Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.2509

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (1):** 484-488 (2017)

International Journal of Pure & Applied Bioscience

Research Article

OPEN ACCESS

Nitrogen Application Frequency on the Yield of Drip Irrigated Potato (*Solanum tuberosum* L.) *Cv*. Kufri Bahar

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Received: 24.01.2017 | Revised: 5.02.2017 | Accepted: 6.02.2017

ABSTRACT

The experiment comprising of four levels of nitrogen, i.e., 90(N_1), 120(N_2), 150(N_3) and 180(N_4) kg/ha and three fertigation frequencies, i.e., every 3rd day (F_1), every 6th day (F_2) and every 9th day (F_3), was carried out at Research Farm of the Department of Vegetable Science, CCS H.A.U., Hisar during Rabi season of 2014-15 to evaluate the effect of fertigation frequency and nitrogen level on the yield and yield parameter of potato cv. Kufri Bahar. The treatments were laid out in randomized block design with three replications. The number of tuber/m^2 (>50-75g and >75g grade), yield of tuber/m^2 (>50-75g and >75g grade), total tuber yield were significantly higher when fertigation applied at every 3rd day. However, number of tuber/m^2 (up to 25g, >25-50g grade), yield of tuber/m^2 (up to 25g and >25-50g) grade were maximum in F_3. Nitrogen levels exhibited significant difference for growth and yield. The maximum value for number of tuber/m^2 (>50-75g and >75g), yield of tuber/m^2 (>50-75g and >75g), total tuber yield were maximum with N_2. Interaction effect of fertigation frequency and nitrogen levels showed remarkable variation. The maximum number of tuber/m^2 (>50-75g and >75g), total tuber yield with F_1N_2. When fertigation applied at every 3rd day with nitrogen @120 kg/ha was found significantly superior to all other treatments combination.

Key words: *Drip irrigation, Fertigation frequency, Nitrogen, Potato and 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[4,11]. India has the largest irrigation network in the world; its irrigation efficiency has not been more than 40%. The modern method of irrigation provides scope to utilize water and fertilizer nutrients effectively by minimizing the losses of irrigation water and plant nutrients in the form of deep percolation and surface runoff. Drip irrigation applies water directly on or below the soil surface near the root zone of plant and delivers the required quantity of water in relatively small amounts precisely to plant root zone through emitters placed along a low pressure delivery system.

Cite this article: Ghiyal, V., Bhatia, A.K. and Batra, V.K., Nitrogen Application Frequency on the Yield of Drip Irrigated Potato (*Solanum tuberosum* L.) *Cv*. Kufri Bahar, *Int. J. Pure App. Biosci.* **5(1):** 484-488 (2017). doi: http://dx.doi.org/10.18782/2320-7051.2509

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[13]. In fertigation, nutrient use efficiency could be as high as 90% compared to 40-60% in conventional methods. The amount of fertilizer lost through leaching can be as low as 10% in fertigation where as it is 50% in the traditional system. Adoption of micro-irrigation systems may help to increase the irrigated area, productivity of crops and water use efficiency. 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[3].

MATERIALS AND METHODS

The experiment comprising of four levels of nitrogen, *i.e.,* 90(N_1), 120(N_2), 150(N_3) and 180(N_4) kg/ha and three fertigation frequencies, *i.e.,* every 3rd day (F_1) in 30 split doses, every 6th day (F_2) in 12 split doses and every 9th day (F_3) in 9 split doses, was carried out at Research Farm of the Department of Vegetable Science, CCS H.A.U., Hisar during *Rabi* season of 2014-15. The treatments were laid out in randomized block design with three replications. The net plot size was two rows of 8 m length (8.0x1.2 m). The soil was sandy loam in available organic carbon (0.66%), available nitrogen (105 kg/ha), available phosphorus (8.0 kg/ha) and available potash (225 kg/ha) with pH of 8.3. The air temperature (^oC), relative humidity (%) and the sum of precipitation (mm) during the potato vegetation period at the experimental field are summarized in Figure 1. 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 last 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 20 days after planting. The irrigation was applied at every 3rd day though drip. The number of tuber in each grade (/m^2), weight of tuber in each grade (kg/m^2) and total tuber yield (q/ha) was recorded.

