Agricultural Water Management 163 (2016) 263–274

Contents lists available at ScienceDirect

Agricultural Water Management

journal homepage: www.elsevier.com/locate/agwat

Water and nitrate dynamics in baby corn (*Zea mays* L.) under different fertigation frequencies and operating pressures in semi-arid region of India

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ARTICLE INFO

Article history:
Received 13 January 2015
Received in revised form
28 September 2015
Accepted 1 October 2015
Available online 26 October 2015

Keywords:
Drip irrigation
Water and N management
NO_3-N dynamics

ABSTRACT

Improved water use efficiency, under drip irrigation is reduce percolation and evaporation losses, and provides for environmentally safer fertilizer application through irrigation water in the vicinity of the root zone. The present study was conducted at Water Technology Centre (WTC), Indian Agricultural Research Institute (IARI), New Delhi, India to investigate the impact of fertigation frequency and system operating pressure on the dynamics of NO_3-N in the soil root system of baby corn. The study was conducted during the year 2010–11 for three consecutive seasons consisted of nine treatments which included three system operating pressures (0.5 kg cm^{-2}, 1.0 kg cm^{-2} and 1.5 kg cm^{-2}) and three fertigation frequencies (biweekly, weekly and fortnightly). Higher NO_3-N content was found at surface soil (0–15 cm soil depth) in all the treatments. During initial and developmental stages, total applied nitrogen per fertigation was not fully utilized by plants especially in fortnightly fertigation at 1.0 kg cm^{-2} system operating pressure resulting in increase in NO_3-N content at 0–30 cm soil depth. At maturity stage, when fertigation was over, NO_3-N present in 0–30 cm soil depth leached up to 45 cm soil depth and rest of soil profile remained practically unchanged in its content. NO_3-N in lower soil profiles (30–60 cm soil depth) was marginally affected in biweekly and weekly fertigation frequency schedule. Fluctuations of NO_3-N content at all the depths were more in fortnightly fertigation frequency schedule. Yield attributes of baby corn were significantly affected by fertigation at different system operating pressures.

Notation

q	quintal
L	liter
t	tonnes
ha	hectare

1. Introduction

Maize (*Zea mays* L.) is an important cereal crop in the world. In India, maize is grown in 8.12 million ha with a total production of 19.77 million tonnes at an average productivity of 2.43 t ha^{-1}(Ramachandrappa et al., 2004). Baby corn is a high value vegetable with huge potential for its commercial production. Due to its short maturity period, higher yield potential and scope to earn more within a short span of time, baby corn production is becoming popular among farmers. There is a large demand for high quality of baby corn in the national and international market (Thavaprakaash et al., 2005; Tiwari et al., 1998). Three crops of baby corn in a year may resulted in good return per unit area per unit time besides providing good quality green fodder for animals, avenues for crop diversification, value addition and enhanced revenue generation (Pandey et al., 2002).

Water distribution in the root zone under drip irrigation is by far not uniform (wet zones underneath dripper, dry zones in between drippers). However, drip irrigation has the potential to supply just enough water to fulfill the demand of the crop, provide that the crop is able to locate its roots in the wetted zone. Improved water use efficiency under drip irrigation by reducing percolation and evaporation losses, provides environmentally safer fertilizer application

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http://dx.doi.org/10.1016/j.agwat.2015.10.002
0378-3774/

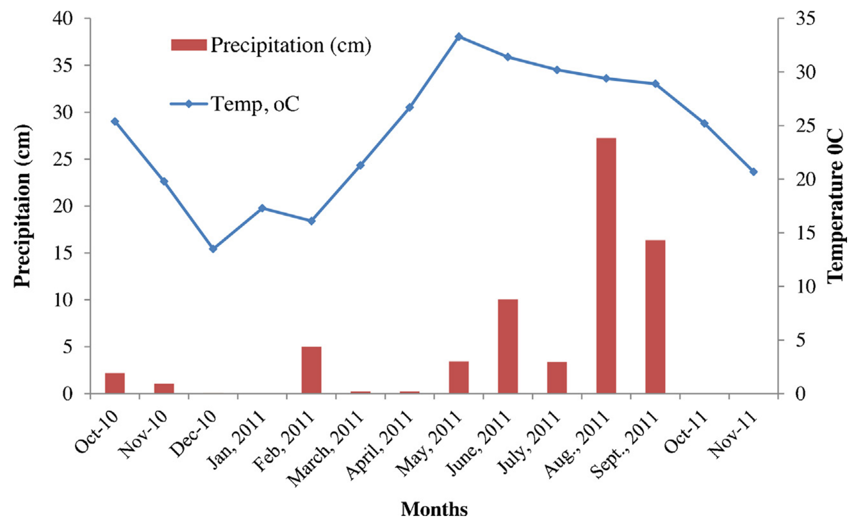

Fig. 1. Mean monthly temperature and monthly total average rainfall during study period.

