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Lay by method of weed management practices in tuberose under irrigated condition

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Abstract
A Field experiment was conducted during 2017-2018 at farmer's field Chinnapudur, Dharmapuri (dit) to study the lay by method of weed management practices for season long weed control in tuberose under irrigated condition. The result indicated that lay by method of weed control were found to be superior to the other treatments. Among the lay by treatments pre-emergence application of pendimethalin at 3 days after planting *fb* hand hoeing + pendimethalin at the rate of 1.5 kg ha^{-1} on 30, 90,150, 210 days after planting significantly reduced the weed growth and recorded higher flower yield (13.30 t ha^{-1}).The result significantly superior over other treatments. Control plot caused the reduction in flower yield of tuberose.

Keywords: Lay, method, weed management practices, tuberose

Introduction
Tuberose (*Polianthes tuberosa* L.) is the important commercial flower crops is native of Mexico and belongs to the family Amaryllidaceae. It occupies a prominent position among commercial flower crops is known for the sweet fragrance, beauty and longer keeping quality of flower spikes. They are various factors which affect the tuberose production which includes pest, disease and weed infestation in field. Among these factors weed is the major problem in commercial flower production in general. Weeds cause severe damage to its crop by competing for water, nutrients, light and space, also act as alternate host for several insect pests and pathogen (Shalini and Patil, 2006) [2]. The yield of the crop is reduced for about 30-40 per cent when the weeds are present throughout the season. Weed management in tube rose is very tedious process since it is used for both flower and bulb production. Weeds could be controlled by hand weeding. However, hand weeding is laborious, time consuming, costly and tedious. Herbicides are the alternate way of weed control in flower cultivation. Rapid growth of weeds during the initial stage leads to the weed competition. Pre-emergence herbicide offers the alternate option to control weeds during the initial growth stage. The choice of post emergence herbicides are limited in tuberose. Therefore field experiment was conducted to study the effect of pre-emergence and post- emergence herbicides compared with hand weeding and untreated check for evaluating weed control efficacy for obtaining high yield of tuberose.

Materials and Methods
A Field experiment was carried out during *rabi* seasons 2017-2018 at farmers field, Chinnapudur, Dharmapuri (dit) (12˚20'N latitude and 78˚18'E longitude) respectively to study the lay by method of season long weed control in irrigated tuberose. The experiment was laid out in randomized block design and replicated thrice. The treatments comprised of ten different weed management practices *viz*., T_1-Pendimethalin @ 1.0 kg ha^{-1} on 3 DAP *fb* Paraquat 1.0 kg ha^{-1} on 30 & 150 DAP + quizalofop-ethyl 50g ha^{-1} on 90 and 210 DAP, T_2 - Pendimethalin @ 1.0 kg ha 3 DAP *fb* hand hoeing + pendimethalin @ 1.5 kg ha^{-1} on 30, 90,150, 210 DAP, T_3 - Pendimethalin @ 1.0 kg ha^{-1} on 3 DAP *fb* hand hoeing + alachlor @ 1.5 kg ha^{-1} on 30 and 150 DAP *fb* hand hoeing + Pendimethalin @1.5 kg ha^{-1} on 90 and 210 DAP. T_4- Pendimethalin @ 1.0 kg ha^{-1} on 3 DAP *fb* hand hoeing + pendimethalin @ 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 @ 1.0 kg ha^{-1} on 3 DAP *fb* hand hoeing + pendimethalin @ 1.5 kg ha^{-1} on 30, 120, 210 DAP, T_6 - Pendimethalin @ 1.0 kg ha^{-1} on 3 DAP *fb* Hand hoeing + Pendimethalin @ 1.5 kg ha^{-1} on 30 DAP *fb* Hand hoeing + Alachlor @ 1.5 kg ha^{-1} on 120 DAP *fb* hand hoeing + Pendimethalin @1.5 kg ha^{-1} on 210 DAP, T_7 - Atrazine @ 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 are sandy clay loam in texture, neutral in pH 7.12, low Ec (0.44 dSm^{-1}), low organic carbon (0.28 per cent) medium in available N (233.26) and in available P (14.80) and K content (290.52). Need based plant protection measures were given as per the crop protection guide, 2018. The growth attributes were recorded from five selected plants in each plot. Observations on weeds were recorded with the help of a quadrate (0.5 m x 0.5 m) placed randomly at two places (outside the net plot area) in each treatment. The data on weeds were subjected to square root transformation ("X+2) to normalize their distribution.

