

Original Research Article

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Bio-efficacy and Phytotoxicity of Oxyfluorfen 2.5% + Glyphosate 41% SC (Ready mix) against Weed Complex in Grape

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ABSTRACT

A field experiments was conducted on grape (*Vitis vinifera* L. cv Thompson seedless at the vineyard of the farmer's field of Vijayapur a district coming under the jurisdiction of University of Agricultural Sciences Dharwad, Karnataka, after October pruning during 2014-15 and 2015-16 to study the bioefficacy of oxyfluorfen 2.5% + glyphosate 41% SC against weed complex. The weed density and weed dry weight recorded at 45 and 60 days after application (DAA) revealed that the dosage of the new herbicide oxyfluorfen 2.5% + glyphosate 41% SC @ 3.625 l ha⁻¹ resulted in better management of the weeds followed by oxyfluorfen 2.5% + glyphosate 41% SC @ 3.125 l ha⁻¹. The weed control efficiency based on weed dry weight over control at 45 and 60 DAA resulted in better efficacy of these herbicide doses .It observed that plots treated with oxyfluorfen 2.5% + glyphosate 41% SC @ 3.625 l ha⁻¹ and 3.125 l ha⁻¹ provided significantly superior management of the weeds in grape vineyard compared to other treatments. Among the herbicides, significantly higher grape yield (21.83 t/ha) was recorded with application of oxyfluorfen 2.5% + glyphosate 41% SC @ 3.625 l ha⁻¹ which was on par with oxyfluorfen 2.5% + glyphosate 41% SC @ 3.125 l ha⁻¹ (21.68 t/ha). Higher monetary benefit cost ratio (9.60) was recorded with oxyfluorfen 2.5% + glyphosate 41% SC @ 3.125 l ha⁻¹ followed by oxyfluorfen 2.5% + glyphosate 41% SC @ 3.625 l ha⁻¹ (9.32). The hand weeding treatment showed lower benefit cost ratio (5.76). Other treatments were economically not beneficial to control weeds in grape crop. No symptoms of phytotoxicity were observed at 1, 3, 5, 7 and 10 days after the application with oxyfluorfen 2.5% + glyphosate 41% SC @ 3.125 and 6.25 l ha⁻¹.

Keywords

Grape, Seedless,
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Introduction

Grape (*Vitis vinifera* L.) is one of the most important fruit crops of temperate zone, which has acclimatized to sub-tropical and tropical agro climatic conditions prevailing in the Indian subcontinent. In India, grapes are grown under different soil and cultural conditions. Grapevines and weeds compete for water, nutrients, and light. The primary goal of weed management is to optimize yield

by minimizing weed competition. Weeds reduce yields by competing with crops. Weeds reduce harvest efficiency, as well. timely weed removal, wise use of herbicides, and prevention of weed seed production are an integral part of a good weed management system.

Weed flora varies according to the climate and physio-chemical properties of the soil. Irrespective of the agro climatic conditions,

Parthenium hysterophorus, *Cynodon dactylon* *Cyperus rotundus* are the common weeds in the Indian vineyards although as many as 378 species of weeds have been reported to infest the cultivated lands in Karnataka (Krishna Sastry *et al.*, 1980). Weed menace has been considered as one of the major constraints in grape production. Timely weeding reduces the crop-weed competition, resulting higher crop yields (Stevenson *et al.*, 1986). Hand weeding, though an efficient method, is laborious, costly, time consuming and unsuitable for large grape vineyards (Bajwa *et al.*, 1989).

This necessitates the use of herbicides for weed management in developing countries like India. In the past, majority of workers have tried either pre-emergence or post-emergence application of herbicides for the control of weeds in the grape vineyard. No single herbicide either as pre-emergence or post-emergence can offer a long lasting control of weeds in vineyards since grape vines are irrigated and the soil moisture is maintained throughout the year, which helps the weeds to grow almost throughout the year. Keeping all these aspects in mind, the present investigation was undertaken to study the bioefficacy and phytotoxicity of Oxyfluorfen 2.5% + Glyphosate 41% SC (Ready mix) against Weed Complex in Grape.

