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Efficacy of post-emergence herbicides alone and as tank mixtures on weed control, growth and yield of roselle (*Hibiscus sabdariffa*)

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ABSTRACT

A field experiment was conducted during rainy season of 2010-11 and 2011-12 at Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh to evaluate the efficacy of post-emergence herbicides alone and as tank mixtures on weed control, growth and fibre yield of roselle (*Hibiscus sabdariffa*). The post-emergence treatments applied at 20 days after sowing (DAS) include, fenoaxaprop-ethyl 56, quizalofop-ethyl 50, pyrithiobac 63 g/ha alone and tank mixtures of fenoxaprop-ethyl 56 + pyrithiobac 63 g/ha, quizalofop-ethyl 50 + pyrithiobac 63 g/ha in comparison with standard herbicide, pendimethalin 750 g/ha (pre-emergence), hand weeding at 20 and 40 DAS and weedy check. All the treatments were replicated thrice in a randomized block design. Results indicated that post-emergence (PoE) tank mix application of pyrithiobac 63 g/ha with quizalofop-ethyl 50 or fenoxaprop-ethyl 56 g/ha reduced weed growth at par with pre-emergence (PE) application of pendimethalin 750 g/ha both at 60 DAS and harvest. Post-emergence application of pyrithiobac 63 g/ha either alone or as tank mixture with fenoxaprop-ethyl 56,or quizalofop-ethyl 50 g/ha caused upto 40% injury to roselle crop at 14 days after application. All the weed control treatments significantly influenced crop growth and fibre yield. Among the weed control treatments, maximum fibre yield (2.36 t/ha) and benefit cost ratio (1.65) was obtained with pre-emergence application of pendimethalin 750 g/ha and was at par with alone PoE application of fenoxaprop-ethyl 56 g/ha (2.11 t/ha) and quizalofop-ethyl 50 g/ha (2.03 t/ha). None of the treatments could reach the level of hand weeding at 20 and 40 DAS, which significantly recorded the highest fibre yield (2.91 t/ha). Season long weed competition caused 46% reduction in fibre yield of roselle. It was concluded that the pre-emergence application of pendimethalin 750 g/ha was found to be effective and economical in controlling weeds in roselle.

Keywords: *Hibiscus sabdariffa*, Post-emergence herbicides, Roselle, Tank mixtures, Weed control

Roselle (*Hibiscus sabdariffa*) is an important fibre crop in North coastal districts of Andhra Pradesh, India. Due to initial slow growth during early stage of crop, weeds effectively compete with the crop for nutrients, water *etc.* and reduce the yield upto an extent of 60% depending upon type and intensity of weed flora (Fageiry 1985 and Ghorai *et al*. 2008). Further, during rainy season due to incessant rains, inter-cultivation is not possible which also results in severe weed competition. Due to shortage of labour and increased cost of labour wages, farmers are repeatedly asking for selective post-emergence herbicides. Lack of effective herbicides and the increased risk involved in application of herbicides to roselle crop which is very sensitive to herbicides are the major bottle-necks in realization of potential yield of roselle. Though information on selectivity of some of the PE herbicides like trifluralin, pendimethalin and post-emergence herbicide like quizalofop-ethyl *etc* is available (Fageiry 1985, Ghorai *et al*. 2008) information pertaining to efficacy of fenoxaprop-ethyl, quizalofop-ethyl, pyrithiobac on roselle is scanty, particularly under local conditions of Andhra Pradesh, India. Keeping all these in view, the present investigation was undertaken to evaluate the efficacy of different post-emergence herbicides alone and as tank mixtures for broad-spectrum weed control in comparison with present recommended herbicide like pendimethalin in roselle.

