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Short Communication

Effect of irrigation systems and NPK levels on onion (*Allium cepa* L.) in temperate hills

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Onion is important crop of India occupying 1.06 million ha area with production of 15.1 million tones (Anon. 2011) however, the productivity of this crop in the country is low (14.2 tones per ha). The commercialization of onion in hilly areas of Uttarakhand is still awaited due to poor availability of quality seeds of improved cultivars, inputs required for crop management, marketing facilities and technology extension activities. Agroclimate-specific scientific knowledge is also meager in this region. All these cumulatively lead to poor acreage, productivity and profitability of onion in hilly areas. Effective use of irrigation water and fertilizers are very important for onion cultivation in hills as both of these inputs are scarce and expensive in this region. Onion crop requires heavy and frequent irrigation and therefore, surface irrigation by flooding the water in plots has been tradition in valleys and plains for this crop. Micro-irrigation system (drip and sprinkler) is the best way to reduce the amount of irrigation water needed to onion (Shock *et al.,* 2007; Halvorson *et al*., 2008) particularly in hilly areas. These methods improve efficiency of irrigation water and fertilizer nutrients, and also hydrothermal regimes and physical conditions of the soil by maintaining proper balance between soil air and water in the rhizosphere for better root growth and bulb development which results in to higher yield of quality bulbs. A more uniform application of water can be achieved with drip irrigation with little or no runoff, evaporation, water contact with leaves which reduces disease potential and deep percolation of water (Shock, 2006; Shock *et al*., 2004, 2007). Therefore, working out a suitable combination of irrigation system and NPK level in respect of bulb yield is crucial for enhancing productivity of onion in Uttarakhand hills.

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This experiment was conducted during *Rabi* 2012-13 in the Research Block of Department of Vegetable Science, Uttarakhand University of Horticulture and Forestry, Ranichauri, Tehri-Garhwal falling in temperate hill zone of Uttarakhand (2000 m altitude, 30^0 15'N latitude and 78^0 02'E longitude) with onion cv. Agrifound Light Red. The experiment was laid out in two factors RBD with four replications. The first factor included irrigation systems *viz*., drip (I_1) and sprinkler (I_2) and the second factor comprised of three doses of NPK *viz*., 50:40:40 kg/ha (F_1), 100:60:50 kg/ha (F_2) and 150:80:60 kg/ha (F_3), respectively. The seedlings were transplanted on 20th December at spacing of 20x10 cm in the plots of 9.0 m^2 area. The complete doses of P and K were applied at the time of transplanting in the form of DAP and MOP, respectively, and as such 15% of N in F_1 and 10% of N in each F_2 and F_3 were applied as basal with DAP. Rest of N was applied in the form of Urea in two split doses during February and March. As far as irrigation systems were concerned, the laterals of drip system with inline/flat drippers of 16 mm OD/30cm/2 lph were placed in each inter-row. The crop was irrigated with drip system at alternate day to maintain 125-150% cumulative pan evaporation (CPE) water level. This corresponded to operate the system for 1.0 -1.25 hours in each irrigation. Sprinkler system was also operated once in a week to apply irrigation at 150% CPE water level. The characters on plant growth and bulb yield were recorded in all treatments and analyzed statistically (Table 1).

The results indicated that irrigation systems had significant influence on number of leaves per plant, leaf dry matter content, lateral bulb diameter, vertical bulb diameter and bulb weight. Drip irrigation resulted in significantly higher number of leaves per plant (9.95), leaf dry matter content (43.56%), lateral and vertical bulb diameter (6.31 cm and 8.62 cm, respectively) and bulb weight (131.49 g). However, bulb yield, specific gravity of bulbs and bulb volume was not affected

Table 1: Performance of Onion cv. Agrifound Light Red under different irrigation systems and NPK levels