Materials and Methods

A field experiment was conducted on grape (*Vitis vinifera* L.cv. Thompson seedless) at the vineyard of the farmer's field (Location latitude 16.52 N and longitude 75.69 E) of Vijayapura district coming under the jurisdiction of University of Agricultural Sciences Dharwad, Karnataka, India. after October pruning of 2014-15 and 2015-16. The trial was laid out in randomized complete block design, having eight treatments with three replications, to test the effect of various

treatments for managing weeds in the grape vineyards under tropical conditions of Vijayapura, Karnataka. The vines selected were spaced at 2.4 m between rows and 1.2 m within rows. The plot size was 9.6 m x 6.0 m accommodating 20 vines in each treatment. Irrigation and fertilizer requirements were followed as per recommended package. All the herbicides were applied at 3 to 4 leaf stage of weed in vineyard using spray volume 500 l ha⁻¹ with the help of knapsack sprayer fitted with a flood jet nozzle WFN 0.040. Weeds were counted by taking a quadrant of 1m x 1m placed at random inside the each treated plot. The total number of dicot and monocot weeds present in the quadrant frame was counted at 45 and 60 days after herbicide treatment. The sum of all weeds was recorded as total weed count per square meter. For dry weight, the above ground portion of the weeds in the quadrant was collected from each plot at 45 and 60 days after treatment.

The weed samples were air dried and later oven dried to constant weight at 60 oC and dry weight was recorded. Based on weed dry weight weed control efficiency was calculated. Grape yield per hectare was calculated based on bunch weight at the time of crop harvest. The yield of ten vines in each treatment was recorded and average yield per hectare was calculated and expressed in tonnes. Benefit cost ratio using cost of inputs used was also calculated. All weed parameters studied showed high degree of variation. Therefore, data was subjected to square-root transformation as suggested by Gomez and Gomez (1984) to make the analysis of variance valid. The dominant weed flora includes grasses - *Cynodon dactylon*, *Setaria verticiliata*, *Digitaria sanguinalis*. Broadleaf - *Parthenium hysterophorus*, *Euphorbia hirta*, *Portulaca oleracea*, *Tridax procumbens*, *Amaranthus sp*, *Phyllanthus maderaspatensis*, *Cardiospermum helicacabum* *Cleome viscosa* and sedges - *Cyperus rotundus*. The

observation on phytotoxicity of grape vine was recorded at 1, 3, 5, 7 and 10 days after application of herbicide on the basis of rating scale (PRS). The parameters on phytotoxicity were recorded considering vein clearing, chlorosis, necrosis, wilting, scorching, hyponasty and epinasty. The observation on the level of phytotoxicity through visual assessment of crop response was rated on the scale of 0-10. Rating “0” indicates no visible injury and “10” indicates the complete destruction of the crop. Hand weeding treatment was also included. The treatments details are as given below (Table 1).

Results and Discussion

Effect of herbicides on weed density

Herbicide treatments in grape vineyard significantly reduced weed population. Lowest weed density (3.0 m⁻²) was observed after 45 days of application of Oxyfluorfen 2.5% + Glyphosate 41% SC @ 3.625 l ha⁻¹ followed by application of Oxyfluorfen 2.5% + Glyphosate 41% SC @ 3.125 l ha⁻¹ (3.2 m⁻²). However, after 60 days of spraying of herbicides, highest weed control was observed with lowest weed density (3.6 m⁻²) in Oxyfluorfen 2.5% + Glyphosate 41% SC @ 3.625 l ha⁻¹ treated plot compared to rest of the herbicides followed by the same herbicide applied @ 3.125 l ha⁻¹. This might be due to persistence of glyphosate for a longer period.

Similar results were observed by Gaziev and Voevodin (1985) who showed that glyphosate persisted in soil for three to five months under rainfed conditions and three months under irrigated conditions (Table 2 and 3). After 60 days of spraying highest weed density was recorded in weedy check treatment which was in contrast with the findings of Rekha *et al.*, (2002) and Hussain *et al.*, (2008). The results are in conformation with the earlier works by Hebbethwaite and Schepens (1986), Bajwa (1990) and Bajwa *et al.*, (1992), who also reported glyphosate as very effective for controlling both mono and dicot weeds in grapes.

Effect of herbicides on dry weight of weeds and weed control efficiency

Application of Oxyfluorfen 2.5% + Glyphosate 41% SC (RM) with other herbicides treatments in ‘Thompson seedless’ grape vineyard significantly reduced the dry weight of all types of weeds both at 45 and 60 days compared to weedy check. Oxyfluorfen 2.5% + Glyphosate 41% SC @ 3.625 ha⁻¹ or 3.125 l ha⁻¹ showed its superiority by recording lower dry weight of weeds compared to other post emergent herbicides like glyphosate 41% SL, diuron % 80 WP and oxyfluorfen 23.5 % EC (Table 3 and 4). Similar results were obtained by Bajwa *et al.*, (1993) and Muniyappa and Prathibha (1993).

Table.1 Treatment detail

T. No.	Treatment	Dose ha ⁻¹	
		a. i. (g)	Formulation (l or kg ha ⁻¹)
1.	Oxyfluorfen 2.5% + Glyphosate 41% SC*	65.625+1076.25	2.625
2.	Oxyfluorfen 2.5% + Glyphosate 41% SC*	78.125+1281.25	3.125
3.	Oxyfluorfen 2.5% + Glyphosate 41% SC*	90.625+1486.25	3.625
4.	Oxyfluorfen 23.5% EC	250	1.00
5.	Glyphosate 41% SL	1230	3.00
6.	Diuron 80% WP	1600	2.00
7.	Weedy check	-	-
8.	Weed free check	-	-

* Ready mix

Table.2 Effect of Oxyfluorfen 2.5% + Glyphosate 41% SC and other herbicides on weed density (m⁻²) at 45 DAA in grapes (Pooled data of two years)

Sl. No.	Treatment	Dose l or kg/ha	<i>Cynodon dactylon</i>	<i>Setaria verticiliata</i>	<i>Parthenium hysterophorus</i>	<i>Euphorbia hirta</i>	<i>Portulaca oleracea</i>	<i>Tridax procumbens</i>	<i>Amaranthus spp.</i>	<i>Cyperus rotundus</i>	Other weeds	Total
1.	Oxyfluorfen 2.5% + Glyphosate 41% SC directed spray as PoE	2.625	3.56	2.89	2.11	2.67	1.22	1.44	1.67	6.22	1.00	22.8
			(2.01)*	(1.84)	(1.62)	(1.77)	(1.31)	(1.39)	(1.47)	(2.59)	(1.22)	(4.8)
2.	Oxyfluorfen 2.5% + Glyphosate 41% SC	3.125	1.89	1.56	1.22	1.56	0.00	0.00	0.22	3.00	0.22	9.7
			(1.54)	(1.43)	(1.31)	(1.43)	(0.71)	(0.71)	(0.83)	(1.87)	(0.85)	(3.2)
3.	Oxyfluorfen 2.5% + Glyphosate 41% SC	3.625	1.67	1.56	1.00	1.33	0.00	0.00	0.00	2.56	0.11	8.2
			(1.47)	(1.43)	(1.22)	(1.34)	(0.71)	(0.71)	(0.71)	(1.69)	(0.78)	(3.0)
4.	Oxyfluorfen 23.5% EC directed spray as PoE	1.000	7.56	6.67	1.89	2.44	0.78	0.78	1.11	4.89	0.67	26.8
			(2.83)	(2.67)	(1.54)	(1.71)	(1.10)	(1.13)	(1.25)	(2.32)	(1.05)	(5.2)
5.	Glyphosate 41% SL directed spray as PoE	3.000	2.33	1.89	1.67	2.11	0.67	0.56	0.78	4.56	0.44	15.0
			(1.68)	(1.54)	(1.47)	(1.62)	(1.08)	(1.02)	(1.13)	(2.24)	(0.97)	(3.9)
6.	Diuron 80% WP directed spray as PoE	2.000	2.56	2.11	1.78	2.33	0.78	0.56	1.00	4.78	0.56	16.5
			(1.75)	(1.62)	(1.51)	(1.68)	(1.13)	(1.02)	(1.22)	(2.29)	(1.02)	(4.1)
7.	Weedy check	-	11.33	8.67	6.44	7.89	4.44	5.00	5.78	16.44	3.78	69.8
			(3.44)	(3.03)	(2.62)	(2.89)	(2.22)	(2.34)	(2.50)	(4.11)	(2.07)	(8.4)
8.	Weed free check	-	1.56	1.33	0.89	1.11	0.00	0.00	0.00	2.44	0.11	7.4
			(1.43)	(1.35)	(1.18)	(1.27)	(0.71)	(0.71)	(0.71)	(1.71)	(0.78)	(2.8)
	SEm±		0.04	0.03	0.05	0.05	0.07	0.05	0.07	0.09	0.04	0.27
	CD (P=0.05)		0.11	0.10	0.15	0.16	0.23	0.14	0.21	0.28	0.11	0.82

