International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(4): 1458-1462

Received: 27-05-2018
Accepted: 28-06-2018

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Effect of irrigation and Fertigation levels on growth and yield of potato

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Abstract
The present investigation was carried out to find out the effect of frequency and dose of nitrogen fertigation on growth and yield of potato under Precision farming Development Centre at the Department of Horticulture, CCS Haryana Agricultural University, Hisar during season of 2014-16. The potato planted at a spacing of 60 cm × 20 cm. The drip irrigation system was installed 16 mm size of lateral having dripper on line of 4 lph capacity. The experiment comprising three levels of drip irrigations *i.e.* 1.0 (I_1), 0.8 (I_2) and 0.6 (I_3) volume of water and four levels of fertilizers based on recommended dose of Potato F_1: 25% of RDF as basal + 75% of RDF through fertigation at 23,30,37,43,51,58, and 65 days after planting. F_2: 50% of RDF as basal + 50% of RDF through fertigation at 23,30,37,43,51,58 and 65 days after planting, F_3: 100% of RDF through fertigation at 23, 30, 37, 43, 51, 58 and 65 days after planting and F_4: RDF application as band placement and furrow irrigation at 30 mm CPE. Planting was done on 12th October, 2014-2016. The maximum plant emergence (98.00% and 99.00%), plant height (90 days after planting) (58.33 cm and 58.90 cm), yield per plot (38.37 kg and 39.97 kg) and total yield was found maximum (319.30 q/ha and 333.00 q/ha) in the treatment combination I_1F_1, respectively during both the season.

Keywords: growth, drip irrigation, fertigation, potato, yield

Introduction
Potato (*Solanum tuberosum* L.) is the third most important food crop after rice and wheat is being grown and consumed in all over the world (FAO, 2014; Singh, 2008) [4, 13]. Its production in many part of the world is highly dependent on inputs of irrigation water and N fertilizer to achieve optimum yield and quality. Water supply is major constraint to crop production. Water is the source of life and has a special place in our planet. Efficient use of water by irrigation is becoming increasingly important, and alternative water application method such as drip, may contribute substantially to the best use of water for agriculture. Drip irrigation also provides application of soluble fertilizers and other chemicals along with irrigation water. Among modern irrigation techniques, drip irrigation has been shown to be a more water efficient alternative than furrow irrigation for potato (Wang *et al.*, 2011) [15]. With the drip irrigation systems, water and nutrients can be applied directly to the crop at the root level, having positive effects on nutrient uptake, yield and water saving and increasing the irrigation performance (Nagaz *et al.*, 2012) [15]. Inadequate N fertilization leads to poorer potato growth and yield while excessive N application leads to delayed maturity, poor tuber quality, and occasionally a reduction in tuber yield (Cerny *et al.*, 2010) [3]. Frequent application of water and nutrients ensure that the root systems well supplied with nutrient solution and prevents the formation of depletion zone resulted from uptake of nutrient between successive fertigation. These inputs must be carefully managed to ensure optimum profits and minimal environmental impacts. Escalating fertilizer costs and declining water availability are causing growers to adopt production practices which allow them to significantly improve water and N use efficiency and decrease labour costs. High level of N tends to reduce tuber development by promoting shoot growth while treatments which inhibit or reduce shoot growth, such as applications of a growth suppressor, promote tuber formation (Peres *et al.*, 2005) [11]. N rate and fertigation frequency resulted in significant differences in total N uptake, N recovery and apparent N use efficiency. As critical as irrigation management, both the timing and amount of N applied to the crop must be managed in a way that supplies sufficient N for crop yield without leaching N of the groundwater. This greatly improves the potential for excellent N use efficiency due to decreased amount of applied N and leaching losses.

Drip irrigation also provides application of soluble fertilizers and other chemicals along with irrigation water. Among modern irrigation techniques, drip irrigation has been shown to be a more water efficient alternative than furrow irrigation for potato. In fertigation Nutrient use efficiency could be as high as 90% compared to 40 - 60% in conventional methods.

Material and Methods

The field experiment was carried out at under Pricision farming Development Centre at the Department of Horticulture, Hisar during Rabi-season 2014-15 and 2015-16. Hisar is situated at latitude of 29º10' N, longitude of 75º 46' E and height of 215.2 metres above mean sea level and falls in semiarid and sub-tropical region with hot and dry summer and sever cold in winter. The soil was sandy loam in available organic carbon (0.66%), available nitrogen (105 kg/ha), available phosphorus (80 kg/ha) and available potash (225 kg/ha) with pH of 8.3. The air temperature (ºC) and relative humidity (%) and during the potato vegetation period at the experimental field. The experiment was laid out in split plot design. The net plot size was two rows of eight-meter length each (8.0 × 1.2 m). Farm yard manure (FYM) @ 50 t/ ha was applied prior to field preparation and full dose of phosphorus and potash were applied as basal dose. Potato tubers of *cv*. Kufri Bahar were planted at 60 × 20 cm spacing in the second week of October. Immediately after planting a common irrigation was applied in all the treatments through conventional furrow method for uniform and rapid germination. The differential drip fertigation treatments were started from third week of planting.

The crop was subjected to four levels of nitrogen *i.e.* F_1: 25% of RDF as basal +75% of RDF through fertigation at 23,30,37,43,51,58,and 65 days after planting, F_2: 50% of RDF as basal + 50% of RDF through fertigation at 23,30,37,43,51,58 and 65 days after planting, F_3: 100% of RDF through fertigation at 23, 30, 37, 43, 51, 58 and 65 days after planting, F_4: RDF application as band placement and furrow irrigation at 30 mm CPE and three irrigation levels *i.e.* I_1: 60% of 10 mm CPE, I_2: 80% of 10 mm CPE and I_3: 100% of 10 mm CP. Hence, twenty one treatment combinations were used for conducting present study. The irrigation was applied at every 3rd day though drip.

Results and Discussion

The data pertaining to percentage of plant emergence have been presented in figure 1, it is clear from the figure that different fertigation and irrigation frequencies have significant effect on the percentage of plant emergence. Among all the irrigation and fertigation level maximum plant emergence was recorded with the interaction of I_1F_1 (98.00% and 99.00%) during 2014-15 and 2015-16, respectively.

