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Evaluation of different herbicides in tuberoses under irrigated condition

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Abstract

An experiment was carried out to evaluate the effect of different herbicides in tuberoses under irrigated condition grown at farmer's field Chinnapudur, Dharmapuri (dist) during 2017-2018 and 2018-2019 season. The major weeds infecting the field were *Cleome viscosa*, *Convolvulus arvensis*, *Commelina benghalensis*, *Trianthema portulacastrum*, *Phyllanthus niruri*, *Cyperus rotundus*, *Dactyloctenium aegyptium* and *Cynodon dactylon*. The uncontrol plots recorded maximum weeds throughout the season. Whereas significantly low weed count, fresh weight and dry weight were recorded in pre-emergence herbicide application of pendimethalin @ 1.0 kg ha⁻¹ on 3 DAP followed by hand hoeing + pendimethalin @ 1.5 kg ha⁻¹ on 30, 90, 150, 210 DAP (T₂). Pre emergence application of atrazine @ 1.0 kg ha⁻¹ on 3 DAP (T₇) registered increased weed control efficiency with 74.60 per cent on 30 days after planting. However the application of pendimethalin @ 1.0 kg ha⁻¹ on 3 DAP followed by hand hoeing + pendimethalin @ 1.5 kg ha⁻¹ on 30, 90, 150, 210 DAP (T₂) registered increased plant height, spike length, rachis length and number of florets.

Keywords: Tuberoses, herbicides, pre-emergence, weed control efficiency

Introduction

Tuberoses (*Polianthes tuberosa* L.) is one of the significant commercial flower crops of India and is native of Mexico. It belongs to the Amaryllidaceae family. It is extensively named as Rajanigandha. It occupies a top position among commercial flower crops is known for the good fragrance, beauty and enhanced keeping quality of flower spikes. The large spikes of tuberoses are used for vase and bouquet preparation whereas the loose florets were used for garlands preparation, ornaments and buttonhole use. The flower emits a pleasant fragrance and the source for production of tuberoses oil. The flower oil is one of the most high-priced perfume raw materials. Tuberoses is an important bulbous flower crop grown throughout the world for cut flower and loose flower production. It includes the varieties like single, semi-double, double and variegated. Tuberoses 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. The growth and flower yield of the crop plant mainly depends on the cultivation operations followed in field condition. The factor which affect the tuberoses production which includes pest, disease and weed infestation in field. The above mentioned factors severely affect the flower quality, spike production, fragrance, keeping quality and flower production. Among these factors weed is the major problem in commercial flower production in general.

Weed management in tuberoses is very difficult process since it is used for both flower and bulb production as reported by (Shalini and Patil, 2010) [5]. Weeds could be controlled by hand weeding since, hand weeding is laborious, time consuming and become demand due to labour scarcity in rural folk. Even though, some labours are available, dictated contracted system become more expensive in controlling weeds. Delay in removal of weeds is not proficient in reducing weeds and obtaining maximum yield as against periodical removal of weeds. Under this situation, employment of herbicides offers another potential method in control of weeds.

Materials and Methods

The field study was carried out under open field condition at farmer's field Chinnapudur,

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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 trial was ploughed twice followed by well decomposed farm yard manure was applied evenly at a rate of 12.5 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. The experiment was conducted in RBD and replicated thrice. Ten treatments including control- weed free. The treatments comprised of ten different weed management practices viz., T₁: 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, T₂: Pendimethalin @ 1.0 kg ha⁻¹ on 3 DAP fb hand hoeing + pendimethalin @ 1.5 kg ha⁻¹ on 30, 90, 150, 210 DAP, T₃: 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, T₄: 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, T₅: Pendimethalin @ 1.0 kg ha⁻¹ on 3 DAP fb hand hoeing + pendimethalin @ 1.5 kg ha⁻¹ on 30, 120, 210 DAP, T₆: 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, T₇: Atrazine @ 1 kg ha⁻¹ on 3 DAP, T₈: Hand weeding at 30, 90, 150 and 210 DAP, T₉: Weed free check, T₁₀: 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 count was recorded on 30, 90, 150 and 210 days after planting using the quadrat was placed randomly at three sites per plot. Weed control efficiency (WCE) was calculated with following formula.