Other weeds - *Cleome viscosa*, *Digitaria sanguinalis*, *Phyllanthus madraspatensis* and *Cardiospermum helicacabum*;

*Data in the parentheses indicate the transformed values $\sqrt{x+0.5}$, PoE: Post emergence

Table.3 Effect of Oxyfluorfen 2.5% + Glyphosate 41% SC and other herbicides on weed density (m⁻²) at 60 DAA in grapes (Pooled data of two years)

Sl. No.	Treatment	Dose l or kg/ha	<i>Cynodon dactylon</i>	<i>Setaria verticiliata</i>	<i>Parthenium hysterophorus</i>	<i>Euphorbia hirta</i>	<i>Portulaca oleracea</i>	<i>Tridax procumbens</i>	<i>Amaranthus spp.</i>	<i>Cyperus rotundus</i>	Other weeds	Total
1.	Oxyfluorfen 2.5% + Glyphosate 41% SC directed spray as PoE	2.625	3.78	3.11	2.67	3.00	1.56	1.67	2.00	6.56	1.22	25.6
			(2.07)*	(1.90)	(1.78)	(1.87)	(1.43)	(1.47)	(1.58)	(2.65)	(1.31)	(5.1)
2.	Oxyfluorfen 2.5% + Glyphosate 41% SC	3.125	1.89	2.00	1.56	1.56	0.56	0.78	0.67	3.11	0.44	12.6
			(1.54)	(1.58)	(1.41)	(1.43)	(1.02)	(1.13)	(1.08)	(1.90)	(0.97)	(3.6)
3.	Oxyfluorfen 2.5% + Glyphosate 41% SC	3.625	1.78	1.78	1.33	1.44	0.33	0.56	0.67	3.00	0.33	11.2
			(1.51)	(1.50)	(1.35)	(1.39)	(0.91)	(1.00)	(1.08)	(1.79)	(0.91)	(3.4)
4.	Oxyfluorfen 23.5% EC directed spray as PoE	1.000	7.78	6.89	2.44	2.56	1.00	1.33	1.67	5.22	0.78	29.7
			(2.87)	(2.71)	(1.71)	(1.74)	(1.22)	(1.35)	(1.47)	(2.39)	(1.09)	(5.5)
5.	Glyphosate 41% SL directed spray as PoE	3.000	2.44	2.67	2.11	2.22	0.89	1.22	1.33	5.00	0.67	18.6
			(1.71)	(1.78)	(1.62)	(1.65)	(1.18)	(1.31)	(1.35)	(2.34)	(1.08)	(4.4)
6.	Diuron 80% WP directed spray as PoE	2.000	2.67	2.78	2.33	2.33	1.00	1.22	1.44	5.00	0.78	19.6
			(1.78)	(1.81)	(1.68)	(1.68)	(1.22)	(1.31)	(1.39)	(2.34)	(1.13)	(4.5)
7.	Weedy check	-	13.67	10.00	7.56	8.44	5.22	5.89	6.44	18.22	4.00	79.4
			(3.76)	(3.23)	(2.83)	(2.98)	(2.39)	(2.52)	(2.63)	(4.32)	(2.12)	(8.9)
8.	Weed free check	-	1.78	1.56	1.11	1.33	0.33	0.44	0.44	2.78	0.33	10.1
			(1.51)	(1.43)	(1.27)	(1.35)	(0.91)	(0.97)	(0.97)	(1.81)	(0.91)	(3.3)
	SEm±		0.05	0.05	0.06	0.04	0.05	0.05	0.04	0.12	0.03	0.11
	CD (P=0.05)		0.15	0.16	0.19	0.13	0.14	0.16	0.13	0.37	0.09	0.32

Other weeds - *Cleome viscosa*, *Digitaria sanguinalis*, *Phyllanthus madraspatensis* and *Cardiospermum helicacabum*

*Data in the parentheses indicate the transformed values $\sqrt{x+0.5}$, PoE: Post emergence

