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Original Research Article

Studies on Fertigation Management in Post *Kharif* Maize

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A B S T R A C T

An experiment was conducted during post *kharif* season of 2015-16 at Department of Agronomy Vasantrao Naik Krishi Vidyapeeth, Parbhani with twelve treatment combination of irrigation levels (3) and fertigation (4) replicated thrice under split plot design. Result indicated that the application of 100 percent recommended dose fertilizer through drip (F_1) recorded significantly higest growth and yield of maize over the application of fertilizer with 100 % RDF through soil and 50% RDF through drip, respectively but it was on par with 75% RDF through drip. Significantly lowest growth parameter and yield were recorded at 50% RDF through drip and were at par with 100% RDF through drip.

Keywords

Fertigation management, *Kharif*, maize, irrigation

Introduction

Maize (*Zea mays L.*) also called corn, is one of the most crucial and strategic crop in the world. Its origin is in Mexico (Central America) and it is also called as queen of cereals due to its great importance in human, animal diet and high yielding ability. Maize is principally a rainy season crop and requires a minimum soil temperature of 13ºC for germination and root development (optimum range 21ºC - 27ºC). It response well to warm conditions (optimum of 21ºC - 30ºC) as growth increases with temperature up to 30ºC.

It is ranked third after wheat and rice in area and production but in productivity, it surpasses all cereals.). In India, area and production of maize is about 9.43 million hectares, 24.35 million tones, respectively, having average productivity of about 2337 kg/ha. Under Marathwada condition, low temperature and lack of irrigation facilities during the post-rainy season are the major constraint for growth and development of *rabi* maize. When crop is grown at low temperature, there is delayed germination and poor plant stand. However, to exploit the production of post *kharif* maize, there is urgent need of proper cultivation technology.

Fertigation refers to the combined application of water and soluble fertilizer through an irrigation system. Normally

many soils in India are coarse textured with low organic matter content and are inherently low in fertility. Such soils often required replenishment of nutrient deficiency by application of manures and fertilizers to increase crop yield. Now a day's micro irrigation technique such as the drip and micro sprinkler irrigation systems are gaining momentum and popularity amongst the farmers. Conventional method of applying fertilizers by broadcasting uniformly on the surface or by drilling a continuous band of fertilizers alongside the row crop are not compatible with drip irrigation system, because in drip irrigation system water is applied only to a fraction of soil volume (near the root zone). In this wetted zone only we have to apply fertilizers with nutrients, which are essential for plant growth. Surface application of dry fertilizers may not ensure optimum placement, requires lot of man power and time consuming processes compared to fertigation through drip system. Drip irrigation is more desirable than any other irrigation methods for several reasons. Two improved advantages are (1) water conservation (drip requires about half as much water over the growing season as surface irrigation) and (2) the potential for significantly improving fertilizer management. Fertigation is timely application of small amount of fertilizer through drip tubes directly to the root zone. Compared to conventional soil application, fertigation improves fertilizer use efficiency. Subsequently, comparable or better yields and quality can be produced with 20 – 50 % less fertilizers.

Materials and Methods

Field experiment was conducted during 2015-16 post *kharif* on the experimental farm Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The soil in the experimental plot was medium deep black and well drained. The topography of the land was fairly leveled. In investigation time minimum temperature ranged between 14^0C to 20^0C and maximum temperature ranged between 30 to 35 ^{0}C during the crop growth period as well as Minimum evaporation ranged between 2.6 to 2.8 and maximum evaporation ranged between 8.6 to 8.8 during the crop growth period.

The experiment was laid out in spilt plot design with three replications. Each replication consist of 12 treatment combination with three irrigation levels *viz*., I_1: 1.0 PE through drip, I_2: 0.8 PE through drip and I_3: 0.6 PE through drip were taken in main plot and four fertigation levels *viz.*, F_1: 100 RDF through drip, F_2: 75 RDF through drip. F_3: 50 RDF through drip, F_4: 100 RDF through soil in sub plot. The gross plot size 6 x 5 m and net plot size 3.6 x 4.4 m.

First fifteen day common irrigations were applied to all plots. After that irrigations were applied as per treatment. The pan evaporation was measured daily from the U.S.W.B. class 'A' open pan evaporimeter installed at the Central meteorology observatory, Department of meteorology, VNMKV, Parbhani during the period of experiment. The volume of water to be applied was calculated as per the treatment of irrigation level.

The recommended dose of maize was 150:75:75:10 kg. NPK Zn per hectare. For F_1, F_2 and F_3 treatments NPK dose was applied through water soluble fertilizers namely Urea 0:52:34, 0:0:50, zink sulfate. Fertigation was given through the venturi of 0.75 inches. To these treatments during first week no fertigation was given. Up to 80 days 4 split doses of nitrogen will be given

at 20 days interval and P, K, Zn in 2 splits at the time of sowing and 30 days after sowing. For treatment F_4 50 percent P, K Zn and 25% N were applied as a basal dose and remaining 75% dose of N was applied at 20 day interval. The N, P, and K Zn were supplied through urea 10:26:26 zink sulfate, respectively.

Results and Discussion

Data on effect of different irrigation levels on growth, yield attributes and yield of post kharif maize is given in table 1, and 2.