RESULTS AND DISCUSSION

Numbers of tubers in different grades

The number of tubers up to 25 g and >25-50 g was found highest with fertigation on every 9th day and minimum was observed with fertigation at every 3rd day (Table 1). In case of nitrogen levels, the maximum number of up to 25 g and >25-50 g tubers was recorded with application of nitrogen @180 kg/ha, while the minimum was observed with nitrogen @120 kg/ha. Significantly higher number of tubers of >50-75 g and >75 g was recorded with F_1, while the lowest weight of these grade tubers was observed with F_3. Among the nitrogen levels, the application of nitrogen @120 kg/ha was significantly increased the number of >50-75 g and >75 g tubers, whereas, minimum number of these grade tubers was observed with nitrogen @180 kg/ha. The present results are in harmony with the findings of Singh *et al*[12]., who also observed significant effect of irrigation on number of different grade tubers. Behnam Etemad and Mansour Sarajuoghi[2] showed that the maximum numbers of tuber was in condition of application of 200 Kg/ha N fertilizer. All different level of N fertilizer reduced number of tubers after 75 days application. This study also showed that the interaction of different levels of N fertilizer × different of application times significantly affected number of tuber per square meter ($P \leq 0.05$).

Weight of tubers in different grades

Significantly higher weight of tubers of >50-75 g and >75 g was recorded with F_1, while the lowest weight of these grade tubers was observed with F_3. Among various nitrogen levels, application of nitrogen @120 kg/ha resulted significantly higher weight of >50-75 g and >75 g grade tubers, whereas, minimum weight of these grade tubers was observed with N_4. Weight of tubers of up to 25 g and

>25-50 g was found highest with F_3 and minimum was observed with F_1. In case of nitrogen levels, maximum weight of up to 25 g and >25-50 g tubers was recorded with N_4, while the minimum was observed with N_2. These results confirm to the findings of Sandhu *et al*[10]., who also reported that increased in fertilizer dose from 75 to 100, 100 to 125 and 125 to 150 % of RDF, significantly increased in the yield of A and B grade potato tubers. Although, the yield of C and D grade tubers also increased with the increased in fertilizer dose. The results are in agreement with the findings of Kumar *et al*[7]., and Zaman *et al*[14]., who reported that organic nutrients performed better in giving greater number of small and medium sized potato tubers, while inorganic source of nutrient was in favor of producing large and very large sized tubers. Similarly, Khurana *et al*[6]., also reported the increase in >75 g potato tuber yield with the increase in fertilizer doses from 125 to 150% of RDF.

Total tuber yield

The total tuber yield (q/ha) was significantly influenced by fertigation frequency and nitrogen levels. It is evident from the results that the maximum total tuber yield (296.50 q/ha) was obtained with F_1 followed by F_2 and minimum (268.00 q/ha) with F_3. The maximum (292.33 q/ha) total tuber yield was observed with N_2, while minimum yield (264.69 q/ha) was recorded in N_4. The tuber yield also varied significantly due to the interaction of fertigation frequency and nitrogen levels. Interaction effect revealed maximum (307.78 q/ha) total tuber yield with F_1N_2 followed by F_1N_3, while F_3N_4 recorded lower (252.80 q/ha) total tuber yield. Kumar *et al*[8]., 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). These findings are in conformity with the results of Khalak *et al*[5]. Similarly, Badr *et al*[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[9] also reported a positive response to potato yield and quality to increasing N rate, and found that total yield was maximized with nitrogen @224 kg/ha. Behnam Etemad and Mansour Sarajuoghi[2] this study showed that the interaction of different levels of N fertilizer × different times of application significantly affected tuber yield ($P \leq 0.05$).