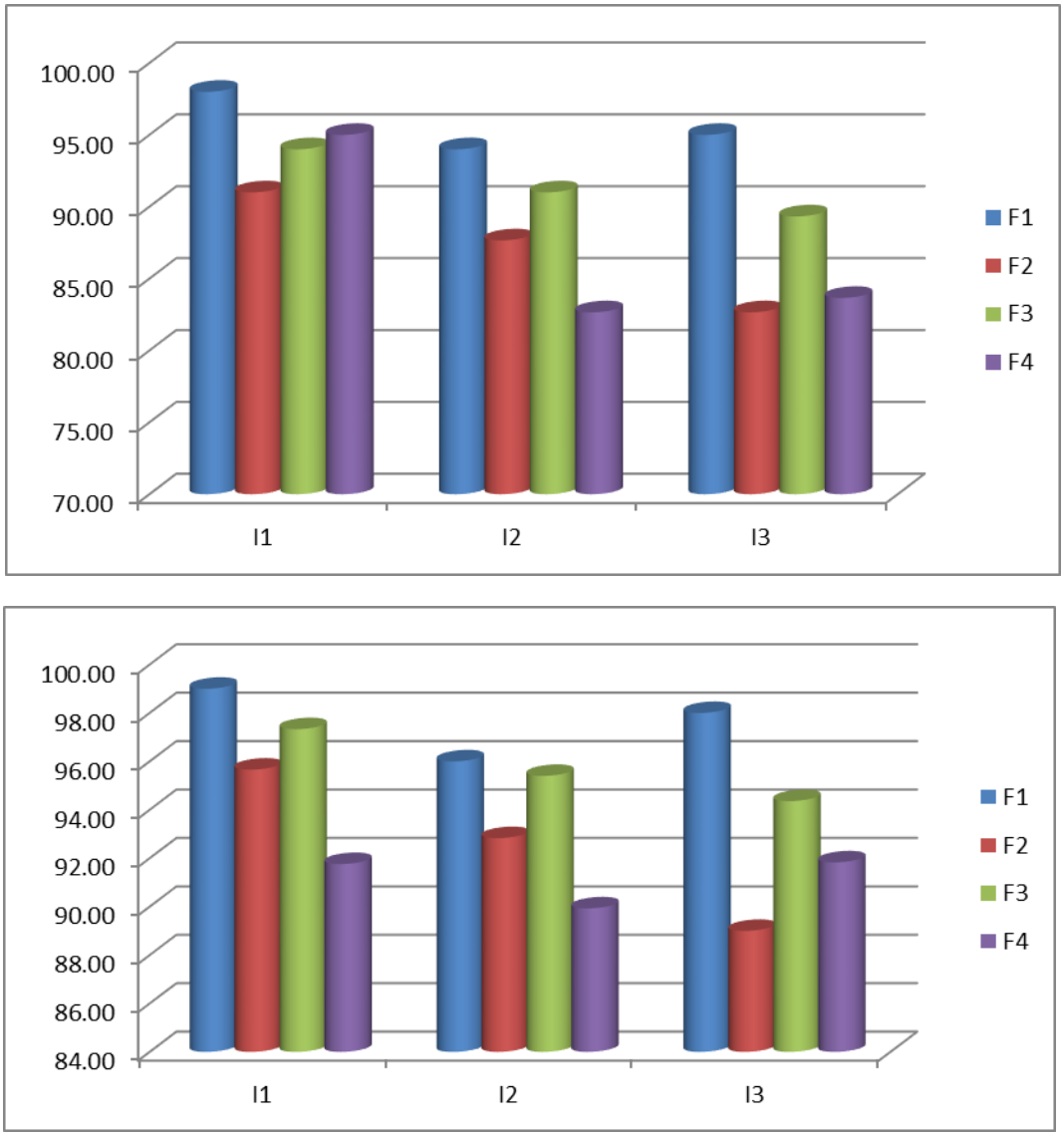


Fig 1: Effect of different levels of irrigation and nitrogen on plant emergence (Days) of potato cv Kufri Bahar

It was observed that the difference in plant height of potato plants (after 90 days of planting) was significant under various irrigation and fertigation treatments during both the years (Figure 2). The maximum plant height (58.33cm and 58.90 cm) was recorded with irrigation level 60% of 10 mm CPE with fertigation level 1 (25% of RDF as basal +75% of RDF through fertigation at 23,30,37,43,51,58,and 65), whereas, minimum plant height (44.66 cm and 48.50 cm) was observed from treatment combination F_4I_3 during both the years of investigation. Plant height increased significantly with increase in N levels through fertigation. The lowest plant height was recorded with application of RDF application as band placement and furrow irrigation at 30 mm CPE. The increase in plant height with increased levels of N application by fertigation can be ascribed to the role of nitrogen in meristematic activity, which increases the number of nodes or internodal length (Rana *et al.*, 2001). Adequate supply of nitrogen leads to synthesis of proteins from carbohydrates which help in increasing the plant height (Panchbhai *et al.*, 2005).