through irrigation water (Mmolawa and Or, 2000). The baby corn crop is one of the suitable crops for drip irrigation system with a line source as it is grown in rows on ridges (Zhu et al., 2007). Drip irrigation system enhances the productivity and crop growth (Lamm et al., 2001; Brien et al., 2001). Fertigation provides optimum nutrient content to the crop to get optimum yield and significantly better quality produce. It enables the application of soluble fertilizers and other chemicals along with irrigation water in the vicinity of the root zone (Patel and Rajput, 2000; Narda and Chawla, 2002). The application of water and nutrients in small doses at frequent intervals in the crop root zone ensures their optimum utilization and higher crop yield. The application of N in split doses influence the cob yield and other growth parameters of baby corn (Mmolawa and Or, 2000; Muthukumar et al., 2005; Sampathkumar et al., 2010). Rajput and Patel (2006) found that yield of onion was not significantly different in daily, alternate day and weekly fertigation

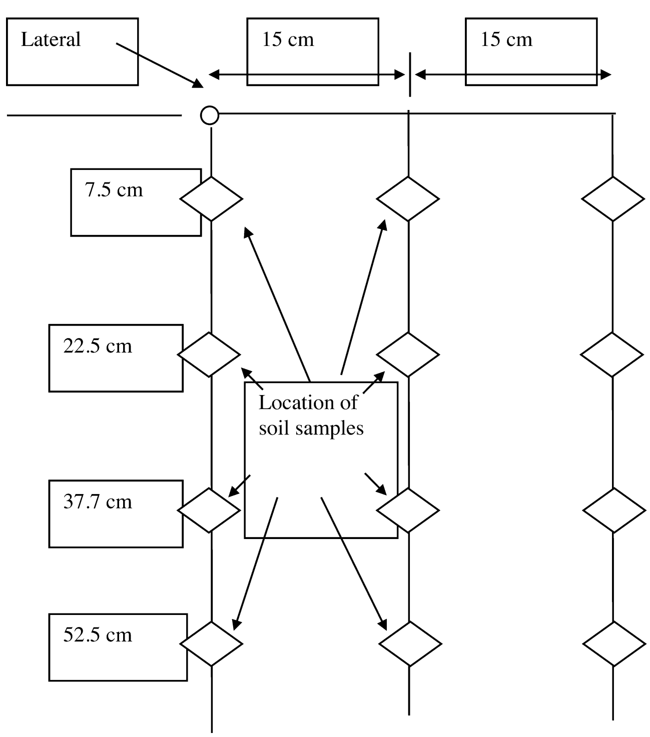

Fig. 2. Method of soil sampling collection.

though there was a trend of lower yields with monthly fertigation. The highest yield was recorded in daily fertigation (28.74 t ha^{-1}) followed by alternate day fertigation (28.4 t ha^{-1}). Badr and Abou El-Yazied (2007) found the highest total tomato yields of 67.75, 65.13 and 63.29 t ha^{-1} with the fertigation frequencies of 1, 3 and 7 days respectively. Yield with the biweekly fertigation frequency was significantly lower than these values (54.32 t ha^{-1}).

Fertigation provides optimum nutrient required for the crop to get optimum yield as well as significantly better quality produce can be achieved only with uniform distribution of nutrients throughout the field (Rajput and Patel, 2006). Thus, fertigation uniformity is an important factor for the design and use of micro irrigation system to realize saving of water and fertilizers and obtain better quality and quantity of produce without degradation of soil and groundwater (Rajput and Patel, 2006). Drip irrigation system operating pressure is also an important factor which affects the drip irrigation and fertigation application uniformity.

Frequent fertigation in small doses matching the crop nutrient demand by low-volume irrigation systems is desirable (Bar-Yosef and Sagiv, 1982; Stark et al., 1983; Burt et al., 1995; Stephens, 1997). However, there is limited evidence of the benefits of high-frequency fertigation in field. Daily or weekly fertigation significantly increased tomato yield compared to less frequent fertigation in loamy sand soil (Cook and Sanders, 1991). There, was no advantage of biweekly over weekly fertigation. Stark et al. (1983) advocated continuous fertigation of surface drip-irrigated tomatoes (*Lycopersium esculentum* L.) with concentrations of 100–200 mg N L^{-1} in the applied irrigation water. Locascio and Smajstrla (1995) observed that tomato yields with daily fertigation did not show increase in tomato yield *vis-a-vis* weekly fertigation in a fine sandy soil. Yield of drip-irrigated peppers (*Capsicum annum* L.) were not affected by fertigation interval (11 or 22 days) in a loamy sand soil (Neary et al., 1995). Rajput and Patel (2006) found the highest yield of onion in daily fertigation as compared to alternate day fertigation whereas, the lowest yield was recorded in monthly fertigation frequency.

The high-frequency fertigation with drip-irrigation for vegetable crops is preferred to less frequent fertigation. Fertigation frequency is one of the major management variables with drip-irrigation systems that have not been adequately investigated (Rajput and Patel, 2006). Very little work has been conducted on baby corn with drip irrigation, however, no work is reported on baby corn with fertigation in India. In view of this, present field experiment was conducted first time in India to investigate the