Effect of fertigation levels

Growth attributes

Data on growth attributes at all observations indicated that 100 % RDF through drip showed maximum plant height, mean number of functional leaves per plant and dry matter per plant than rest of the fertigation levels *viz*., 75% RDF through drip (F_2), 100% RDF through soil (F_4) and 50% RDF through drip (F_3), respectively at all observations. Moreover, for all growth attributes, 100% RDF through drip (F_1) and 75% RDF through drip (F_2) were at par and 50% RDF through drip (F_3) recorded lowest value of all growth attributes at all observations.

Better growth attributes under 100% RDF through drip as compared to lower dose of fertilizer through soil application indicated that maize crop showed better response to increased fertilization of NPK and also better performance of water soluble fertilizers over application of fertilizers through soil. This might be attributed to better availability of nutrient under application of water soluble fertilizer which resulted in better or on par growth attributes with low fertigation levels i.e. 50% RDF and 75% RDF through drip over 100% RDF through soil. Similar results were found by Sampatkumar and Pandian (2010) and Muthukrishnan *et al.*, (2011)

Yield attributing characters of maize *viz*., number of cobs per plant, average weight of cob, number of grain per cob and number of grain row per cob, weight of grain per plant were differed statistically due to various fertigation levels. 100% RDF through drip (F_1) recorded significantly higher values of all above referred yield attributes over 100% RDF through soil application (F_4) and 50% RDF through fertigation (F_3), respectively. However, the treatment 100% RDF through fertigation (F_1) was at par with 75% RDF through fertigation (F_2) for all yield attributes. The lowest values of yield attributes were observed with 50% RDF through drip (F_3) and were at par with 100% RDF through soil application (F_4). This effect was obviously due to high efficiency and easy availability of plant nutrients through the water soluble fertilizers. As availability of source in respect of maize increased with the increase in level of fertigation, the production in sink in the crop also followed same trend. These results are in conformity with those obtained by Gholap (1999). Iqbal *et al.*, (2003) and Hassanein *et al.*, (2006).

Significantly higher grain yield (kg/ha) was obtained with 100% RDF through fertigation (F_1), than 100% RDF through soil (F_4) and 50% RDF through drip (F_3) which was on par with 75% RDF through fertigation (F_2).

Moreover, 75% RDF with fertigation was on par with 100% RDF through soil and their by saving 25% NPK for obtaining on par yield with 100% RDF with soil. Application of water soluble fertilizer with drip also proved useful for saving of labour.

Table.1 Growth parameters as influenced by different treatments

Treatment	Mean plant height at harvest (cm)	Mean no of functional leaves plant^{-1}	Mean dry matter production plant^{-1} (gm/plant)
FERTIGATION LEVELS			
F_1 at 100% RDF Through drip	207.51	15.55	262.73
F_2 at 75% RDF Through drip	199.63	15.07	252.82
F_3 at 50% RDF Through drip	174.31	13.54	221.39
F_4 at 100% RDF Through soil	185.34	14.27	235.12
S.E ±	5.95	0.40	7.40
C.D at 5%	17.68	1.18	21.99

Table.2 Effect of different irrigation levels on yield attributes

Treatment	No of cob/plant	Cob weight/plant (gm)	Husk Weight/plant (gm)	Spindle weight/plant^{-} (gm)^{1}	No of grain/cob	No of grain row/cob
FERTIGATION LEVELS						
F_1 at 100% RDF Through drip	1.32	235.71	14.96	21.26	488.11	14.19
F_2 at 75% RDF Through drip	1.27	227.61	14.44	20.53	471.34	13.70
F_3 at 50% RDF Through drip	1.12	200.45	12.72	18.08	415.09	12.06
F_4 at 100% RDF Through soil	1.18	212.26	13.47	19.14	439.55	12.77
S.E ±	0.04	6.32	0.40	0.57	13.09	0.38
C.D at 5%	0.11	18.78	1.19	1.69	38.89	1.13

Table.3 Effect of different irrigation levels on yield

Treatment	Grain yield (kg/ha)	Husk weight (kg/ha))	Spindle weight (kg/ha)	Fodder yield (kg/ha)	Biological yield (kg/ha)	Harvest index
FERTIGATION LEVELS						
F_1 at 100% RDF Through drip	8926.05	749.09	1110.66	12653.56	23436.50	38.08
F_2 at 75% RDF Through drip	8619.30	723.34	1072.49	12251.64	22624.75	38.09
F_3 at 50% RDF Through drip	7590.70	637.02	944.50	10928.25	20145.35	37.66
F_4 at 100% RDF Through soil	8037.92	674.55	1000.15	11552.61	21265.23	37.78
S.E ±	239.37	20.09	29.78	341.98	627.28	-
C.D at 5%	711.22	59.69	88.50	1016.12	1863.81	-

Higher yield under water soluble fertilizer with drip also reported by Ponnuswamy and Santhi (2008). Similar trend was observed for husk, spindle and fodder yield.

Significantly higher grain yield, fodder yield and biological yield was observed with 100% RDF through drip (F_1) than 100% RDF through soil (F_4) and 50% RDF through drip (F_3), however, it was found comparable with 75% RDF through drip (F_2).

Harvest index showed little variation among fertigation levels, 75% RDF through drip (F_2) was numerically higher than rest of treatments followed by 100% RDF through drip (F_1), 100% RDF through soil (F_4) and 50% RDF through drip (F_3), respectively. This indicated little effect on sink-source relation due to fertigation levels.

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