Results and Discussion

Effect on weeds

The major grass weeds found in the experimental field were *Cynodon dactylon, Dactyloctenium aegyptium*. In sedges *Cyperus rotundus* is the key sedge weeds in the experimental trial. The important broad leaved weeds were *Commelina benghalensis, Convolvulus arvensis, Cleome viscosa, Trianthema portulacastrum* and *Phyllanthus niruri* were found throughout the growing period. The weed density and dry weight were recorded at 30, 90,150 and 210 DAP (Table 1 & 2).The lay by application of pre- emergence herbicide followed by pre-emergence (3, 30, 90,150 and 210 DAP) with different doses significantly reduced the weed density and weed dry weight compared to other weed control treatments.

The pre-emergence application of pendimethalin at the rate of 1 kg ha^{-1} on 3 Days after planting *fb* Hand hoeing + pendimethalin at the rate of 1.5 kg ha^{-1} on 30, 90,150, 210 Days after planting (T_2) recorded the low weed density and weed dry weight. The reduction in weed density might be due to effective weed control treatments either by herbicide or manual or both (Raj *et al*., 2010) [1]. Two years mean data indicates that weed population reduced significantly in most of the chemical and cultural treatments as compared to control plot. Among the herbicide treatments the total number of weeds per m^2 and dry weight of weeds were less with application of pendimethalin at the rate of 1 kg ha^{-1} on 3 days after planting *fb* hand hoeing + pendimethalin at the rate of 1.5 kg ha^{-1} on 30, 90,150, 210 Days after planting (T_2) effectively controlled the weeds like sedges, grasses and broad leaved weeds. Continues application of herbicides effectively reduced the weed seed germination. This results corroborates with the findings of Jadhav *et al*. (2018) [6] in rose. The highest weed dry weight was recorded in unweeded check T_{10}. These might be due to presence of weed growth during the entire crop growth period as reported by Sharma *et al*. (2014) [3] in chrysanthemum.

Effect on crops

The maximum plant height was recorded with Weed free check (T_9). These might be due to absence of weeds throughout the growing period. The herbicide treatments were found to have significant effect on the vegetative growth parameters and flowering attributes as compared to unweeded check during the both the years. The maximum plant height (62.51) were obtained with the application of application of pendimethalin at the rate of 1 kg ha^{-1} on 3 days after planting *fb* hand hoeing + pendimethalin at the rate of 1.5 kg ha^{-1} on 30, 90,150, 210 days after planting (T_2) which was on par with the weed free check (T_9). Maximum rachis length (33.5) were obtained with the application of pendimethalin at the rate of 1 kg ha^{-1} on 3 Days after planting *fb* Hand hoeing + pendimethalin at the rate of 1.5 kg ha^{-1} on 30, 90,150, 210 days after planting (T_2). number of florets per plant (51.27), Weight of 100 florets (124.17), Flower yield (13.30 t ha^{-1}) (Table 3) were significantly higher with lay by method of herbicide application. This might be due to competition is less for water, light, nutrient, space and sun light leading to the more source and sink activity of crop plants. This result similar with the Rathod and Venugopal (2017) [4] in tuberose and Kumar *et al*. (2017) [5] in chrysanthemum.

Table 1: Effect of weed control treatments on total weed density (No.m^{-2}) during 2017-2018

T. No	Treatments	Total weed density (No.m^{-2})			
		30 DAP	90 DAP	150 DAP	210 DAP
T_1	Pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* Paraquat at 1.0 kg ha^{-1} on 30 & 150 DAP + Quizalofop-ethyl 50g ha^{-1} on 90 and 210 DAP	34.30 (3.43)	99.70 (5.77)	81.01 (5.20)	64.47 (4.60)
T_2	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	30.33 (3.24)	59.30 (4.46)	49.17 (4.10)	34.00 (3.43)
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 at 1.5 kg ha^{-1} on 90 and 210 DAP	30.73 (3.26)	63.40 (4.60)	58.15 (4.46)	39.07 (3.65)
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 at 1.0 kg ha^{-1} on 120 DAP *fb* Quizalofop-ethyl at 50g ha^{-1} on 210 DAP.	31.83 (3.31)	100.47 (5.80)	71.19 (4.83)	62.04 (4.52)
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.	32.30 (3.33)	90.40 (5.53)	63.77 (4.64)	53.59 (4.24)
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.	32.20 (3.33)	95.81 (5.69)	73.30 (4.98)	59.00 (4.45)
T_7	Atrazine at 1 kg ha^{-1} on 3 DAP.	31.60 (3.30)	120.27 (6.36)	91.28 (5.54)	81.07 (5.24)
T_8	Hand weeding on 30,90,150 and 210 DAP	54.07 (4.20)	81.83 (5.25)	72.02 (4.93)	58.24 (4.43)
T_9	Weed free check	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)
T_{10}	Unweeded check	89.83 (5.50)	163.28 (7.35)	210.28 (8.36)	242.57 (8.98)
	SEd	0.41	0.34	0.39	0.45
	CD(P= 0.05)	0.85	0.71	0.81	0.93