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MATERIALS AND METHODS

A field experiment was conducted consecutively for two years during rainy seasons of 2010-11 and 2011-12 at Acharya N.G. Ranga Agricultural University, Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh, India. The soil of the experimental field was clay loam with a p^H of 7.8, with low in available nitrogen and phosphorus and high in available potassium. The experiment consisting of eight treatments (**Table 1**) was laid out

in a randomized block design with three applications. Roselle variety '*AMV5 (Durga)*' was sown by adopting a spacing of 30 x 10 cm during last week of June 2010 (first year) and 1st week of July, 2011 (second year). The crop survived entirely on the rainfall received only during both the years (1084.1 mm in 48 rainy days during first year and 568.8 mm in 38 rainy days during second year). All the locally recommended package of practices except weed control were followed to raise the roselle crop. All the post-emergence herbicides were sprayed with knapsack sprayer fitted with a flat fan nozzle at 20 DAS as per schedule using a spray volume of 500 l/ ha. Crop injury score was assessed by visual scoring at 7 and 14 days after spraying herbicides (Rao 2000). The data on total weed density and weed dry weight per unit area were recorded at 60 days after sowing (DAS) and at harvest. The data on weed density and dry weight were subjected to square root transformation before statistical analysis to normalize their distribution (Panse and Sukhatme 1978). Economics of different treatments were calculated taking into prevailing market prices of inputs and out put.

RESULTS AND DISCUSSION

Effect on weeds

The experimental field was dominated by the natural infestation of grasses like *Echinochloa colona* (L.) Link, *Dinebra retroflexa* Jacq, *Panicum repens* L. *Dactyloctenium aegyptium* L, *Cynodon dactylon* (L) Pers, (grasses). Among broad-leaved weeds, *Phyllanthus niruri* L, *Celosia argenteaL*, *Abutilon indicum* G. Don, *Digera arvensis* Forsk, *Cleome viscosa* L., *Trianthema portulacastrum* L., *Parthenium hysterophorus* L, *Physalis minima* L, *Cynotis cucullata* Kunth were dominated and *Cyperus rotundus* L (sedge) also present but its population was negligible. Among the weed groups, broad-leaf weeds constituted 60 grasses 37 sedge 3%.

The density and dry weight of weeds were significantly reduced by all the treatments except alone PoE application of fenoxaprop-ethyl 56 g/ha and quizalofopethyl 50 g/ha compared to weedy check (**Table 1**) at both stages of observation. Among the weed control treatments, PoE tank mix application of pyrithiobac 63 g + quizalofop 50 g/ha was effective in reducing the weed growth and recorded maximum weed control efficiency (WCE) and was found to be at par with tank mix application of pyrithiobac 63 g + fenoxaprop-ethyl 56 g/ha and also with alone PoE application of pyrithiobac 63 g/ha and PE application of pendimethalin 750 g/ha. The increased weed control in these treatments might be due to effective control of weeds during the critical period of crop growth. However, none of the weed control treatments could reach the level of hand weeding at 20 and 40DAS which recorded the highest WCE at both stages of observation.

Effect on roselle crop

Among the treatments, PoE application of pyrithiobac 63 g/ha applied either alone or in combination with grassy herbicides (fenoxaprop-ethy 56 g/ha and quizalofop-ethyl 50 g/ha) resulted in severe crop injury of 40% at 14 days after application. Further, these treatments recorded lower plant height and crop dry weight compared to weedy check at both stages of observation due to crop injury (**Table 2**). Among the treatments, the maximum plant girth of 4.6 cm was recorded in the treatment PE application of pendimethalin 750 g/ha and was at par with all other treatments except with alone application of pyrithiobac 63 g/ha. Among the herbicide treatments, PE application of pendimethalin 750 g/ha significantly recorded the highest fiber yield (2.36 t/ ha) over PoE application of pyrithiobac 63 g/ha either alone or in combination with grassy herbicides, but was at par with alone application of grassy herbicides. The increased yield in these treatments

Table1. Effect of different treatments on density and dry weight of weeds in roselle (pooled data of 2 years)