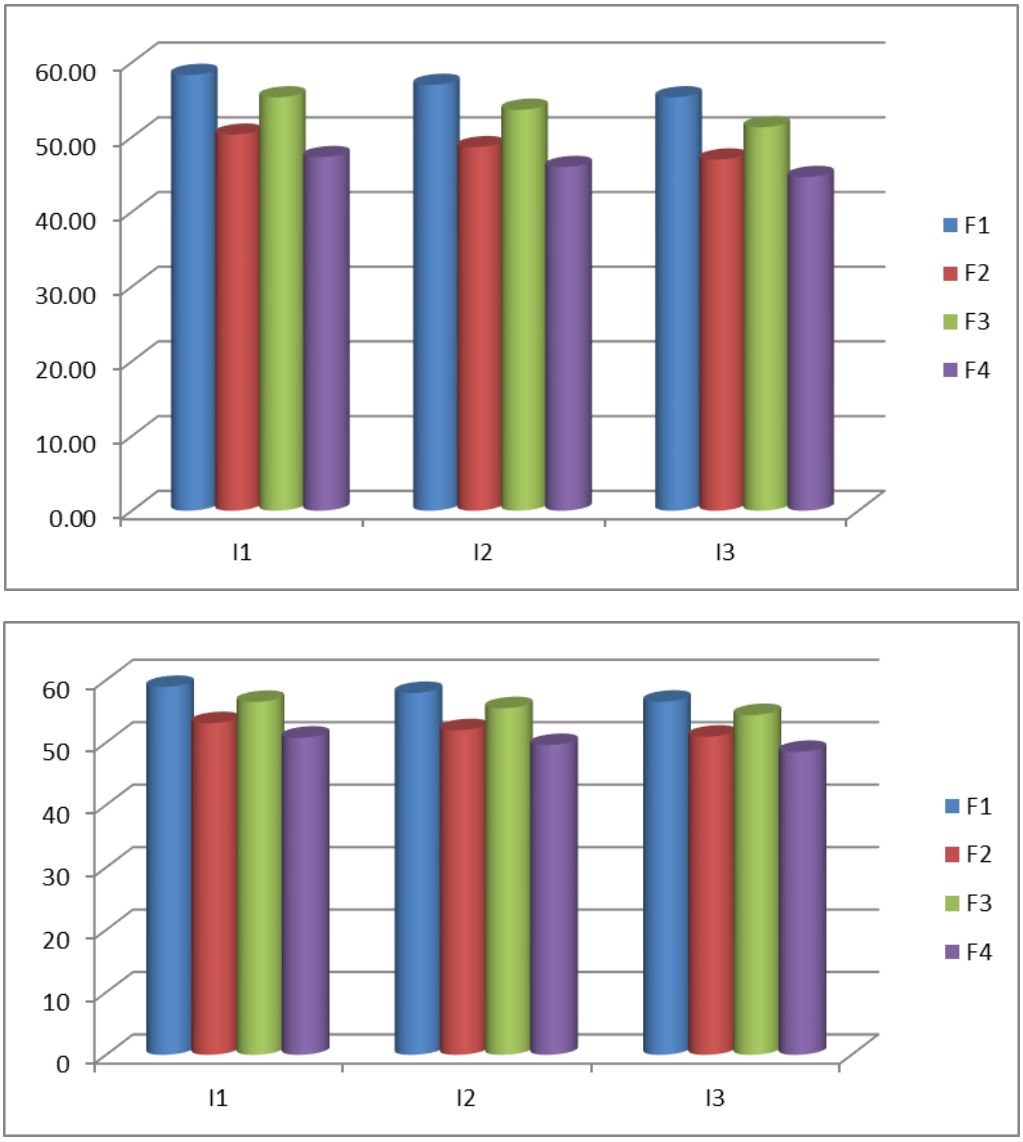


Fig 2: Effect of different levels of irrigation and nitrogen on plant height (cm) of potato cv Kufri Bahar after 90 days of planting

The interaction effect of irrigation and nitrogen level also showed remarkable variation among the treatment combination concerning total weight of tuber/ plot (Figure 3). The treatment combination level F_1I_1 (60% of 10 mm CPE with 25% of RDF as basal +75% of RDF) showed the highest level of interaction effect on total weight of tuber (38.37 kg/ plot and 39.97 kg/ plot), while the treatment combination irrigation level 60% of 10 mm CPE with nitrogen level RDF application as band placement and furrow irrigation at 30 mm CPE showed the minimum value of total weight of tuber (23.52 kg/plot and 26.43 kg/plot) during 2014-15 and 2015-16, respectively. Higher rate of N nutrition through fertigation was needed to maximize yields when sufficient amounts of irrigation water were applied (Thompson *et al.*, 2000 and Rajasekaran, 2007) [14, 12]. The results of Janat (2007) [5] revealed that compared to furrow irrigation, higher marketable tuber yields of spring potato was obtained with fertigation and the magnitude of increase was 4, 2, 31 and 13% for N fertilizer rates of 70, 140, 210 and 280 kg N ha^{-1} respectively.

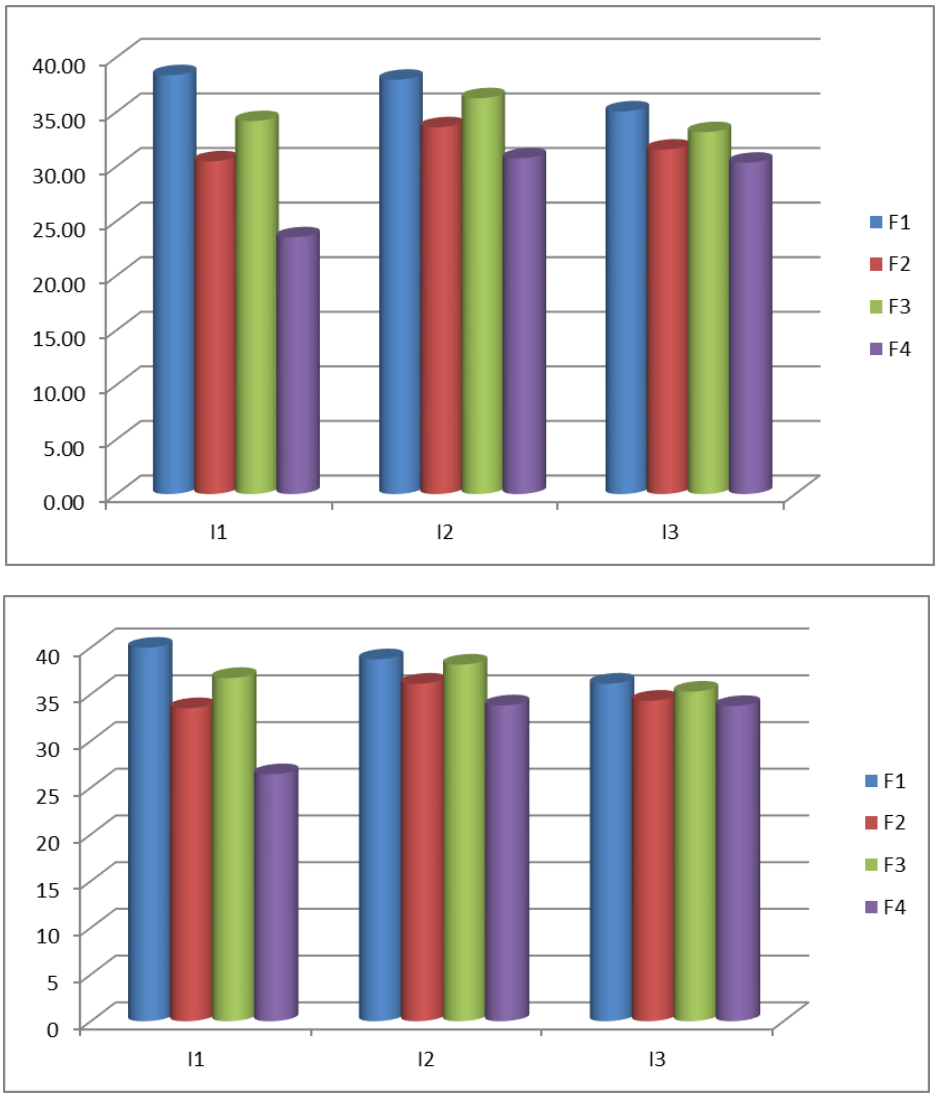
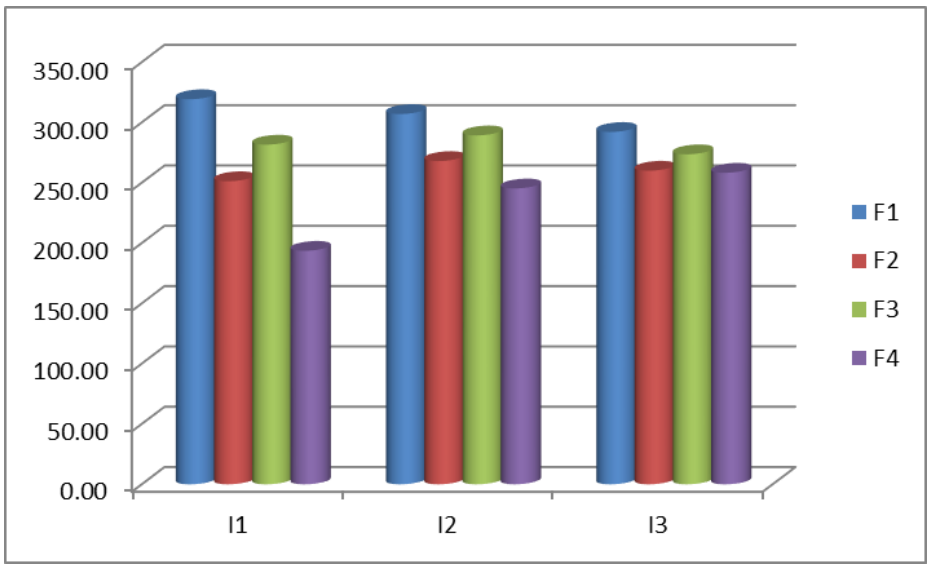