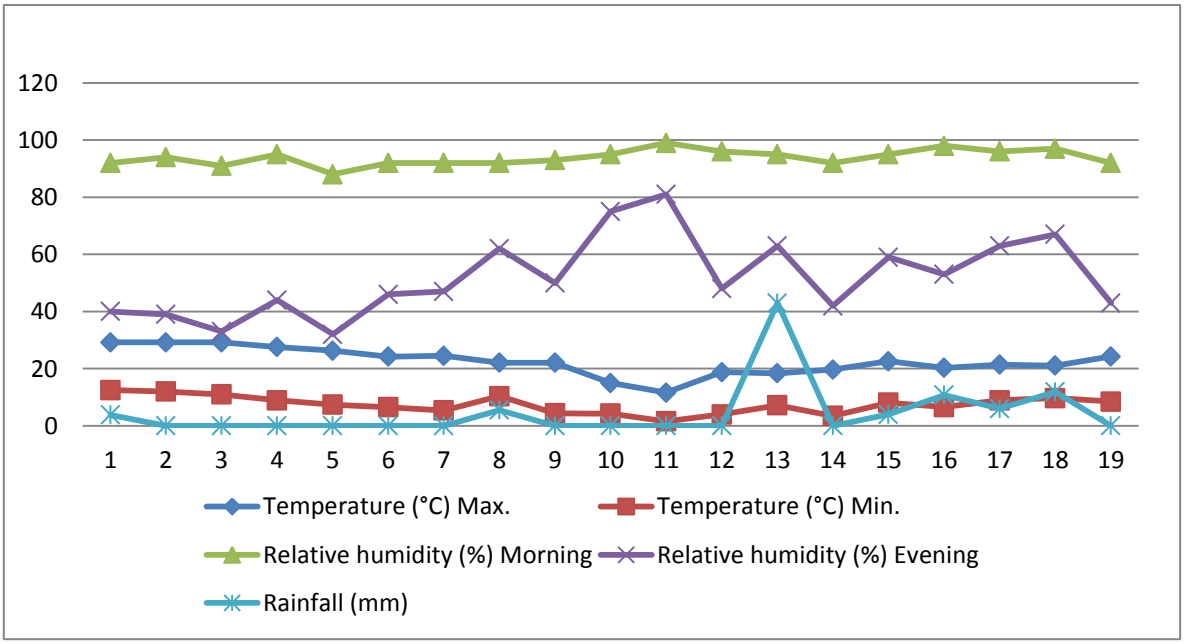

Fig. 1: The air temperature (°C), relative humidity (%) and sum of precipitation (mm) during the potato vegetation period at the experimental field

