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Effect of different herbicides on physiological parameter of tuberose under irrigated condition

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Abstract
To know effect of different herbicides on physiological growth parameters of tuberose a experimental trial was laid out at farmer's field Chinnapudur, Dharmapuri (dit) during 2017-2018 and 2018-2019 seasons. The trial was formulated in randomize block design with ten treatments and replicated thrice. Among different herbicide treatment application of pendimethalin at the rate of 1.0 kg ha^{-1} on 3 days after planting *fb* hand hoeing + pendimethalin at 1.5 kg ha^{-1} on 30, 90, 150, 210 days after planting (T_2) increased photosynthetic rate (31.62 and 32.80 µmol m^{-2} s^{-1}), transpiration rate (22.85 & 24.45 mmol $m^{-2}s^{-1}$), reduced leaf temperature(28.9 and 28.6ºC). In contract to this unweeded check resulted reduced photosynthetic rate, transpiration rate and increased leaf temperature. All the above mentioned physiological parameters are correlated with flower yield of tuberose.

Keywords: tuberose, herbicide, photosynthetic rate, transpiration rate, leaf temperature

Introduction
Flowers are being grown throughout India for various purposes. They play a major part in our tradition and society since from olden days. Flowers are used for different use like garland making, work ship, decoration, cut flower making and used in different social functions. Now a day flower based industry gain higher profit to the farmers by production of potted plants and nursery plants, flower trade, seed and bulb production, essential oils extraction and nursery plant production.
Among the different flower crop tuberose is chief commercial flower crops of India and belongs to Mexico. It comes under family of Amaryllidaceae. Tuberose occupies a prime position among commercial flower crops owing to the perfume and long lasting keeping quality of flowers. Spikes of tuberose were used for vase and bouquet preparation. Tuberose is main bulbous flower crop since cultivated throughout the world for cut flower and loose flower production. It includes the varieties like single, semi-double, double and variegated. Flowers of the single type are commonly used for making garlands, loose flowers and essential oil. While the double type is used for cut flower making, interior decoration and garden display. Tuberose is grown in huge scale in various parts of tropical and sub-tropical countries like South Africa, North Carolina, France and Italy. In India tuberose is widely grown in many states like Karnataka, Tamil Nadu, Maharashtra, West Bengal and Andhra Pradesh (Namhisan and Krishnan, 1983) [4]. In Tamil Nadu it is cultivated mainly in areas like Dharmapuri, Krishnagiri, Tiruvannamalai, Salem, Namakkal, Trichy and Madurai are the leading districts in tuberose cultivation with 4979 hectares and yield of 13.25 t ha^{-1}. In Dharmapuri, tuberose is cultivated in 3191 hectares with the average productivity of 16.8 t ha^{-1}.
The development of the crop mainly depends on the cultivation operations followed in field condition. Tuberose is affected by different factors like insects, pathogen and different weed infestation in field. In the above mentioned different factors weed is the chief problem in commercial flower production in common. Flower crops are severely affected by weed competition and these is a need to keep weed free environment from planting until critical weed free period. In general, crucial time of crop weed competition is longer in direct planting compared to transplanted crop. Weeds cause harm to its flower crop by competing for natural resource like light, water, space and nutrients and serve as host for numerous insects (Shalini and Patil, 2010) [5]. Therefore, clean and weed free condition is maintained in modern farming. In general crop growth and development are influenced by various environmental factors which includes the stress are important yield reducing factors. The stress to the plant is due to the pest, disease and weed interference in the crop. The leaf water potential is an important parameter for identification of plant is healthy or under the stress condition. The reduction in water content in plants results in reduced transpiration rate and photosynthetic rate.
Retrieving the above mentioned facts, this current investigation was used to know detailed information about the result of herbicide and physiological parameters in tuberose.