Table.4 Effect of Oxyfluorfen 2.5% + Glyphosate 41% SC and other herbicides on weed biomass (g m⁻²) at 45 DAA in grapes (Pooled data of two years)

Sl. No.	Treatment	Dose l or kg/ha	<i>Cynodon dactylon</i>	<i>Setaria verticiliata</i>	<i>Parthenium hysterophorus</i>	<i>Euphorbia hirta</i>	<i>Portulaca oleracea</i>	<i>Tridax procumbens</i>	<i>Amaranthus spp.</i>	<i>Cyperus rotundus</i>	Other Weeds	Total
1.	Oxyfluorfen 2.5% + Glyphosate 41% SC directed spray as PoE	2.625	2.73	1.86	2.18	2.86	1.36	1.86	1.66	3.00	1.42	18.9
			(1.80)*	(1.53)	(1.63)	(1.83)	(1.36)	(1.53)	(1.47)	(1.87)	(1.38)	(4.4)
2.	Oxyfluorfen 2.5% + Glyphosate 41% SC	3.125	1.14	0.73	0.88	1.06	0.00	0.00	0.46	1.38	0.34	6.0
			(1.28)	(1.11)	(1.17)	(1.25)	(0.71)	(0.71)	(0.98)	(1.37)	(0.92)	(2.5)
3.	Oxyfluorfen 2.5% + Glyphosate 41% SC	3.625	1.02	0.69	0.82	1.00	0.00	0.00	0.00	1.25	0.26	5.0
			(1.23)	(1.09)	(1.15)	(1.22)	(0.71)	(0.71)	(0.71)	(1.32)	(0.87)	(2.4)
4.	Oxyfluorfen 23.5% EC directed spray as PoE	1.000	3.86	2.73	1.74	1.83	1.00	1.42	1.26	2.11	0.98	16.9
			(2.08)	(1.79)	(1.49)	(1.51)	(1.20)	(1.38)	(1.33)	(1.59)	(1.22)	(4.2)
5.	Glyphosate 41% SL directed spray as PoE	3.000	1.85	1.30	1.63	1.73	0.96	1.31	1.18	2.02	0.92	12.9
			(1.52)	(1.34)	(1.46)	(1.49)	(1.21)	(1.34)	(1.28)	(1.59)	(1.15)	(3.7)
6.	Diuron 80% WP directed spray as PoE	2.000	1.93	1.40	1.69	1.82	0.97	1.36	1.23	2.10	0.95	13.5
			(1.56)	(1.38)	(1.48)	(1.52)	(1.21)	(1.36)	(1.31)	(1.61)	(1.20)	(3.7)
7.	Weedy check	-	9.74	7.02	8.63	9.70	5.06	6.80	6.24	10.69	4.88	68.8
			(3.19)	(2.74)	(3.00)	(3.19)	(2.35)	(2.70)	(2.57)	(3.34)	(2.31)	(8.3)
8.	Weed free check	-	0.86	0.58	0.63	0.90	0.00	0.00	0.00	1.02	0.18	4.2
			(1.17)	(1.04)	(1.06)	(1.18)	(0.71)	(0.71)	(0.71)	(1.23)	(0.82)	(2.2)
	SEm±		0.05	0.03	0.08	0.05	0.06	0.04	0.09	0.06	0.07	0.04
	CD (P=0.05)		0.14	0.10	0.23	0.15	0.18	0.13	0.27	0.18	0.20	0.12

Other weeds - *Cleome viscosa*, *Digitaria sanguinalis*, *Phyllanthus madraspatensis* and *Cardiospermum helicacabum*

*Data in the parentheses indicate the transformed values $\sqrt{x+0.5}$, PoE: Post emergence

Table.5 Effect of Oxyfluorfen 2.5% + Glyphosate 41% SC and other herbicides on weed biomass (g m⁻²) at 60DAA in grapes (Pooled data of two years)

