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Influence of doses of water soluble fertilizers on the floral parameters of tuberose (*Polianthes tuberosa* L.) cv. Prajwal under drip irrigation systems

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Abstract
The experiment was carried out to find out the effect of water soluble fertilizers (Urea, N:P:K::19:19:19 and N:P:K::13:00:45) with different doses and combination with straight fertilizers (Urea, DAP and MOP) in tuberose (*Polianthes tuberose*) cv. Prajwal at G.B. Pant University of Agriculture and Technology, Pantnagar during March 2016-January 2018. The bulbs of appropriate size (4.5-5.0 cm) were planted at spacing of 40 × 40 cm. The maximum number of open florets (27.10), unopened florets (16.27) and maximum total number of florets (43.30) at 50 per cent flower opening stage were found with T_1 treatment (75% of RDF using water soluble fertilizers). The same treatment showed maximum days to withering of lowest floret commences (9.92 days) and also possessed the longest duration of flowering (17.32 days).

Keywords: Drip irrigation, fertigation, water-soluble fertilizers, tuberose

Introduction
In present era, urbanization has shifted the society towards flower culture. Fresh cut flowers are highly perishable commodities and are used for decorative purposes such as floral arrangements and bouquets at formal events; designs for weddings and funerals; gifts on occasions, and in times of illness, and at holidays; corsages and boutonnieres; and informal displays to beautify homes and public places. Tuberose (*Polianthes tuberosa* L.) is a flower crop which possess strong and pleasant fragrance along with the elegant white beauty of the floral spike. Tuberose, also named as *Rajnigandha*, *Nishigandha*, *Gul-e-chari* and *Sem Pangi* and belonging to the Amaryllidaceae family, occupies the prime position among the commercial bulbous flowers because of its hardiness, beauty and pleasant fragrance of flowers and hence valued for multipurpose uses such as in the form of cut flower for floral arrangements, bouquets, as loose flowers in the preparation of aesthetic garlands and essential oil (concrete and absolute) for use in the perfumery and cosmetics. Tuberose flowers have medicinal importance too and is considered to be emetic and diuretic. The concept of drip fertigation possess immense potential to change the present status of productivity in agriculture by reducing the wastage of fertilizers through improved fertilizer use efficiency and thus, helps in economizing the use of water and fertilizers and is more economical as reduces the cost of water, fertilizers, labour and energy.
Hence, standardization of optimum doses of fertilizers through drip irrigation is required for improving the fertilizer use efficiency in tuberose. Keeping in view, the above facts, the experiment was conducted to study the influence of doses of water soluble fertilizers and combining with straight fertilizers through drip irrigation on floral parameters in tuberose cv. Prajwal.

Materials and Methods
Investigation was carried out during March 2016 to January 2018 at Model Floriculture Centre, G.B. Pant University of Agriculture and Technology, Pantnagar to study the effect of doses of water soluble fertilizers through drip irrigation in tuberose cv. Prajwal. The soil at the experiment site was sandy loam soil with a pH of 6.68 and EC of 0.43 dS/m. The experiment was laid out in Randomized Block Design (RBD) comprising seven treatments with three replications. The treatments consists of T_1: 75% of RDF with Water soluble fertilizers (WSF), T_2: 100% of RDF with WSF, T_3: 125% of RDF with WSF, T_4: 75% of RDF as WSF + 25% of RDF as straight fertilizers (SF), T_5: 50% of RDF as WSF + 50% of RDF as SF, T_6: 25% of

RDF as WSF + 75% of RDF as SF, T_7: 100% of RDF as SF (control). Recommended dose of fertilizers per hectare was 200:200:200 kg of NPK was applied through fertigation and manual help as per the treatment. At last ploughing 250 kg of FYM per hectare as basal were applied uniformly for all the treatments.

The field was divided into raised beds of height of 25 cm and width of 90 cm for allotment of various treatments. A spacing of 30 cm between the beds was provided for separation of treatments and replications and also for easy inter-cultural operation. Double row planting system was adopted with the spacing of 120 X 40 X 40 cm (row/plant). The drip irrigation system and venturi injector fertigation unit were installed as per the experimental layout and treatment plan. Water soluble fertilizers and straight fertilizers were applied as per the treatment combinations. Fertigation was given as per the schedule at different plant growth stages. Observations for growth and flowering characters were collected and subjected to statistical analysis under simple RBD using ANOVA.

Results and Discussion

The data pertaining to floral characters are presented in Table 1 and Table 2, respectively.

Significant results were obtained for floral characters in both the years of experiment and simultaneously in the pooled data. Among all the treatments, the treatment T_2 i.e. 100 per cent of RDF using WSF showed the maximum number of open florets at 50 per cent flower opening stage (24.50) which is at par with treatment T_1 i.e. 75 per cent of RDF using WSF (24.30) in the first year of study and in the second year and in the pooled data the treatment T_1 (29.80 and 27.10) showed the maximum number of open florets at 50 per cent flower opening stage which was at par with treatment T_4 (29.40 and 26.81), respectively. The maximum number of unopened florets at 50 per cent flower opening stage was found in treatment T_1 (14.50, 18.00 and 16.27) in first year, second year and in the pooled mean of both the years of study which is at par with treatment T_2 (13.90, 15.90 and 14.93). The maximum total number of florets at 50 per cent flower opening was found in treatment T_1 (38.90) in first year followed by T_2 (38.50) and T_4 (37.90). In the second year and in the pooled mean of both the years of study treatment T_1 (47.80 and 43.30) depicted the maximum total number of florets at 50 per cent flower opening which is at par with T_4 (47.00 and 42.50) and T_2 (44.50 and 41.50), respectively. In the first year trial (2016-17), the maximum days to withering of lowest floret commences were in T_1 (9.18 days) treatment which was followed by T_4 (8.40 days), T_2 (8.32 days), T_5 (8.16 days), T_6 (7.65 days) and T_7 (7.32 days). During the second year and consequently, in the pooled mean calculated the treatment T_1 (10.67 and 9.92 days) showed the maximum days to withering of lowest floret commences which was followed by T_4 (10.20 and 9.30 days), T_2 (9.43 and 8.88 days), T_5 (9.23 and 8.70 days), T6 (8.63 and 8.14 days) and T_3 (7.92 and 7.59 days) whereas control (7.40 and 7.36 days) had earliest withering of lowest floret.

Among the different fertigation doses examined, application of 75 per cent of RDF with WSF had significantly increased the number of open, unopened and total number of florets at 50 per cent flowering and days to withering of lowest floret commences and this might be because of the reduced dose of N which was responsible for vegetative growth of plants while P and K threshold value particular of any crop had a significant effect on quantity and quality of flowering (Gurav *et al.* (2004) [3]. Fertigation with 125 per cent of RDF with WSF resulted in negative effect due to fertilizer application beyond the threshold demand by the crop as drip fertigation reduced the loss of fertilizer due to leaching and increased the fertilizer use efficiency by accumulating the fertilizer near the root zone area which increased the absorption of fertilizers by the plant. These results were supported by Khan *et al.* (1996) [4], Shadhishar (2004) [5] in tuberose and Ganesh *et al* (2014) [2] in chrysanthemum.

During first year (2016-17), the treatment T_1 (16.46 days) had the longest duration of flowering which was followed by T_4 (16.19 days), T_2 (15.74 days), T_5 (15.73 days), T_6 (14.64 days) and T_3 (13.50 days). Again, in the second year (2017-18) and in the pooled mean of both the years, the treatment T_1 (18.18 and 17.32 days) possessed the longest duration of flowering which was followed by T_4 (17.41 and 16.80 days), T_5 (16.92 and 16.33 days), T_2 (16.81 and 16.27 days), T_6 (15.05 and 14.84 days) and T_3 (14.34 and 13.92 days). However, among all the treatments, the shortest duration of flowering was observed under control (11.73, 12.18 and 11.2 days) in the first year, second year and in the pooled mean, respectively. The duration of flowering increased in lower doses of fertilizer using WSF through drip fertigation system as drip irrigation system is an efficient method for application of fertilizers and increased the total number of florets per spike and delay in withering of lower florets, considerably increased the duration of flowering in the present study which was calculated from the day of basal floret opening to the day of 50 per cent withering reported. Similar results were illustrated by Sujatha *et al.* (2002) [6] in gerbera, Biradar (2002) [1] in tuberose, Gurav *et al.* (2004) [3] in gerbera and Shadhidhar (2004) [5] in tuberose.

Table 1: Effect of straight and water soluble fertilizers and their combinations on number of open, unopened and total number of florets at 50 per cent flowering of tuberose cv. Prajwal

Treatments	Total number of open florets			Total number of unopened florets			Total number of florets		
	2016-17	2017-18	Pooled mean	2016-17	2017-18	Pooled mean	2016-17	2017-18	Pooled mean
T_1	24.30	29.80	27.10	14.50	18.00	16.27	38.90	47.80	43.30
T_2	24.50	28.60	26.60	13.90	15.90	14.93	38.50	44.50	41.50
T_3	18.10	22.70	20.40	7.40	8.60	8.04	25.50	31.30	28.40
T_4	24.20	29.40	26.80	13.60	17.60	15.64	37.90	47.00	42.50
T_5	21.90	25.30	23.60	11.10	14.10	12.57	33.00	39.40	36.20
T_6	17.60	22.70	20.10	9.00	10.10	9.55	26.60	32.70	29.70
T_7	16.10	21.90	19.00	7.30	8.60	7.92	23.40	30.50	26.90
CD at 5%	2.72	1.44	1.36	4.00	6.50	4.26	2.42	6.70	4.11
S.Em+	0.87	0.46	0.44	1.28	2.10	1.37	0.78	2.16	1.32

Table 2: Effect of straight and water soluble fertilizers and their combinations on Days to withering of lowest floret and duration of flowering of tuberose cv. Prajwal

Treatments	Days to withering of lowest floret			Duration of flowering		
	2016-17	2017-18	Pooled mean	2016-17	2017-18	Pooled mean
T_1	9.18	10.67	9.92	16.46	18.18	17.32
T_2	8.32	9.43	8.88	15.74	16.81	16.27
T_3	7.25	7.92	7.59	13.50	14.34	13.92
T_4	8.39	10.20	9.30	16.19	17.41	16.80
T_5	8.16	9.23	8.70	15.73	16.92	16.33
T_6	7.65	8.63	8.14	14.64	15.05	14.84
T_7	7.32	7.40	7.36	11.73	12.18	11.96
CD at 5%	0.49	0.98	0.62	2.69	1.19	1.46
S.Em+	0.16	0.31	0.20	0.86	0.38	0.47

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