$$\text{Weed control efficiency(\%)} = \frac{W_{pc} - W_{pt}}{W_{pc}} \times 100$$

Effect on weed population

In present study, species such as *Commelina benghalensis*, *Convolvulus arvensis*, *Cleome viscosa*, *Trianthema portulacastrum* and *Phyllanthus niruri*, *Cyperus rotundus* and *Dactyloctenium aegyptium*, *Cynodon dactylon* were dominated throughout the growing period. Similarly, Yadav *et al.* (2009)^[7] stated that onion field is dominated by various kinds of weeds like *Cyperus rotundus*, *Convolvulus arvensis*, *Melilotus indica* and *Chenopodium mural*. Among the different weed control treatments effectively reduced the weed population compared to the unweeded check. Pre emergence application of

pendimethalin @ 1.0 kg ha⁻¹ on 3 DAP fb hand hoeing + pendimethalin @ 1.5 kg ha⁻¹ on 30, 90, 150, 210 DAP (T₂) recorded reduced weed count, dry weight, increased weed control efficiency and reduced weed index in both the years (Table 1 & 2) Similar results were recorded by (Anandamurthy and Narayangowda, 1993)^[1]. However the application of atrazine @ 1.0 kg ha⁻¹ on 3 DAP (T₇) effectively controlled the broadleaved weeds with density of 1.51 No.m⁻² 30 DAP. These show the effectiveness of atrazine over the broad leaf weeds. Similar result were recorded in rose cultivation reported by (Singh, 2000)^[6].

The higher weed control efficiency (89.55, 87.62) were recorded with pre emergence application of pendimethalin @ 1.0 kg ha⁻¹ on 3 DAP fb hand hoeing + pendimethalin @ 1.5 kg ha⁻¹ on 30, 90, 150, 210 DAP (T₂). The experimental finding collaborates with Ravneet Kaur *et al.* (2014)^[4]. The same trend was seen in application of 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 with (87.33, 86.39). These results clearly show the effectiveness of herbicide over the weeds. Similar result was reported by (Kumar *et al.*, 2012)^[3] with increased weed control efficiency 78.2 per cent was obtained with two hand hoeings followed with application of pendimethalin plus hand weeding recorded 76.9 per cent in tuberose. The variability in weed population in different treatment could be attributed to the fact some herbicidal treatments were more effective in weed control than others.

Effect of different herbicide on plant growth

The data presented in Table 3 and 4 showed that significantly short plant height was recorded in unweeded check (22.50, 23.07 cm), whereas tallest plant height (62.22, 61.79 cm) was found in (T₂). The decrease in plant height in unweeded check could be the adverse effect of weeds on growth of tuberose. Result prove (Table 3 & 4) that pre emergence application of pendimethalin @ 1.0 kg ha⁻¹ on 3 DAP fb hand hoeing + pendimethalin @ 1.5 kg ha⁻¹ on 30, 90, 150, 210 DAP (T₂) recorded significantly superior spike length (115.13, 114.60), rachis length (33.47, 31.73), spike weight (29.22, 30.43), number floret per spike (56.16, 53.12), days taken for first flower opening (78.20, 75.93), weight of 100 floret (124.17, 124.80 g). From the study it clearly shows that the flower diameter and number of leaves were not affected by application of different herbicides. The growth parameters in unweeded check is significantly affected these might be due to the presence of weed throughout the growth period leads to heavy competition for nutrients, space, light and water. Similar results were reported by (Bond and Oliver, 2006)^[2] reported that in chrysanthemum cultivation.