Sl. No.	Treatment	Dose l or kg/ha	<i>Cynodon dactylon</i>	<i>Setaria verticiliata</i>	<i>Parthenium hysterophorus</i>	<i>Euphorbia hirta</i>	<i>Portulaca oleracea</i>	<i>Tridax procumbens</i>	<i>Amaranthus spp.</i>	<i>Cyperus rotundus</i>	Other Weeds	Total
1.	Oxyfluorfen 2.5% + Glyphosate 41% SC directed spray as PoE	2.625	4.01	2.75	3.36	4.16	2.00	2.62	2.21	4.32	1.73	27.2
			(2.12)*	(1.80)	(1.96)	(2.15)	(1.58)	(1.76)	(1.64)	(2.19)	(1.49)	(5.3)
2.	Oxyfluorfen 2.5% + Glyphosate 41% SC	3.125	1.51	1.03	1.36	1.58	0.77	0.95	0.82	2.03	0.54	10.6
			(1.42)	(1.24)	(1.36)	(1.44)	(1.13)	(1.20)	(1.15)	(1.59)	(1.02)	(3.3)
3.	Oxyfluorfen 2.5% + Glyphosate 41% SC	3.625	1.46	1.00	1.28	1.50	0.73	0.88	0.79	1.97	0.41	10.0
			(1.40)	(1.22)	(1.33)	(1.41)	(1.11)	(1.17)	(1.13)	(1.57)	(0.95)	(3.2)
4.	Oxyfluorfen 23.5% EC directed spray as PoE	1.000	5.86	3.80	2.46	2.82	1.44	1.73	1.58	3.00	1.28	24.0
			(2.52)	(2.07)	(1.72)	(1.82)	(1.39)	(1.49)	(1.44)	(1.87)	(1.33)	(4.9)
5.	Glyphosate 41% SL directed spray as PoE	3.000	2.62	1.75	2.33	2.70	1.31	1.62	1.49	2.87	1.16	17.9
			(1.76)	(1.50)	(1.68)	(1.79)	(1.34)	(1.45)	(1.41)	(1.83)	(1.29)	(4.3)
6.	Diuron 80% WP directed spray as PoE	2.000	2.69	1.82	2.41	2.79	1.36	1.70	1.55	2.92	1.21	18.5
			(1.78)	(1.52)	(1.70)	(1.81)	(1.36)	(1.48)	(1.43)	(1.85)	(1.31)	(4.4)
7.	Weedy check	-	12.58	8.70	11.19	13.25	6.21	7.95	7.28	13.67	5.52	86.4
			(3.61)	(3.03)	(3.41)	(3.70)	(2.59)	(2.90)	(2.78)	(3.76)	(2.45)	(9.3)
8.	Weed free check	-	1.25	0.95	1.16	1.41	0.63	0.82	0.73	1.81	0.30	9.1
			(1.32)	(1.20)	(1.29)	(1.38)	(1.06)	(1.15)	(1.11)	(1.52)	(0.89)	(3.1)
	SEm±		0.04	0.03	0.04	0.04	0.03	0.03	0.03	0.04	0.03	0.12
	CD (P=0.05)		0.12	0.10	0.11	0.12	0.08	0.10	0.09	0.12	0.09	0.36

Other weeds - *Cleome viscosa*, *Digitaria sanguinalis*, *Phyllanthus madraspatensis* and *Cardiospermum helicacabum*

*Data in the parentheses indicate the transformed values $\sqrt{x+0.5}$, PoE: Post emergence

Table.6 Effect of Oxyfluorfen 2.5% + Glyphosate 41% SC and other herbicides on species wise Weed Control Efficiency (%) in grapes at 45 days after application. (Pooled data of two years)

Sl. No.	Treatment	Dose 1 or kg/ha	<i>Cynodon dactylon</i>	<i>Setaria verticiliata</i>	<i>Parthenium hysterophorus</i>	<i>Euphorbia hirta</i>	<i>Portulaca oleracea</i>	<i>Tridax procumbens</i>	<i>Amaranthus spp.</i>	<i>Cyperus rotundus</i>	Other weeds
1.	Oxyfluorfen 2.5% + Glyphosate 41% SC directed spray as PoE	2.625	71.97	73.50	74.74	70.52	73.12	72.65	73.40	71.94	70.90
2.	Oxyfluorfen 2.5% + Glyphosate 41% SC	3.125	88.30	89.60	89.80	89.07	100.00	100.00	92.63	87.09	93.03
3.	Oxyfluorfen 2.5% + Glyphosate 41% SC	3.625	89.53	90.17	90.50	89.69	100.00	100.00	100.00	88.31	94.67
4.	Oxyfluorfen 23.5% EC directed spray as PoE	1.00	60.37	61.11	79.84	81.13	80.24	79.12	79.81	80.26	79.92
5.	Glyphosate 41% SL directed spray as PoE	3.00	81.01	81.48	81.11	82.16	81.03	80.74	81.09	81.10	81.15
6.	Diuron 80% WP directed spray as PoE	2.00	80.18	80.06	80.42	81.24	80.83	80.00	80.29	80.36	80.53
7.	Weedy check	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.	Weed free check	-	91.17	91.74	92.70	90.72	100.00	100.00	100.00	90.46	96.31