Materials and method
The investigation was carried out under open field condition at farmer's field Chinnapudur, Dharmapuri (dit) during 2017-2018 and 2018-2019 seasons. The experimental site is located at 12˚,22'23''N latitude and

78˚,12’13” E longitude at an altitude of 490 m above mean sea level. The experimental field was ploughed twice and well decomposed FYM was applied evenly for about 50 t/ha. Healthy bulbs of tuberose which were free from pest and disease were selected for planting in main field with bulb diameter 2.5 - 3.0 cm. Prior to the planting the bulbs were treated with chemicals like CCC 5000 ppm (5 g/L) before planting in main field to increase the yield. The treated bulbs were sown at 40 cm between rows and 30 cm between bulb to bulb to maintain optimum plant population in the field. Ten treatments including control- weed free The treatments comprised of ten different weed management practices *viz*., T_1-Pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* Paraquat 1.0 kg ha^{-1} on 30 & 150 DAP + quizalofop-ethyl 50 g ha^{-1} on 90 and 210 DAP, T_2 - Pendimethalin at 1.0 kg ha 3 DAP *fb* hand hoeing + pendimethalin at 1.5 kg ha^{-1} on 30, 90, 150, 210 DAP, T_3 - Pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* hand hoeing + alachlor at 1.5 kg ha^{-1} on 30 and 150 DAP *fb* hand hoeing + Pendimethalin at1.5 kg ha^{-1} on 90 and 210 DAP. T_4 - Pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* hand hoeing + pendimethalin at 1.5 kg ha^{-1} on 30 DAP *fb* Paraquat 1.0 kg ha^{-1} 120 DAP *fb* quizalofop-ethyl 50g ha^{-1} on 210 DAP, T_5 Pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* hand hoeing + pendimethalin at 1.5 kg ha^{-1} on 30, 120, 210 DAP, T_6 - Pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* Hand hoeing + Pendimethalin at 1.5 kg ha^{-1} on 30 DAP *fb* Hand hoeing + Alachlor at 1.5 kg ha^{-1} on 120 DAP *fb* hand hoeing + Pendimethalin at 1.5 kg ha^{-1} on 210 DAP, T_7 - Atrazine at 1 kg ha^{-1} on 3 DAP, T_8 - Hand weeding at 30, 90, 150 and 210 DAP, T_9 - Weed free check, T_{10} - Control. The soil type of the experimental field is sandy clay loam in texture, neutral in pH 7.30 and 7.03 low Ec (0.44, 0.48 dSm^{-1}), low organic carbon (0.27, 0.23 per cent) medium in available N (234.26, 223.8) and in available P (15.80, 14.62) and K content (282.52, 273.41) recorded in both the years. The weeds were counted on 30, 90,150 and 210 days after planting using the quadrate was placed randomly at three sites per plot.

Physiological parameters

Gas exchange parameters in crop

Gas exchange parameters in crop were performed using Portable Photosynthesis System made with a halogen lamp positioned on the cuvette. Wholly 3 readings were taken in the same leaf. Leaves were placed in a 3 cm^2 leaf chamber and PPFD at 1200 µmol photons m^{-2} s^{-1}, and relative humidity (50-55%) were set. Measurement was recorded between 11 am to 12.30 pm. Fig: 1

Fig 1: Measurement on gas exchange parameters using portable photosynthesis system

Using portable photosynthesis system, the following gas exchange parameters were noted and the values expressed as in parentheses.

Transpiration rate (E: mmol H_2O m^{-2} s^{-1})

Photosynthetic rate (Pn: µmol CO_2 m^{-2} s^{-1})

Leaf temperature (T: °C)

Result and discussion

Effect of herbicide on photosynthetic rate, transpiration rate and leaf temperature

Among the different herbicide treatments application of pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* hand hoeing + pendimethalin at 1.5 kg ha^{-1} on 30, 90,150, 210 DAP (T_2) recorded the increased photosynthetic rate of 31.62 and 32.80 µmol m^{-2} s^{-1} in both the years. The lowest photosynthetic rate was recorded with unweeded check (T_{10}) with 26.60 and 28.59 µmol m^{-2} s^{-1}. Similar reading were recorded by Channappagoudar *et al*. (2007) in potato. The increased photosynthetic rate and transpiration rate is due to the availability of water to the tuberose by no competition for soil moisture to the crop due to the absence of weeds. In unweeded check (T_{10}) reduced

photosynthetic rate and transpiration rate due to the competition for the moisture between tuberose and weeds. The result was similar to the finding of Channappagoudar and Biradar (2007) in onion. The increased leaf temperature is due to crop faces drought stress condition. Since, there is presence of weeds throughout the crop period.