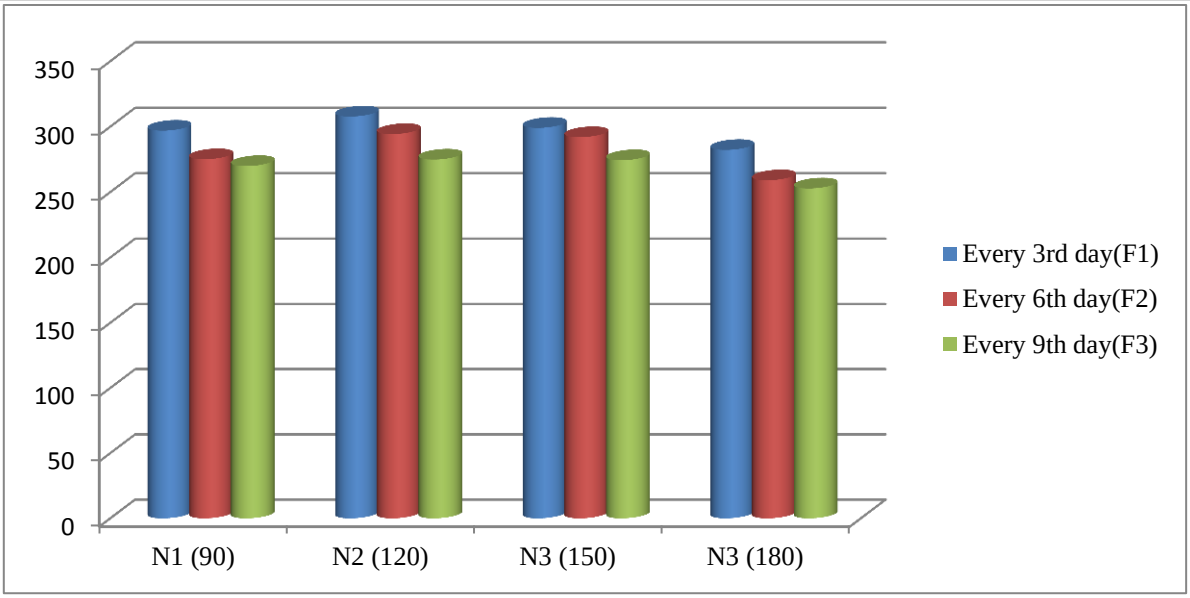

Fig. 2: Effect of fertigation frequency and nitrogen levels on total tuber yield (q/ha) in Potato *cv.* Kufri Bahar

Table 1: Effect of nitrogen levels and fertigation frequency on yield contributing parameters and tuber yield (q/ha) in Potato *cv.* Kufri Bahar

N rate Kg/ha	Fertigation frequency	Number of tuber/m^2				Yield of tuber kg/m^2				Total tuber yield (q/ha)
		Up to 25g	**25-50g**	**50-75g**	**Above 75g**	**Up to 25g**	**25-50g**	**50-75g**	**Above 75g**	
90(N_1)	**F_1**	15.14	7.93	9.47	7.07	0.24	0.51	0.93	1.14	296.95
	F_2	16.25	8.83	9.10	5.63	0.27	0.62	0.88	1.06	275.13
	F_3	18.39	9.00	7.47	5.07	0.32	0.66	0.80	0.96	269.93
120(N_2)	**F_1**	13.05	7.20	11.17	8.57	0.18	0.34	0.98	1.24	307.78
	F_2	13.42	7.60	10.77	7.93	0.24	0.44	0.91	1.23	294.34
	F_3	15.86	8.10	8.93	7.80	0.26	0.57	0.86	1.21	274.88
150(N_3)	**F_1**	13.11	7.77	9.93	7.57	0.22	0.43	0.92	1.23	299.06
	F_2	15.81	8.50	9.80	7.43	0.25	0.56	0.89	1.20	292.01
	F_3	16.55	8.60	8.53	6.23	0.27	0.59	0.82	1.13	274.38
180(N_4)	**F_1**	15.42	8.13	7.90	5.80	0.27	0.63	0.80	1.22	282.22
	F_2	17.11	9.77	7.47	5.23	0.28	0.68	0.80	1.03	259.04
	F_3	18.72	11.07	6.93	4.93	0.32	0.71	0.71	0.98	252.80
Mean	**N_1**	16.59	8.59	8.68	5.92	0.28	0.60	0.87	1.06	280.33
	N_2	14.11	7.63	10.29	8.10	0.23	0.45	0.92	1.22	292.33
	N_3	15.16	8.29	9.42	7.08	0.25	0.53	0.87	1.19	288.48
	N_4	17.08	9.66	7.43	5.32	0.29	0.67	0.77	1.08	264.69
	F_1	14.18	7.76	9.62	7.25	0.22	0.48	0.91	1.21	296.50
	F_2	15.65	8.68	9.28	6.56	0.26	0.58	0.87	1.13	280.13
	F_3	17.38	9.19	7.97	6.01	0.29	0.63	0.80	1.07	268.00
CD at 5%	**Frequency**	**0.29**	**0.27**	**0.26**	**0.28**	**0.03**	**0.05**	**0.07**	**0.07**	**2.85**
	Nitrogen	**0.34**	**0.32**	**0.30**	**0.32**	**0.04**	**0.06**	**0.06**	**0.08**	**3.29**
	F × N	**0.59**	**0.56**	**0.53**	**0.55**	**NS**	**NS**	**NS**	**NS**	**5.71**

*NS = Non-significant, CD= Critical difference, DAP = Days after planting, N = Nitrogen, F = Frequency

CONCLUSION

Potato yield and its components were significantly affected be N application rate and fertigation frequency. Based on the findings of one season study conducted during *Rabi* season 2014-15, it may be concluded that when nitrogen @ 120 kg/ha was applied through drip irrigation at every 3rd day, it gave significantly maximum higher tuber yield.

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