Other Weeds - *Cleome viscosa*, *Digitaria sanguinalis*, *Phyllanthus madraspatensis* and *Cardiospermum helicacabum*

Table.7 Effect of Oxyfluorfen 2.5% + Glyphosate 41% SC and other herbicides on species wise Weed Control Efficiency (%) in grapes at 60 days after application. (Pooled data of two years)

Sl. No.	Treatment	Dose 1 or kg/ha	<i>Cynodon dactylon</i>	<i>Setaria verticiliata</i>	<i>Parthenium hysterophorus</i>	<i>Euphorbia hirta</i>	<i>Portulaca oleracea</i>	<i>Tridax procumbens</i>	<i>Amaranthus spp.</i>	<i>Cyperus rotundus</i>	Other weeds
1.	Oxyfluorfen 2.5% + Glyphosate 41% SC directed spray as PoE	2.625	68.12	68.39	69.97	68.60	67.79	67.04	69.64	68.40	68.66
2.	Oxyfluorfen 2.5% + Glyphosate 41% SC	3.125	88.00	88.16	87.85	88.08	87.60	88.05	88.74	85.15	90.22
3.	Oxyfluorfen 2.5% + Glyphosate 41% SC	3.625	88.39	88.51	88.56	88.68	88.24	88.93	89.15	85.59	92.57
4.	Oxyfluorfen 23.5% EC directed spray as PoE	1.000	53.42	56.32	78.02	78.72	76.81	78.24	78.30	78.05	76.81
5.	Glyphosate 41% SL directed spray as PoE	3.000	79.17	79.89	79.18	79.62	78.90	79.62	79.53	79.01	78.99
6.	Diuron 80% WP directed spray as PoE	2.000	78.62	79.08	78.46	78.94	78.10	78.62	78.71	78.64	78.08
7.	Weedy check	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.	Weed free check	-	90.06	89.08	89.63	89.36	89.86	89.69	89.97	86.76	94.57

Other Weeds - *Cleome viscosa*, *Digitaria sanguinalis*, *Phyllanthus madraspatensis* and *Cardiospermum helicacabum*

Table.8 Grape yield as influenced by herbicide treatments

Treatment		Dose l or kg/ha	2013 yield(t/ha)	2014 yield(t/ha)	Pooled yield(t/ha)
1.	Oxyfluorfen 2.5% + Glyphosate 41% SC directed spray as PoE	2.625	21.25	19.65	20.45
2.	Oxyfluorfen 2.5% + Glyphosate 41% SC	3.125	22.53	20.83	21.68
3.	Oxyfluorfen 2.5% + Glyphosate 41% SC	3.625	22.72	20.95	21.83
4.	Oxyfluorfen 23.5% EC directed spray as PoE	1.000	21.53	19.80	20.66
5.	Glyphosate 41% SL directed spray as PoE	3.000	21.00	20.05	20.52
6.	Diuron 80% WP directed spray as PoE	2.000	21.61	19.92	20.76
7.	Weedy check	-	20.38	18.85	19.61
8.	Weed free check	-	23.17	21.23	22.20
Sem ±			0.24	0.21	0.20
CD @ (P=0.05)			0.73	0.63	0.60

Table.9 Incremental benefit cost ratio of Oxyfluorfen 2.5% + Glyphosate 41% SC on grape (Pooled data)

