574	1.7
CV%	7.08	5.9	9.19	4.9	6	8	5.3
Interaction (I×F)	NS	NS	NS	S	S	NS	NS

stages of crop growth (Table. 1). But their interaction was found to be non significant. However, taller plants (240.4 cm) and higher dry matter accumulation (22357.3 kg ha^{-1}) at harvest were recorded under irrigation at 3 days interval with 100% ET_C compared to irrigation at 3 days interval with 80% ET_C alternate irrigation at 3 days interval with 100% ET_C and 50% ET_C and alternate irrigation at 3 days interval with 80% ET_C and 40% ET_C. Availability of sufficient soil moisture at different growth stages due to irrigation, enhanced the growth of plant. Similar effect of increased drip irrigation levels on plant height was also reported by Shirazi *et al.* (2011) and Awasthy *et al.* (2015). Among the fertigation levels, significantly higher plant height (238.0 cm) and dry matter accumulation (21931.9 kg ha^{-1}) were recorded with 100% RDN compared to 75 and 50% RDN. Maize plants under irrigation at 3 days interval with 100% ET_C reached to 50 % tasseling and silking (58.3 and 57.8 days, respectively) significantly earlier over the other treatments. Among the fertigation levels, less number of days to 50 % tasseling and silking (52.4 and 59.4 days, respectively) were recorded under fertigation at 100% RDN, which was significantly superior over 75 % (55.3 and 62.3 days, respectively) and 50% RDN (58.3 and 65.3 days, respectively). This might be due to accelerated cell division and cell elongation as promoted by nitrogen. The results are in line with those of Patel *et al.* (2006) and Hassanein *et al.* (2007).

Effect of water management practices on yield parameters of maize

Number of cobs per plant showed a non-significant influence by the irrigation schedules and significant effect with fertigation levels. Higher cob length (19.14 cm) was recorded under irrigation with 3 days interval at 100% ET_C and found at par with irrigation with 3 days interval at 80% ET_C (18.26 cm) and lowest (16.72 cm) under alternate irrigation with 3 days interval at 80% ET_C and 40% ET_C. Kernels per cob (461.7) and test weight (24.73 g) were significantly higher under irrigation with 3 days interval at 100% ET_C compared to other treatments. This might be due to the fact that increasing available soil moisture during vegetative and reproductive growth of maize increased the yield attributes. Fertigating the crop at 100% RDN recorded significantly higher cob length (19.16 cm), kernels per cob (467.0) and test weight (25.73 g) which were significantly superior over 75 % and 50 % RDN. The rate of availability of nutrients might be well in tune with the crop requirement to reflect in terms of increased yield attributes (Table. 2). The significant improvement in yield attributing character noticed with the addition of 100% RDN could be due to the improvement in the growth parameters of a plant. These results are in conformity with that of Ashok Kumar. (2009) and Azhar *et al.* (2011).

Effect of water management practices on yield of maize

Irrigation tried at 3 days interval with 100% ET_C recorded higher kernel yield (6008 kg ha^{-1}) which was significantly superior over other irrigation schedules. Increase in kernel yield under drip irrigation at higher levels of irrigation could be attributed mainly due to improved soil moisture status throughout the crop growth period. Fertigation with 100% RDN recorded significantly higher kernel yield (5753 kg ha^{-1}) over 75 % and 50% RDN. By reducing the amount of irrigation water by 20 to 40 per cent there was about 11 to 52 per cent reduction in kernel yield. 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 increased the yield (Fanish and Muthukrishnan, 2011)

CONCLUSION

Overall, growth and yield of maize were found superior with 100% ETc at 3 days interval over other schedules. Irrigation at 80% ETc at 3 days interval found comparable with 100 % ETc with respect to growth ; however, in case of increasing yield attributes 100 % ETc found significantly higher than 80 % ETc. WUE found higher with irrigation given with 100% or 80 ETc % at 100% RDN. A significant increase in growth and yield of maize resulted with fertigation of 100 % RDN over 50 % and 75 % RDN. Higher BCR realized with application 100 % RDN at 100 % ET_c followed by 80% ETc. Application alternate irrigations with 80 % + 40 % ETc failed to perform with lower BCR in spite of higher WUE due to significantly lower kernel yield compared with other irrigation schedules.

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