Data were subjected to $\sqrt{(X + 0.5)}$ transformation. Figures in parenthesis are means of transformed values

Table 2: Effect of weed control treatments on total weed dry weight (Kg ha^{-1}) during 2017-2018

T. No	Treatments	Total weed dry weight (Kg ha^{-1})			
		30 DAP	90 DAP	150DAP	210 DAP
T_1	Pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* Paraquat at 1.0 kg ha^{-1} on 30 & 150 DAP + Quizalofop-ethyl 50g ha^{-1} on 90 and 210 DAP	204.48 (8.18)	259.4 (9.32)	354.06 (10.85)	440.38 (12.06)
T_2	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	151.23 (7.09)	173.69 (7.59)	208.00 (8.35)	242.58 (9.02)
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 at 1.5 kg ha^{-1} on 90 and 210 DAP	162.07 (7.32)	186.07 (7.89)	237.17 (8.92)	261.22 (9.35)
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 at 1.0 kg ha^{-1} on 120 DAP *fb* Quizalofop-ethyl at 50g ha^{-1} on 210 DAP.	200.28 (8.06)	263.50 (9.39)	354.37 (10.85)	447.34 (12.15)
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.	179.67 (7.70)	211.82 (8.42)	263.08 (9.39)	314.51 (10.23)
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.	193.31 (7.96)	236.59 (8.90)	299.41 (10)	353.74 (10.82)
T_7	Atrazine at 1 kg ha^{-1} on 3 DAP.	210.36 (8.27)	266.76 (9.45)	379.68 (11.24)	452.47 (12.25)
T_8	Hand weeding on 30,90,150 and 210 DAP	188.77 (7.92)	214.28 (8.44)	268.83 (9.49)	295.11 (9.93)
T_9	Weed free check	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)
T_{10}	Unweeded check	364.10 (10.83)	506.89 (12.89)	651.92 (14.70)	1103.54 (19.02)
	SEd	0.54	0.43	0.38	0.93
	CD(P= 0.05)	1.13	0.89	0.80	1.94

Data were subjected to $\sqrt{(X + 0.5)}$ transformation. Figures in parenthesis are means of transformed value

Table 3: Effect of weed control treatments on growth and flowering characters during 2017-2018

T. No	Treatments	Plant height (cm)	Rachis length (cm)	No of florets per plant	Weight of 100 florets (g)	Flower yield (t ha^{-1})
T_1	Pendimethalin at 1.0 kg ha^{-1} on 3 DAP *fb* Paraquat at 1.0 kg ha^{-1} on 30 & 150 DAP + Quizalofop-ethyl 50g ha^{-1} on 90 and 210 DAP	32.16	25.9	42.41	122.85	9.19
T_2	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	62.51	33.5	51.27	124.17	13.30
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 at 1.5 kg ha^{-1} on 90 and 210 DAP.	60.67	32.3	51.18	124.04	12.43
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 at 1.0 kg ha^{-1} on 120 DAP *fb* Quizalofop-ethyl at 50g ha^{-1} on 210 DAP.	33.09	25.3	44.20	123.41	9.15
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.	50.90	27.6	50.42	121.48	11.28
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.	38.67	25.2	47.87	123.66	9.82
T_7	Atrazine at 1 kg ha^{-1} on 3 DAP.	32.27	24.2	41.27	124.19	7.58
T_8	Hand weeding on 30,90,150 and 210 DAP	41.87	26.2	49.51	123.77	11.95
T_9	Weed free check	62.23	33.8	52.59	125.37	14.37
T_{10}	Unweeded check	22.50	17.0	26.53	81.83	6.03
	SEd	1.81	1.15	1.94	5.13	0.44
	CD(P= 0.05)	3.76	2.38	4.03	10.64	0.91

Conclusion

Therefore from these study it could be concluded that lay by application of pendimethalin at the rate of 1 kg ha^{-1} on 3 Days after planting *fb* Hand hoeing + pendimethalin at the rate of 1.5 kg ha^{-1} on 30, 90,150, 210 Days after planting (T_2) were found to be superior to suppress the weeds and to result in higher growth and flowering parameters in tuberose.

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