Since management of weeds in tuberose at critical stage is crucial, the present study concludes that application of pendimethalin @ 1.0 kg ha⁻¹ on 3 DAP fb hand hoeing + pendimethalin @ 1.5 kg ha⁻¹ on 30, 90, 150, 210 DAP beneficial in reducing weed count and improving the crop growth

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

T. No	Treatments	Grass weed population (No.m ⁻²)	Broad leaved population (No.m ⁻²)	Sedge weed population (No.m ⁻²)	Weed control efficiency (%)
T ₁	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb para @ 1.0 kg ha ⁻¹ on 30 & 150 DAP + quizalofop-ethyl @ 50g ha ⁻¹ on 90 and 210 DAP	10.73 (3.35)	24.41 (4.99)	29.33 (5.46)	77.27
T ₂	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 30, 90,150, 210 DAP	8.04 (3.06)	9.23 (3.12)	12.37 (3.59)	89.55
T ₃	Pendi @ 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 + pendu @ 1.5 kg ha ⁻¹ on 90 and 210 DAP	8.50 (3.00)	10.09 (3.25)	15.93 (4.05)	87.83
T ₄	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 30 DAP fb para @ 1.0 kg ha ⁻¹ on 120 DAP fb quizalofop-ethyl @ 50g ha ⁻¹ on 210 DAP.	10.40 (3.30)	25.40 (5.09)	26.23 (5.16)	78.13
T ₅	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 30, 120, 210 DAP.	10.83 (3.37)	21.49 (4.69)	21.27 (4.66)	81.1
T ₆	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 30 DAP fb hand hoeing + alachlor @ 1.5 kg ha ⁻¹ on 120 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 210 DAP.	12.67 (3.63)	22.37 (4.78)	23.97 (4.94)	73.32
T ₇	Atrazine @ 1.0 kg ha ⁻¹ on 3 DAP.	26.20 (5.17)	46.02 (6.82)	50.82 (6.47)	56.62
T ₈	Hand weeding at 30,90,150 and 210 DAP	13.30 (3.71)	51.78 (7.23)	51.42 (6.38)	58.93
T ₉	Weed free check	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	100
T ₁₀	Unweeded check	104.88 (9.47)	72.86 (8.54)	105.94 (10.33)	0
	SEd	0.16	0.23	0.44	-
	CD(P= 0.05)	0.34	0.49	0.93	-

Data were subjected to $\sqrt{(X + 0.5)}$ transformation. Figures in parenthesis are means of transformed values. Pendi- Pendimethalin, DAP- days after planting, Para- Paraquat

Table 2: Effect of weed control treatments on weed population (No.m⁻²) during 2018-2019

T. No	Treatments	Grass weed population (No.m ⁻²)	Broad leaved population (No.m ⁻²)	Sedge weed population (No.m ⁻²)	Weed control efficiency (%)
T ₁	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb para @ 1.0 kg ha ⁻¹ on 30 & 150 DAP + quizalofop-ethyl @ 50g ha ⁻¹ on 90 and 210 DAP	18.35 (4.34)	26.10 (5.15)	28.53 (5.38)	72.44
T ₂	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 30, 90,150, 210 DAP	10.10 (3.25)	8.19 (2.94)	13.15 (3.69)	87.62
T ₃	Pendi @ 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 + pendu @ 1.5 kg ha ⁻¹ on 90 and 210 DAP	11.31 (3.39)	8.24 (2.96)	15.04 (3.94)	86.39
T ₄	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 30 DAP fb para @ 1.0 kg ha ⁻¹ on 120 DAP fb quizalofop-ethyl @ 50g ha ⁻¹ on 210 DAP.	14.54 (3.88)	26.37 (5.17)	26.87 (5.22)	71.59
T ₅	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 30, 120, 210 DAP.	12.01 (3.54)	22.24 (4.77)	22.03 (4.75)	77.85
T ₆	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 30 DAP fb hand hoeing + alachlor @ 1.5 kg ha ⁻¹ on 120 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 210 DAP.	13.03 (3.68)	24.06 (4.95)	25.63 (5.11)	70.82
T ₇	Atrazine @ 1.0 kg ha ⁻¹ on 3 DAP.	45.83 (6.81)	49.76 (7.09)	41.69 (5.07)	47.8
T ₈	Hand weeding at 30,90,150 and 210 DAP	38.24 (6.21)	43.49 (6.63)	48.16 (4.82)	48.88
T ₉	Weed free check	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	100
T ₁₀	Unweeded check	82.87 (8.92)	74.53 (8.39)	96.73 (9.86)	0
	SEd	0.21	0.25	0.19	-
	CD(P= 0.05)	0.43	0.52	0.41	-

