Advances in Bioresearch
Adv. Biores., Vol 9 (6) November 2018: 96-101
©2018 Society of Education, India
Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.9.6.96101

Advances in Bioresearch

ORIGINAL ARTICLE

Evaluation of Bio-Efficacy and Phytotoxicity of Metolachlor 50% EC Against the Weed Floras in Soybean Crop and Residual Effect on Succeeding Wheat Crop

Dinesh Kumar Jajoria[1*], Shanti Kumar Sharma[2], Roshan Choudhary[3]
1. Department of Agronomy, SKN College of Agriculture, Jobner, SKNAU, Jobner, Jaipur, Rajasthan, India
2.Agricultural Research Station, RCA-Campus, MPUAT, Udaipur, Rajasthan, India
3.Department of Agronomy, RCA, MPUAT, Udaipur, Rajasthan, India
*Correspondence author email: dineshjajoria.agro@sknau.ac.in

ABSTRACT
Soybean crop is highly susceptible to weed infestation because of its slow growth in this initial stage up to 40 days. A field experiment was conducted during kharif, 2015 at instructional farm of Rajasthan College of Agriculture, Udaipur, Rajasthan to study on evaluation of Bio-efficacy and phytotoxicity of metolachlor 50% EC against the weed floras in soybean crop and residual effect on succeeding wheat crop. The experiment laid out on sandy clay loam soil by adopting randomized block design which included four replication and six treatments viz. T1: Metolachlor 50% EC (1600 ml/ha), T2: Metolachlor 50% EC (2000 ml/ha), T3: Metolachlor 50% EC (2400 ml/ha), T4: Pendimethalin 30% EC (3300 ml/ha), T5: Hand weeding (15 and 30 DAS and T6:Untreated control. