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Effect of different NPK levels and intervals of fertigation on growth and yield of onion (*Allium cepa* L.) in the central dry zone of Karnataka

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Abstract
A field experiment was conducted during *Rabi*, 2019 at ICAR, Krishi Vigyan Kendra, Babbur Farm, Chitradurga to study the effect of different NPK levels and intervals of fertigation on growth and yield of Onion (*Allium cepa* L.). The experiment was laid out in randomized block design with six fertigation treatments *viz.* T_2 – 100% RDF NPK @ 10 days interval, T_3 – 75% RDF NPK @ 10 days interval, T_4 – 50% RDF NPK @ 10 days interval, T_5 – 100% RDF NPK @ 7 days interval, T_6 – 75% RDF NPK @ 7 days interval, T_7 - 50% RDF NPK @ 7 days interval and T_1 - 100% RDF NPK through soil application (Control). The treatments were replicated thrice. On the basis of results obtained the maximum plant height (cm), Number of leaves and leaf length (cm), were recorded with the application of 100% RDF @ 10 days interval (T_2) which was statistically on par with application of 100% RDF @ 7 days interval (T_5) and yield attributes *viz.* bulb dry matter (g plant $^{-1}$), weight of five bulbs (g), Bulb yield (t ha $^{-1}$) were recorded highest with application of 100% RDF @ 10 days interval (T_2) T_2 recorded a yield of 25.7 t/ha. Which was around 22.7 per cent more as compared to T_7 (50% RDF NPK through fertigation at 7 days interval) and 14.4 percent increase over control (Soil application of 100% RDF NPK). Thus, drip fertigation at 10 days interval helped to improve the onion plant growth and bulb yield, particularly the composition 100% RDF through fertigation @ 10 days interval.

Keywords: Fertigation, growth, yield attributes, NPK

Introduction
Onion (*Allium cepa* L.) is one of the important bulbous crops cultivated all over the world and consumed in many ways. India is the second largest producer of onion in the world. Indian onions are famous for their pungency and are available round the year. Indian onions have two crop cycles, first harvesting starts in November to January and the second harvesting from January to May. Among the fresh vegetables, exported onion is always at the top followed by other vegetables. Onion crop is highly responsive to nutrient application but with the lack of proper knowledge, farmers are applying either excess or lower doses of fertilizers. Improper time of application, inadequate rainfall and lack of suitable water quality, the average yield of onion is below the world average. Farmers are mainly following the basal and split application of recommended dose of fertilizers. By adopting the fertigation techniques in onion cultivation, it is possible to increase its productivity and also fertilizer use efficiency. Thus, suitable recommendation of fertilizers for drip fertigation at different intervals is need of the hour to solve the problem of proper fertilizer schedule for fertigation in onion.

Drip irrigation system is the most efficient method of water application which is ideally suited for controlling the placement and supply rate of water-soluble fertilizers. By adopting drip system, we can also reduce the problem of ground water pollution due to leaching of excessive fertilizers. It can also improve the fertilizer and nutrient use efficiency. Using drip irrigation system, we can bring more and more cultivable area under irrigation, thereby increasing agriculture production. Therefore, in order to increase the agriculture production, it is very much necessary to shift from conventional method of fertilizer application to advanced fertigation system by using water soluble fertilizers through drip fertigation.

Materials and Methods
A field experiment was carried out at ICAR Krishi Vigyan Kendra, Babbur Farm, Chitradurga, UAHS, Shivamogga during *Rabi* 2019 to assess the effect of different NPK levels and

intervals of fertigation on growth and yield of onion (*Allium cepa* L.). The experiment consists of six fertigation treatments and one control with soil application, replicated thrice in randomized block design. The treatments are T_1- 100% RDF NPK through soil application, T_2 – 100% RDF NPK through fertigation at 10 days interval, T_3 – 75% RDF NPK through fertigation at 10 days interval, T_4 – 50% RDF NPK through fertigation at 10 days interval, T_5 - 100% RDF NPK through fertigation at 7 days interval, T_6 - 75% RDF NPK through fertigation at 7 days interval and T_7 - 50% RDF NPK through fertigation at 7 days interval. The soil of the experimental site was of clay loam texture with initial pH of 9.01, EC – 0.60 dS m^{-1}, low in organic carbon content (4.5 g kg^{-1}) and the soil was moderately fertile with available nitrogen (193. 50 kg ha^{-1}), available phosphorous (11.40 kg ha^{-1}), available potassium (242.60 kg ha^{-1}). Arka nikethan variety of onion was transplanted at a spacing of 10 cm X 15 cm. The recommended dose of fertilizers for onion are 125, 75, 125 kg of N, P_2O_5 and K_2O ha^{-1} respectively were applied along with soil application of FYM @ 30 t ha-1(one month before transplanting) and bentonite coated sulphur @ 30 kg ha^{-1} were applied prior to transplanting. The experimental plot was maintained weed free by regular hand weeding. Plant protection measures were followed as and when required for all the treatments. Harvesting was carried out when onion bulbs attained the physiological maturity stage. After the harvest bulbs from each treatment were collected separately. Yield attributes were recorded at the time of harvest. Bulb yield from each treatment was recorded kilograms and then converted into tonnes ha $^{-1}$. Statistical data was analyzed by standard procedure.

Results and Discussion

Growth parameters

The results of the present investigation revealed that growth parameters such as plant height, number of leaves and leaf length of onion were influenced significantly by different levels and intervals of NPK fertigation treatments. Maximum plant height (63.3 cm), Maximum number of leaves (10.78) were recorded with the application of 100 per cent RDF NPK through fertigation at 10 days interval (T_2) and it was found to be on par with application of 100 per cent RDF NPK through fertigation at 7 days interval (T_5: plant height- 63.2 cm and number of leaves: 10.47) followed by the application of 75 per cent RDF through fertigation at 10 days interval (T_3: 62.6 cm of plant height and 9.98 leaves) and significantly lower plant height and number of leaves were recorded in treatment receiving 50 per cent RDF through fertigation at 7 days interval i.e., T_7 (61.0 cm and 8.78).

Significant difference was observed in leaf length between the different fertigation treatments. Higher leaf length (47.3 cm) was noticed in T_2 (100 per cent RDF through fertigation @ 10 days interval) and it was followed by the treatment receiving 100 per cent RDF through fertigation at 7 days interval (T_5) with 45.5cm and T_3- 75 per cent RDF through fertigation @ 10 days interval (44.0 cm). Whereas, the lower leaf length was recorded in T_7- 50 per cent RDF through fertigation at 7 days interval (41.3 cm).

Table 1: Effect of different NPK levels and intervals of fertigation on growth parameters of onion

Treatments	Plant height (cm)	Number of leaves (No.)	Leaf length (cm)
	90 DAT		
T_1: 100% RDF NPK through soil application (Control)	62.3	9.10	42.1
T_2: 100% RDF NPK through drip fertigation @ 10 days interval	63.3	10.78	47.3
T_3: 75% RDF NPK through drip fertigation @ 10 days interval	62.6	9.98	44.0
T_4: 50% RDF NPK through drip fertigation @ 10 days interval	62.3	8.98	42.4
T_5: 100% RDF NPK through drip fertigation @ 7 days interval	63.2	10.47	45.5
T_6: 75% RDF NPK through drip fertigation @ 7 days interval	62.3	9.89	42.8
T_7: 50% RDF NPK through drip fertigation @ 7 days interval	61.0	8.78	41.3
S.Em.±	0.08	0.16	0.32
C.D at 5%	0.25	0.49	0.94

Note: RDF- Recommended dose of fertilizers + FYM, DAT- Days after transplanting

The significant higher plant height, number of leaves and leaf length recorded under 100 per cent RDF NPK applied through fertigation at 10 days interval might be because of balanced nutrition, better water and nutrient utilization which results in better vegetative growth and higher photosynthetic rate. These results are in accordance with Kebede (2003) [12] in Onion, Prabhakar, *et al*., (2011) [17] in *rabi* Onion, and Pooja, *et al*. (2018) [16] in Onion, Feleafel (2013) [8] in Eggplant, Der *et al*., (2018) [5] in Garlic. Mishra *et al*., 2005 [14], reported that drip fertigation at regular intervals provides a uniform moisture regime and nutrients in the soil and thereby, leading to activate roots for a longer duration and maximize the availability of nutrients and better translocation of food materials that enhance the plant vegetative growth along with maintenance of the soil moisture and soil temperature at optimum level. Howard, *et al.,* (2000) [10] also reported the importance of drip fertigation at frequent intervals leading to uniform moisture regimes and nutrient pool in the soil and thereby, activate the roots for a longer duration and increased the nutrient availability and translocation of photosynthates.

Yield Parameters

Dry matter production increased with increased levels of fertigation. In the present study, application of 100 *per cent* of water soluble fertilizer produced the highest dry matter. Highest bulb dry matter was recorded in the treatment receiving 100 *per cent* RDF of NPK through fertigation at 10 days interval *i.e.*, T_2 (12.32 g plant $^{-1}$), followed by T_5 (100 *per cent* RDF of NPK through fertigation at 7 days interval) which recorded 12.09 g $plant^{-1}$. However, lower bulb dry matter was recorded in T_7 (50 *per cent* RDF of NPK through fertigation at 7 days interval) which recorded 8.6 g $plant^{-1}$. The increase in bulb dry matter in T_2 was up to 30*per cent* over T_7 and 8.8*per cent* over T_1 (control). This might be due to the fact that nitrogen and other nutrients might have enhanced the photosynthetic ability while better absorption and availability of K could have enhanced the translocation of metabolites from source to sink and dry matter accumulation

in bulbs could also be partly due to remobilization and translocation of photosynthates accumulated in leaves to bulbs at maturity stage (Bender *et al*., (2015) [2] in Soy bean). Similar pattern of dry matter accumulation was observed in onion bulb crop (Sullivan *et al*., 2001 Thangasamy, 2016), El-Sherif *et al*. (1993) [20, 22, 7] in tomato, Thakur *et al.* (1991) [21] in Cauliflower, Neary *et al*., (1995) [15] in bell pepper.