Data were subjected to $\sqrt{(X + 0.5)}$ transformation. Figures in parenthesis are means of transformed values Pendi- Pendimethalin, DAP- days after planting, Para- Paraquat

Table 3: Effect of weed control treatments on plant parameters during 2017-2018

	Treatments	Plant height (cm)	No. of leaves plant ⁻¹	Spike weight (g)	Days taken for first flower opening
T ₁	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb para @ 1.0 kg ha ⁻¹ on 30 & 150 DAP + quizalofop-ethyl @ 50g ha ⁻¹ on 90 and 210 DAP	26.28	22.67	25.50	91.92
T ₂	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 30, 90,150, 210 DAP	48.09	32.17	29.22	78.20
T ₃	Pendi @ 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 + pendu @ 1.5 kg ha ⁻¹ on 90 and 210 DAP	41.33	30.93	27.40	82.45
T ₄	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 30 DAP fb para @ 1.0 kg ha ⁻¹ on 120 DAP fb quizalofop-ethyl @ 50g ha ⁻¹ on 210 DAP.	33.89	25.37	24.50	88.15
T ₅	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 30, 120, 210 DAP.	37.23	30.63	25.82	85.13
T ₆	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 30 DAP fb hand hoeing + alachlor @ 1.5 kg ha ⁻¹ on 120 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 210 DAP.	33.40	28.33	25.55	87.60
T ₇	Atrazine @ 1.0 kg ha ⁻¹ on 3 DAP.	22.15	20.67	24.96	88.17
T ₈	Hand weeding at 30,90,150 and 210 DAP	33.06	32.80	25.88	85.27
T ₉	Weed free check	50.83	41.09	32.04	75.00
T ₁₀	Unweeded check	17.81	16.60	19.19	119.72
	SEd	1.47	1.22	1.20	4.72
	CD(P= 0.05)	3.06	2.53	2.50	9.80

Pendi- Pendimethalin, DAP- days after planting, Para- Paraquat

Table 4: Effect of weed control treatments on plant parameters during 2018-2019

	Treatments	Plant height (cm)	No. of leaves plant ⁻¹	Spike weight (g)	Days taken for first flower opening
T ₁	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb para @ 1.0 kg ha ⁻¹ on 30 & 150 DAP + quizalofop-ethyl @ 50g ha ⁻¹ on 90 and 210 DAP	26.09	22.67	25.05	92.21
T ₂	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 30, 90,150, 210 DAP	43.27	32.17	30.43	75.93
T ₃	Pendi @ 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 + pendu @ 1.5 kg ha ⁻¹ on 90 and 210 DAP	43.11	30.93	28.43	82.17
T ₄	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 30 DAP fb para @ 1.0 kg ha ⁻¹ on 120 DAP fb quizalofop-ethyl @ 50g ha ⁻¹ on 210 DAP.	34.15	25.37	24.91	88.00
T ₅	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 30, 120, 210 DAP.	39.56	30.63	25.13	84.57
T ₆	Pendi @ 1.0 kg ha ⁻¹ on 3 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 30 DAP fb hand hoeing + alachlor @ 1.5 kg ha ⁻¹ on 120 DAP fb hand hoeing + pendu @ 1.5 kg ha ⁻¹ on 210 DAP.	35.59	28.33	26.22	86.90
T ₇	Atrazine @ 1.0 kg ha ⁻¹ on 3 DAP.	25.90	20.67	23.79	88.52
T ₈	Hand weeding at 30,90,150 and 210 DAP	33.34	32.80	25.20	84.17
T ₉	Weed free check	45.52	41.09	33.13	74.63
T ₁₀	Unweeded check	17.13	16.60	17.30	114.73
	SEd	1.44	1.22	1.11	3.61
	CD(P= 0.05)	3.00	2.53	2.30	7.49

Pendi- Pendimethalin, DAP- days after planting, Para- Paraquat

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