Fig 3: Effect of different levels of irrigation and nitrogen on yield/ plot (kg) of potato cv Kufri Bahar

The data presented in Figure 4 show that all the irrigation treatments different significantly with respect to potato tuber yield (q/ha) in both the years. The tuber yield of potato increased distinctly with 60% of 10 mm CPE. The uppermost value for mean tuber yield (319.30 q/ha and 333.00 q/ha) was recorded with the treatment combination F1I1 (60% of 10 mm CPE with 25% of RDF as basal +75% of RDF), while the lowest tuber yield (193.60 q/ha and 220.00 q/ha) was recorded with F_4I_1 treatment combination. Kumar *et al.*, (2006) [6] reported that crop responded to nutrient application rate under drip fertigation with fertilizer level F_1 (Fertigation levels N 187: P_2O_5 63:K_2O 125 kg/ha) producing the highest tuber yield, followed by F_2 (141:47:93 kg/ha) and F_3 (93:32:63 kg/ha).



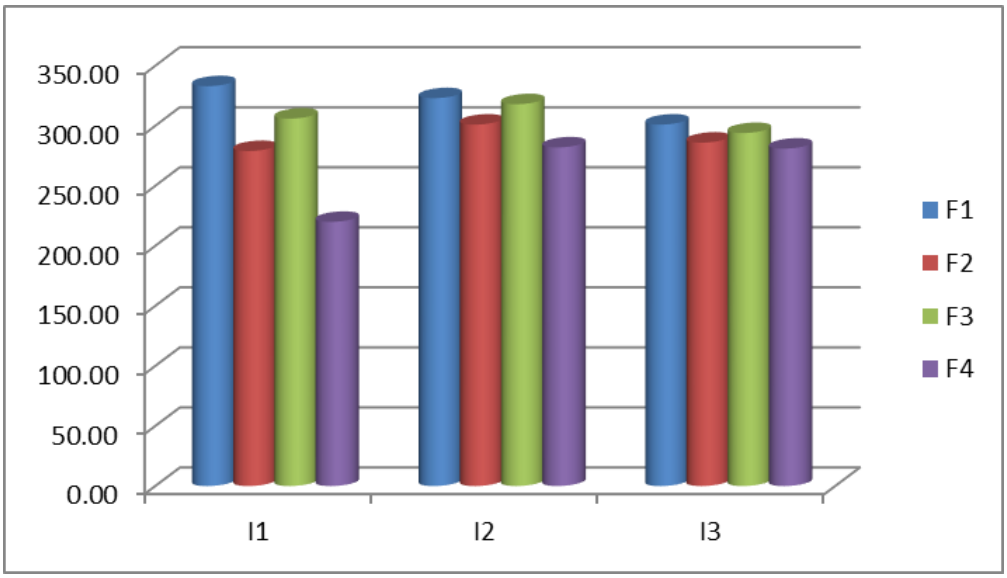


Fig 4: Effect of different levels of irrigation and nitrogen on yield (q/ ha) of potato cv Kufri Bahar

These findings are in conformity with the results of Khalak *et al.,* (1996) [7]. Similarly, Badr *et al.,* (2012) [1] reported the higher tuber yield at higher nitrogen rate compared to the low nitrogen rate and average total yield across fertigation frequencies were 31.25 and 44.03 t/ha for 200 and 300 kg N/ha, respectively. Meyer and Marcum (1998) [9] also reported a positive response of potato yield and quality to increasing N rate, and found that total yield was maximized with nitrogen @224 kg/ha. Behnam and Mansour (2012) [2] showed that the interaction of different levels of N fertilizer × different of application times significantly affected tuber yield ($P \leq 0.05$). A distinct increase tubers yield was observed with T_1 (424.12 Q/ha) (Drip each row) and T_2 (406.75 Q/ha) (Drip each pair) during both the years and in pooled data (Kapadiya *et al.,* 2013) [6].