The highest transpiration rate was noted with the pre emergence application of pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* hand hoeing + pendimethalin at 1.5 kg ha^{-1} on 30, 90,150, 210 DAP (T_2) with 22.85 and 24.45 mmol $m^{-2}s^{-1}$ (Table 1 & 2). Among the different weed control treatments pre emergence application of pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* hand hoeing + pendimethalin at 1.5 kg ha^{-1} on 30, 90,150, 210 DAP (T_2) recorded reduced leaf temperature with 28.9 and 28.6º C recorded in both the years. It was comparable with the pre emergence pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* hand hoeing + alachlor at 1.5 kg ha^{-1} on 30 and 150 DAP *fb* hand hoeing + pendimethalin at 1.5 kg ha^{-1} on 90 and 210 DAP (T_3) with 29.2 and 28.7ºC recorded in both the years.

Moreover, in unweeded check (T_{10}) there is huge competition for water between crops and weeds comparatively weeds are having higher efficiency for water absorption over crop. It causes unavailability of water to the crop leads to drought condition to the crop. At these conditions, transpiration rate decreased leads to less photosynthetic rate and higher leaf temperature causes reduced flower yield.

Table 1: Effect of weed control treatments on gas exchange parameters in tuberose during 2017- 2018

T. No	Gas exchange parameters		
	Photosynthetic rate (µmol m^{-2} s^{-1})	**Transpiration rate (mmol m^{-2} s^{-1})**	**Leaf Temperature (ºC)**
T_1	29.46	19.84	30.4
T_2	31.62	22.85	28.9
T_3	31.25	22.10	29.2
T_4	29.32	19.65	30.3
T_5	30.04	20.20	29.9
T_6	29.23	20.12	30.0
T_7	28.53	19.43	30.2
T_8	30.37	21.34	29.5
T_9	32.35	23.65	28.6
T_{10}	26.60	17.46	30.8
SEd	0.199	0.146	0.07
CD(P=0.05)	0.402	0.296	0.15

Table 2: Effect of weed control treatments on gas exchange parameters in tuberose during 2018 – 2019

T. No	Gas exchange parameters		
	Photosynthetic rate (µmol m^{-2} s^{-1})	**Transpiration rate (mmol m^{-2} s^{-1})**	**Leaf Temperature (ºC)**
T_1	30.53	21.65	30.0
T_2	32.80	24.45	28.6
T_3	32.46	23.50	28.7
T_4	30.52	20.98	30.0
T_5	31.25	22.35	29.6
T_6	30.34	22.17	29.5
T_7	29.88	21.27	29.8
T_8	31.65	23.50	29.0
T_9	34.50	25.58	28.2
T_{10}	28.59	19.80	30.6
SEd	0.208	0.165	0.06
CD(P=0.05)	0.432	0.350	0.12

Weed control treatments on yield attributes of irrigated tuberose

Marked difference in days of first flower opening was observed with the various weed control treatments. Unweeded (T_9) resulted reduced number of days for first flower opening. Among the different weed control treatments lay by application of pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* hand hoeing + pendimethalin at 1.5 kg ha^{-1} on 30, 90, 150, 210 DAP (T_2) caused early flowering (Table 3) (Fig 1 & 2). Days of first flower opening ranges from 21.12 and 29.41 per cent recorded in both the years with the respect to the unweeded check (T_{10}). These were comparable with the application of pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* hand hoeing + alachlor at 1.5 kg ha^{-1} on 30 and 150 DAP *fb* hand hoeing + pendimethalin at 1.5 kg ha^{-1} on 90 and 210 DAP (T_3) recorded with 16.84 and 23.61 per cent recorded during 2017-2018 and 2018-2019. Similar finding was fall in line with the results of Basavaraju *et al*., (1992) [1] resulted in China aster.