Treatment	Dose (g/ha)	Time of application (DAS)	Total Weed density (no./m^2) at		Total weed dry wt. (g/m^2) at		WCE (%) at	
			60 DAS	Harvest	60 DAS	Harvest	60 DAS	Harvest
Weedy check	-	-	12.8(192.5)	8.0(80.7)	21.4(483.3)	11.0(135.7)	-	-
Hand weeding	-	20 & 40	5.9(38.2)	2.7(9.2)	5.0(32.2)	5.0(32.2)	76.6	54.5
Pendimethalin	750	pre	7.7(64.2)	5.3(39.2)	17.3(326.4)	8.3(87.3)	19.2	24.5
Fenoxaprop-ethyl	56	20	11.1(64.2)	5.9(53.0)	18.9(377.0)	10.1(128.2)	11.7	9.1
Quizalofop-ethyl	50	20	10.8(132.2)	5.8(50.0)	19.6(402.5)	9.4(118.2)	8.4	14.5
Pyrithiobac	63	20	8.8(88.8)	4.0(23.3)	16.3(280.0)	8.3(87.8)	23.8	23.6
Fenoxaprop-ethyl + pyrithiobac	56+ 63	20	8.8(87.2)	3.2(15.2)	15.0(233.8)	6.2(53.4)	29.9	43.6
Quizalofop-ethyl + pyrithiobac	50 +63	20	7.6(61.5)	3.2(11.5)	14.8(229.2)	6.1(53.2)	30.8	44.6
LSD (p=0.05)			2.22	1.73	2.90	2.27		

DAS: Days after sowing. Data transformed to $\sqrt{x+0.5}$ transformation. Figures in parentheses are original values

Table 2. Effect of different treatments on growth, yield and yield attributes in roselle (pooled data of 2years)

Treatment	Dose (g/ha)	Time of application (DAS)	Crop Injury % at 7 DAA	Crop injury % at 14 DAA	Plant height (cm)		Crop dry weight (g/m^2) at		Plant girth (cm)	Fibre yield (t/ha)	Cost of treatment (Rs/ha)	BCR (Rs/R)
					60 DAS	Harvest	60 DAS	Harvest				
Weedy check	-		0	0	95.1	218.0	340.3	1707	3.9	1.57	-	0.89s
Hand weeding	-	20 and 40	0	0	117.7	261.1	659.0	2885	5.3	2.91	9000	1.18
Pendimethalin	750	pre	5	0	100.8	236.4	512.4	2229	4.6	2.36	1050	1.65
Fenoxaprop-ethyl	56	20	0	0	92.8	230.0	451.2	1979	4.4	2.11	1050	1.37
Quizalofop-ethyl	50	20	0	0	101.0	234.6	434.5	2007	4.5	2.03	1550	1.08
Pyrithiobac	63	20	50	40	72.1	215.6	332.7	1745	4.0	1.73	1560	0.88
Fenoxaprop-ethyl + pyrithiobac	56 + 63	20	43.3	40	81.4	219.2	318.2	1779	4.5	1.73	2310	0.80
Quizalofop-ethyl + pyrithiobac	50 + 63	20	43.3	40	80.0	223.0	327.6	1851	4.3	1.83	2810	0.85
LSD (p=0.05)					11.65	16.1	86.7	431	0.57	0.42		

DAA: Days after application

might be due to effective control of weeds during the critical period as evidenced by higher WCE, which favoured the increased crop growth and ultimately on yield components and yield. None of the treatments could reach the level of hand weeding at 20 and 40 DAS which recorded the highest fiber yield (2.91 t/ ha) among all the treatments under study. The uncontrolled weed growth during the crop season reduced the fiber yield to the extent of 46% corroborating with those reported by Ghorai *et al.* (2013). Further, the highest benefit cost ratio (BCR) of 1.65 was observed with the PE application of pendimethalin 750 g/ha among all the treatments because of higher fibre yield and lower cost of treatment. Though, hand weeding recorded the highest fibre yield, but BCR is lower (1.18) because of higher cost of labour involved.

Based on the present study, it was concluded that PE application of pendimethalin 750 g/ha was found to be effective and economical in controlling weeds without any crop injury in roselle as an alternative to hand weeding.

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