Treatment	Number of leaves per plant	Leaf length (cm)	Leaf dry matter content (%)	Lateral bulb diameter (cm)	Vertical bulb diameter (cm)	Bulb weight (g)	Bulb volume (cm^3)	Specific gravity of bulb (g/cm^3)	Bulb yield (q/ha)
Irrigation Systems (I)									
Drip (I_1)	9.95	38.01	43.56	6.31	8.62	131.49	145.00	0.91	403.3
Sprinkler (I_2)	8.45	39.02	38.24	5.97	7.90	125.15	148.00	0.85	393.6
SEm±	0.13	0.61	0.91	0.10	0.13	2.87	8.97	0.03	13.18
CD (0.05)	0.28	1.28	1.9	0.21	0.26	6.0	18.71	0.07	27.5
Fertilizer doses (F)									
50:40:40 kg NPK/ha (F1)	8.95	37.12	39.04	6.15	8.36	125.95	133.00	0.95	353.0
100:60:50 kg NPK/ha (F2)	9.42	39.84	41.35	6.16	8.27	128.98	156.50	0.82	401.3
150:80:60 kg NPK/ha (F3)	9.24	38.59	42.30	6.10	8.13	130.02	150.00	0.87	441.1
SEm±	0.16	0.75	1.12	0.12	0.15	3.52	10.99	0.05	16.16
CD (0.05)	0.34	1.57	2.33	0.25	031	7.34	22.92	0.11	33.7
Interaction (I x F)									
I_1 x F_1	9.0	37.43	40.69	6.20	9.02	130.90	132.00	0.99	357.8
I_1x F_2	10.46	37.47	45.35	6.31	8.61	132.35	147.00	0.90	398.9
I_1 x F_3	10.40	39.13	44.62	6.40	8.22	131.21	156.00	0.84	453.3
I_2 x F_1	8.90	36.80	37.38	6.10	7.70	121.01	134.00	0.90	348.2
I_2 x F_2	8.38	42.21	37.36	6.01	7.94	125.61	166.00	0.76	403.7
I_2 x F_3	8.08	38.05	39.98	5.80	8.05	128.84	144.00	0.90	428.9
CV (%)	12.6	7.90	5.3	11.9	6.6	14.3	12.4	4.25	12.6
SEm±	0.23	1.06	1.58	0.17	0.22	4.98	15.54	0.06	22.82
CD (0.05)	0.48	2.21	3.29	0.36	0.45	10.38	32.41	0.13	47.6

significantly by irrigation system although higher values were recorded in drip system for bulb yield (403.3 q/ha) and specific gravity of bulbs (0.91 g/cm^3). Higher but non-significant bulb yield was also realized by Halvorson *et al.* (2008) under drip system as compared to furrow irrigation in onion.

Three levels of NPK applied had significant influence on bulb yield. There was parallelism in increasing doses of NPK from F_1 (50:40:40 kg/ha) to F_3 (150:80:60 kg/ha) and bulb yield from 353.0 to 441.10 q/ha. Simlarly, Anwar *et al.* (2001) and Halvorson *et al.* (2008) have reported an increasing trend of bulb yield onion with increasing level of nitrogen. Significant effect of increasing level of NPK was noted for leaf dry matter content which ranged from 39.04% in F_1 (50:40:40 kg/ha) to 42.30% in F_3 (150:80:60 kg/ha).

The combined effect of irrigation systems and NPK levels had also significant impact on the all bulb plant growth characters. Maximum bulb yield was registered in drip irrigation accompanied with NPK level of 150:80:60 kg/ha (453.30 q/ha) followed by sprinkler irrigation accompanied with NPK level of 150:80:60 kg/ha (428.90 q/ha) which were statistically *at par*. Higher bulb yield in drip system and higher level of NPK was accompanied with high bulb weight, vertical and lateral bulb diameter and leaf growth parameters. According to Pirov (2001) and Halvorson *et al.* (2008) sufficient and uniform soil moisture accompanied with higher level of nitrogen fertilizer is essential for optimum yield in onion. Rest of plant growth and tuber yield characters exhibited variable responses to combination of irrigation systems and NPK levels. In the areas having limited irrigation water, drip system is equally effective for increasing bulb yield through higher level of NPK. On the basis of above findings, irrigation through drip and sprinkler and application of NPK @150:80:60 kg/ha is recommended in rainfed temperate hills of Uttarakhand.

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