Significant difference in days of 50 per cent flowering was registered with the unweeded check (T_9). Among the different herbicidal treatments application of pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* hand hoeing + pendimethalin at 1.5 kg ha^{-1} on 30, 90,150, 210 DAP (T_2) recorded reduced no of days for 50 per cent flowering

with extent of 23.60 and 23.42 percent recorded in both the years. The comparable effect was registered to the extent of 17.42 and 16.39 per cent were recorded during second year with the application of pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* hand hoeing + alachlor at 1.5 kg ha^{-1} on 30 and 150 DAP *fb* hand hoeing + pendimethalin at 1.5 kg ha^{-1} on 90 and 210 DAP (T_3) recorded reduced no of days in 50 per cent flowering. The better flowering parameters were registered is due the better utilization of more photosynthates were accumulated due to more leaves and leaf area in tuberose. However the use of atrazine at 1.0 kg ha^{-1} on 3 DAP (T_7) were not successful compared to that of sequential method of weed control method to the extent of 4.71 and 3.72 per cent observed in both the years.

Table 3: Effect of weed control treatments on yield of flower (t ha^{-1})

T. No	Yield of flower (t ha^{-1})	
	2017-2018	2018-2019
T_1	9.19	9.22
T_2	13.30	13.23
T_3	12.43	12.81
T_4	9.15	9.50
T_5	11.28	12.13
T_6	9.82	9.37
T_7	7.58	7.91
T_8	10.43	11.46
T_9	14.37	14.58
T_{10}	6.08	7.12
SEd	0.46	0.49
CD(P=0.05)	0.96	1.02

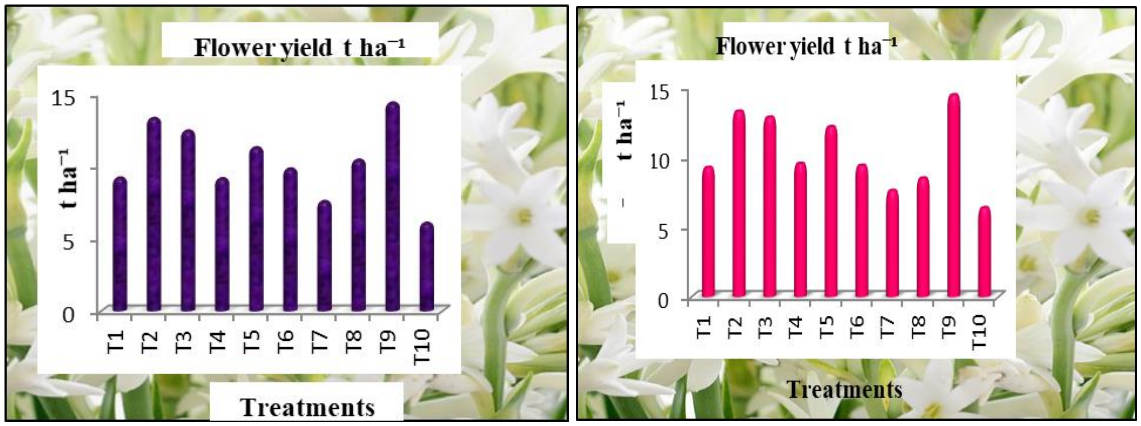

Fig 2 & 3: Effect of weed control treatments on flower yield t ha^{-1} during 2017-2018, 2018-2019.

From these field trial it could be concluded that use of pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* hand hoeing + pendimethalin at 1.5 kg ha^{-1} on 30, 90, 150, 210 DAP (T_2) effectively suppressed the weed growth and resulted better physiological parameters.

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