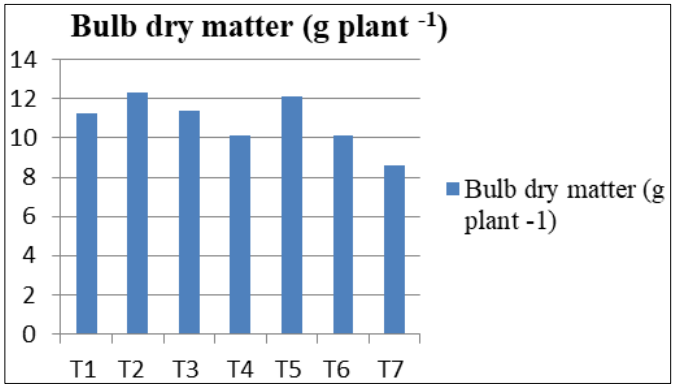

Fig 1: Bulb dry matter in various treatments

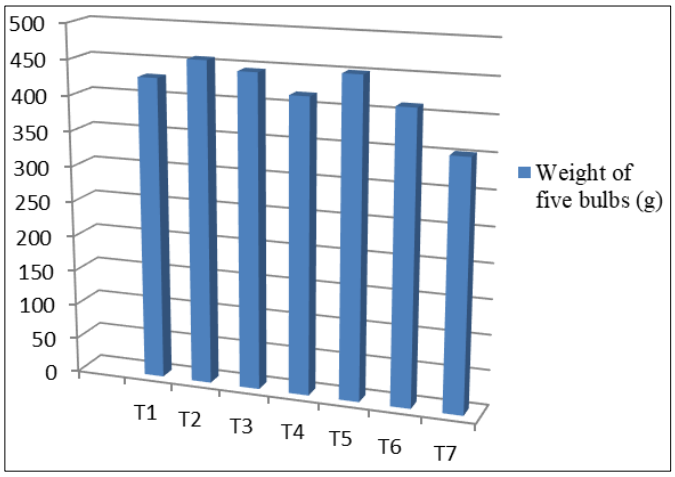

Fig 2: Average weight of 5 bulbs in different treatments

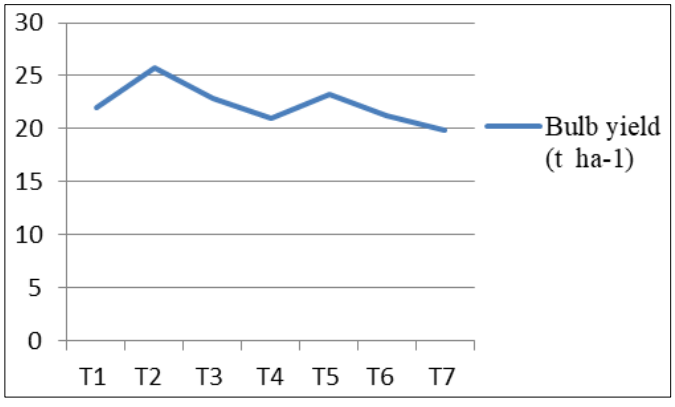

Fig 3: Bulb yield of various treatments

The higher fertigation level with recommended dose of RDF (100 *per cent* RDF) resulted in higher yield and yield contributing parameters like weight of five bulbs and bulb yield and also directly influences the yield per ha^{-1}. Highest weight of five bulbs (456.67 g) and bulb yield (25.7 t ha^{-1}) were recorded in $T_{2,}$ whereas the lowest weight of five bulbs (352.67 g) and bulb yield (19.87 t ha^{-1}) were recorded in T_7 which received the lower level of 50 per cent RDF at 7 days interval. This trend may be probably attributed to higher plant height, number of leaves resulting in greater photosynthetic surface, leading to higher carbohydrate synthesis and translocation to the sink, coupled with marginally higher bulb dry matter and bulb yield. These results are in conformity with the findings of Chopade *et al*. (1998) [4] who found that, application of recommended dose of solid fertilizers in two splits through drip irrigation recorded the highest onion bulb yield while the highest bulb quality was recorded in drip fertigation at 50 per cent of the recommended rate of fertilizers. These results are in agreement with the findings of Rumpel *et al*. (2004) [19], Bhakare and Fatkal (2008) [3], Abdissa *et al.* (2011) [1], Ramana *et al*. (2014) [18], Gupta *et al.* (2016) [9], Dingre *et al.* (2016) [6], Kaur *et al*. (2019) [11], Laxmi *et al.* (2019) [13].

Conclusion

On the basis of results outlined above, we can conclude that among different fertigation treatments analyzed application of 100 per cent RDF NPK through fertigation at 10 days interval has given the best results with respect to all the growth and yield attributes. Thus, we can conclude that drip fertigation at 10 days interval helped to enhance the onion plant growth, bulb dry matter and yield, particularly the application of 100% RDF NPK/ha compared to all other treatments.

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