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Effect of irrigation level and integrated nutrient management on growth and yield of *Rabi* maize (*Zea mays* L.)

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Abstract
An experiment on *rabi* maize constituting three irrigation level *viz.*, 0.4 IW/CPE ratio (I_1), 0.6 IW/CPE ratio (I_2) and 0.8 IW/CPE ratio (I_3) with 80 mm depth of irrigation at each irrigation with eight integrated nutrient management practices *viz.*, N_1 (50% RDF), N_2 (100% RDF), N_3 (FYM @ 10 t ha^{-1}), N_4 (50% RDF + FYM @ 10 t ha^{-1}), N_5 (100% RDF + FYM @ 10 t ha^{-1}), N_6 (Bio-compost @ 10 t ha^{-1}), N_7 (50% RDF + Bio-compost @ 10 t ha^{-1}) and N_8 (100% RDF + Bio-compost @ 10 t ha^{-1}) was conducted at Instructional Farm, N.M. College of Agriculture, Navsari Agricultural University, Navsari during *rabi* season of 2010-2011.The results showed that irrigation level at 0.8 IW/CPE ratio recorded significantly higher grain (3708 kg ha^{-1}) and straw (9470 kg ha^{-1}) yield of maize over other level of irrigation. Moreover, Application of 100% RDF + Bio-compost @ 10 t ha^{-1} (N_8) produced significantly the higher grain (4075 kg ha^{-1}) and straw (8872 kg ha^{-1}) yields than other integrated nutrient management practices.

Keywords: Irrigation level, Integrated Nutrient management, Growth, Yield

Introduction
Maize (*Zea mays* L.) is an ideal crop owing to its quick growing habit, high yielding ability, palatability and nutritious ness. It can be grown in any season and is one of the most important cereal crops of the world characteristics and as such different hybrids, composites and local varieties maturing in 60 to 150 days are being grown Jain *et al.* (1981) [6]. It can be fed to cattle at any stage, as there is no problem of poisoning to cattle with HCN or oxalic acid in plant unlike sorghum and therefore it is called as Queen of cereals and King of fodder. The father of green Revolution Renowned Nobel Laureate Dr. Norman E. Borlaug has mentioned maize as the crop of future. In future maize can play vital role in ensuring food security as well as nutritional security by use of quality protein maize for the country as well as world as a whole. Gujarat occupy an area of 0.42 million hectare with a production of 5.17 million tons of grain with productivity of 1375 kg ha$^{-1.}$ (Anon., 2008-09) [1]. In Gujarat, maize is principally a rainy season crop but the climatic variability and eco-physiological limitations are the major constraints to achieve potential yield of maize in traditional rainfed *kharif* season in tribal areas of Panchamahal, Dahod, Sabarkantha, Banaskantha, Vadodara, Bharuch, Surat, Anand and Kheda districts of Gujarat stat. Recent studies conclusively proved that maize is a potential winter season crop having three times higher yield potential than *kharif* crop Desai and Deore (1980) [3] and Nayak *et al.* (1987)[7]. Water and nutrient is the key factor to increase the productivity of this crop. As it is scare during winter, it's efficient utilization is necessary. However, information regarding irrigation scheduling and use of integrated sources of nutrients is meager; hence the present experiment was conducted.

Materials and Methods
The experiment was conducted during winter (*Rabi*) season of 2010-2011 at Instructional Farm, N.M. College of Agriculture, Navsari Agricultural University, Navsari. The experiment was laid out in split plot design. With three replications through the combinations of three irrigation levels as main plots *viz.*, 0.4 IW/CPE ratio (I_1), 0.6 IW/CPE ratio (I_2) and 0.8 IW/CPE ratio (I_3) with 80 mm depth of irrigation at each irrigation and eight levels of Integrated nutrient management practices as sub plots viz., N_1 (50% RDF), N_2 (100% RDF), N_3 (FYM @ 10 t ha^{-1}), N_4 (50% RDF + FYM @ 10 t ha^{-1}), N_5 (100% RDF + FYM @ 10 t ha^{-1}), N_6 (Bio-compost @ 10 t ha^{-1}), N_7 (50% RDF + Bio-compost @ 10 t ha^{-1}) and N_8 (100% RDF + Bio-compost @ 10 t ha^{-1}) The soil of experimental plots was clayey(black cotton soil) in texture, and slightly alkaline in reaction (pH 7.7), Low in available Nitrogen, Medium in available Phosphorus and rich in potassium. The soil was found slightly alkaline (pH 7.7) with normal electric conductivity. The Gujarat Maize-6 is extra early (75-80 days), drought