Conclusion

Potato yield and its components were significantly affected be N application rate and fertigation frequency. Based on the findings of two season study conducted during Rabi season 2014-15 and 2015-16, it may be concluded that when 75% nitrogen was applied through drip irrigation at every 7th day, it gave significantly maximum higher tuber yield.

References

1. Badr MA, El-Tohamy W, Zaghloul A. Yield and water use efficiency of potato grown under different irrigation and nitrogen levels in an arid region. Agricultural Water Management. 10.1016/j.agwat.2012.03.008.
2. Behnam E, Mansour S. Study of the Effect of Different Levels and Application Timing of Nitrogen Fertilizer on Yield and Number of Potato Tuber of Agria in Ghorveh, Iran. Annals of Biol. Res. 2012; 3(3):1385-1387.
3. Cerny J, Balk J, Kulhnek Kulhanek M, Casova K, Nedved V. Mineral and organic fertilization efficiency in long-term stationary experiments. Plant Soil Env. 2010; 56:28-36.
4. FAO statistical databases FAOSTAT. http://faostat3.fao.org/Accessed, 2014.
5. Janat M. Efficiency of nitrogen fertilizer for potato under fertigation utilizing a nitrogen tracer technique. Communications in soil science and plant analysis. 2007; 38(17):2401-2422.
6. Kapadiya HN, Gohil KB, Trivedi SA. Potato Crop Performance and Economics under Various Irrigation Systems. Indian J Res. 2013; 3:103-104.
7. Khalak A, Kumaraswamy AS. Dry matter accumulation and growth attributes of potato as influenced by irrigation and fertigation application. Mysore J Agril. Sciences. 1996; 30:39-42.
8. Kumar S, Mandal G, Asrey R, Singh, R. Influence of irrigation and fertigation on yield, production efficiency and economic returns of drip irrigated potato under semi-arid environment. Potato J. 2006; 33(3-4):126-130.
9. Meyer RD, Marcum DB. Potato yield, petiole nitrogen, and soil nitrogen response to water and nitrogen. Agronomy J. 1998; 90(3):420-429.
10. Nagaz K, Masmoudi MM, Mechlia NB. Yield response of drip-irrigated onion under full and deficit irrigation with saline water in arid regions of Tunisia. International Scholarly Research Notices (Agronomy) 2012. Article ID 562315, 8 pages doi:10.5402/2012/562315.
11. Peres LEP, Carvvalho RF, Zsogon A, Oscar DBZ, Walter GRR, Silvio T. Grafting of tomato mutants onto potato rootstocks: an approach to study leaf-derived signalling on tuberization. Plant Sci. 2005; 160:680-688.
12. Rajasekaran M. Effect of fertigation on growth, yield and quality of tropical sugar beet. M. Sc. (Ag.) Thesis. Tamil Nadu Agricultural University Coimbatore, 2007.
13. Singh HP. Policies and strategies conducive to Potato development in Asia and the Pacific region. In: Proceedings of the Workshop to Commemorate the International Year of Potato-2008 held on 6 May 2008 at Bangkok, Thailand, 2008, 18-29.
14. Thompson TL, Doerge TA, Godin RE. Nitrogen and water interactions in sub-surface drip irrigated cauliflower. Soil Science Society of Amrican Journal. 2000; 64:406-411.
15. Wang FX, Wu XX, Shock CC, Chu LY, Gu XX, Xue X. Effects of drip irrigation regimes on potato tuber yield and quality under plastic mulch in arid north western China. Field Crops Res. 2011; 122:78-84.