Treatment		Dose (l or kg/ha)	Cost of inputs (Cost of herbicide/ha+ cost of labour for spraying) in Rs. ha ⁻¹	Grape yield (t/ha)	Extra yield over control (t/ha)	Value of additional yield (t/ha)	ICBR
T ₁	Oxyfluorfen 2.5% + Glyphosate 41% SC	2.625	3862.5	20.45	0.84	16800	1:4.35
T ₂	Oxyfluorfen 2.5% + Glyphosate 41% SC	3.125	4312.5	21.68	2.07	41400	1:9.60
T ₃	Oxyfluorfen 2.5% + Glyphosate 41% SC	3.625	4762.5	21.83	2.22	44400	1:9.32
T ₄	Oxyfluorfen 23.5% EC	1.000	3600	20.66	1.05	21000	1:5.83
T ₅	Glyphosate 41% SL	3.000	2740	20.52	0.91	18200	1:6.64
T ₆	Diuron 80% WP	2.000	3400	20.76	1.15	23000	1:6.76
T ₇	Weedy check	-	-	19.61	-	-	-
T ₈	Weed free check	-	9000	22.20	2.59	51800	1:5.76

Table.10 Phytotoxicity on grape (1st season and 2nd season)

Treatment	Dose l or kg/ha	Chlorosis					Wilting					Hyponasity /epinasty					Scorching				
		Days after herbicide application																			
		1	3	5	7	10	1	3	5	7	10	1	3	5	7	10	1	3	5	7	10
Oxyfluorfen 2.5% + Glyphosate 41% SC	3.125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oxyfluorfen 2.5% + Glyphosate 41% SC	6.250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Control	---	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Scale (0-10): 0= 00, 1=1-10%, 2=11-20%, 3=21-30%, 4=31-40%, 5=41-50%, 6=51-60%, 7=61-70%, 8=71-80%, 9=81-90%, 10=91-100%

The application of Oxyfluorfen 2.5% + Glyphosate 41% SC @ 3.625 l ha⁻¹ showed lowest dry weight (2.4 g m⁻²) followed by same herbicide applied @ 3.125 l ha⁻¹ (2.5 g m⁻²) after 45 days of application of herbicides. While, after 60 days, similar trend followed compared to weedy check and other herbicide treatments. These results are in conformity with the results of Mani *et al.*, (1976), Chanana *et al.*, (1975) and Aulakh (1999). The weed control efficiency calculated based on dry weight over weedy check at 45 and 60 DAA resulted in better efficacy of these herbicides (Table 6 and 7). It was observed that treatments with Oxyfluorfen 2.5% + Glyphosate 41% SC @ 3.625 l ha⁻¹ and 3.125 l ha⁻¹ provided significantly superior control of the weeds in grape vineyard compared to other treatments.

Effect of herbicides on grape yield and incremental benefit cost ratio

The data on yield showed significant effect on grape yield (Table 8). Maximum yield (21.83 t ha⁻¹) was produced with Oxyfluorfen 2.5% + Glyphosate 41% SC @ 3.625 l ha⁻¹ weedicide treatment followed by Oxyfluorfen 2.5% + Glyphosate 41% SC @ 3.125 l ha⁻¹ treatment. Increase in yield in herbicide applied treatments and weed free check was due to increase in yield components resulting from control of weeds and lack of moisture and nutrients. Increase yield by the application of herbicides has been reported by Bajwa *et al.*, (1993) and Bajwa *et al.*, (1997).

Higher benefit cost ratio (Table 9) was recorded with Oxyfluorfen 2.5% + Glyphosate 41% SC @ 3.125 l ha⁻¹ (9.60) closely followed by Oxyfluorfen 2.5% + Glyphosate 41% SC @ 3.625 l ha⁻¹ (9.32). The weed free check treatment showed lower benefit cost ratio (5.76). Other treatments were still lower economically to control weeds in grape crop.

Phytotoxicity

Symptoms of phytotoxicity on grape vine are presented in Table 10. No phytotoxic signs or symptoms *viz.*, leaf tip/surface injury, wilting, vein clearing, necrosis, epinasty and hyponasty were observed at 1, 3, 5, 7 and 10 days after the application of Oxyfluorfen 2.5% + Glyphosate 41% SC @ 3.125 and 6.25 l ha⁻¹.

It can be concluded that highest WCE at 45 (%) and 60 DAA (%) during was found with Oxyfluorfen 2.5% + Glyphosate 41% SC @ 3.625 l ha⁻¹ followed by @ 3.125 l ha⁻¹ during the both seasons in grape vine against all type of weed with no phytotoxic effect on grape vine even at double dose of application.

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