escaping and white flint grained composite variety of marginal environment of the tribal belt of Gujarat, Rajasthan and Madhya Pradesh states of India. The complete dose of nitrogen and full dose of Phosphorus and potassium was applied before sowing and remaining half dose of nitrogen was applied at 30 DAS as per the treatments.

Irrigation treatments were imposed after applying two common irrigation for proper germination and establishment of the crop. Irrigation water was measured with a 15 cm Parshal flume installed in the water channel. The dates of irrigation as per various treatments.

Result and Discussion

Growth and yield attributes

A. Irrigation scheduling

All round improvement in growth and yield attributes, character for applying different levels of irrigation. At 60 DAS and at harvest, significantly maximum plant height & Number of leaves per plant (145.91 and 232.05 cm) & (12.20 and 14.93) in sweet corn was recorded with treatment I_3 (0.8 IW/CPE ratios). This might be attributed to rapid meristematic cell division and cell elongation as because irrigation water acts as a medium for dissolving nutrients in soil due to the presence of adequate moisture as compared to relatively stressed plants (Table 1). Application of irrigation at (0.8 IW/CPE ratios) was recording good significantly influenced in a different yield attributes, character *viz.*, Number of cobs per plant (1.25), cob length (13.21 cm), cob girth (13.24 cm), grain yield per cob (33.08 g), grain yield per plant (41.99 g), test weight (16.62 g), grain yield (3708 Kg ha^{-1}) and straw yield (9470 ha Kg ha^{-1}) and it was at par with irrigation given at (0.6 IW/CPE ratios) (Table 2). Similar results of an increase in maize grain and straw yield were found by Gundlur *et al.* (2011) [4]

B. Integrated nutrient management

Data presented in (Table 1 and 2) revealed that all the growth and yield attributes, character *viz.*, plant height at 30, 60 DAS and at harvest (38.51, 146.26 and 235.32 cm), number of cobs per plant(1.28), cob length (14.26 cm), cob girth (13.69 cm), grain yield per cob (38.32 g), grain yield per plant (49.33 g) test weight (17.68 g), grain yield (4075 Kg ha^{-1}) and straw yield (8872 Kg ha^{-1}) were significantly increased with increase in integrated nutrient management levels. The application of 100% RDF + Bio-compost @ 10 t/ha recorded high growth as well as yield attributes and yield of maize and remain at par with treatment N_7 (50% RDF + Bio-compost @ 10 t/ha) and N_5 (100% RDF + FYM @ 10 t/ha) was significantly superior over its lower levels, because of greater availability of nutrients. The results confirm the findings of Channabasavana *et al.* (2002) [2], Hankare *et al.* (2005) [5] and S.A. Shinde *et al.* (2014) [8]

Conclusion

On the basis of experimental results, it can be concluded that grain yield and net profit from *rabi* maize variety GM-6 can be secured by irrigating the crop on the basis of IW/CPE ratio of 0.8 (6 irrigations) and should be applied 100% RDF (120 : 60 : 00 NPK kg ha^{-1}) along with10 t Bio-compost ha^{-1}.

Table 1: Effect of irrigation levels and nutrient management on growth attributes of *rabi* Maize

Treatment	Plant height			Number of leaves per plant		Days to 50% tasseling and silking	
	30 DAS	60 DAS	At harvest	60 DAS	At harvest	Days to 50% tasseling	Days to 50% silking
A. Irrigation levels (I)							
I_1 : 0.4 (IW/CPE ratio)	35.16	124.89	205.51	11.19	13.68	60.59	64.40
I_2 : 0.6 (IW/CPE ratio)	35.13	141.87	223.77	12.15	14.18	63.02	67.80
I_3 : 0.8 (IW/CPE ratio)	35.92	145.91	232.05	12.20	14.93	65.45	72.15
S. Em. ±	0.88	2.91	2.79	0.22	0.23	1.37	1.70
C.D. (P=0.05)	NS	11.44	10.94	0.85	0.92	NS	NS
C.V.%	12.22	10.37	9.15	8.94	8.04	10.65	12.19
B.Nutrition management (N)							
N_1 : 50% RDF	31.71	131.40	211.00	10.99	13.57	61.38	66.01
N_2 : 100% RDF	34.18	135.29	212.14	11.49	13.81	62.28	67.04
N_3 : FYM @ 10 t/ha	34.63	133.43	208.84	11.69	13.83	62.40	67.68
N_4 : 50% RDF + FYM @ 10 t/ha	36.20	138.30	222.81	12.02	14.38	63.33	68.50
N_5 : 100% RDF + FYM @ 10 t/ha	36.64	140.53	229.56	12.24	14.80	63.91	68.99
N_6 : Bio-compost @ 10t/ha	35.31	135.71	217.98	11.84	14.26	62.63	68.17
N_7 : 50% RDF + Bio-compost @ 10 t/ha	36.62	139.53	224.89	12.03	14.53	63.53	68.68
N_8 : 100% RDF + Bio-compost @ 10 t/ha	38.51	146.26	235.32	12.47	14.94	64.69	69.89
S. Em. ±	1.36	5.60	6.55	0.36	0.40	1.49	1.91
C.D. (P=0.05)	3.90	12.80	12.00	NS	NS	NS	NS
C.V.%	11.57	12.21	8.92	9.10	8.49	7.11	8.41
C. Interaction							
I XN	NS	NS	NS	NS	NS	NS	NS

Table 2: Effect of irrigation levels and nutrient management on yield attributes of *rabi* maize

Treatment	No. of cobs plant-1	Cob length (cm)	Cob girth (cm)	Grain yield per cob (g)	Grain yield per plant (g)	Test weight (g) (1000 seed)	Grain yield (Kg ha^{-1})	Straw yield (Kg ha^{-1})
A. Irrigation levels (I)								
I1 : 0.4 (IW/CPE ratio)	1.11	12.54	12.47	28.98	32.54	14.00	2962	5934
I2 : 0.6 (IW/CPE ratio)	1.15	13.20	12.82	32.28	37.19	15.65	3280	8324
I3 : 0.8 (IW/CPE ratio)	1.25	13.21	13.24	33.08	41.99	16.62	3708	9470
S. Em. ±	0.03	0.14	0.14	0.83	1.54	0.42	112	304
C.D. (P=0.05)	0.10	0.55	0.56	3.24	6.03	1.67	439	1196
C.V.%	11.03	5.28	5.43	12.86	14.15	13.50	16.00	18.00
B. Nutrition management (N)								
N1 : 50% RDF	1.06	11.70	12.06	26.79	28.46	13.21	2613	7375
N2 : 100% RDF	1.14	12.96	12.55	27.98	32.21	13.79	3425	8039
N3 : FYM @ 10 t/ha	1.11	12.25	12.30	26.56	29.58	14.06	2528	7343
N4 : 50% RDF + FYM @ 10 t/ha	1.18	13.10	12.65	28.52	33.64	16.22	3436	7566
N5 : 100% RDF + FYM @ 10 t/ha	1.24	13.63	13.43	36.53	45.81	17.47	3986	8276
N6 : Bio-compost @ 10t/ha	1.12	12.66	12.47	30.11	36.09	14.47	2778	7518
N7 : 50% RDF + Bio-compost @ 10 t/ha	1.23	13.29	13.14	34.60	42.81	16.50	3691	8283
N8 : 100% RDF + Bio-compost @ 10 t/ha	1.28	14.26	13.69	38.32	49.33	17.68	4075	8872
S. Em. ±	0.04	0.46	0.35	2.85	3.79	0.79	137	225
C.D. (P=0.05)	0.12	1.10	0.99	8.14	10.83	2.25	392	644
C.V.%	10.71	10.62	8.14	14.71	12.88	15.31	12.00	8.00
C. Interaction								
I XN	NS	NS	NS	NS	NS	NS	NS	NS

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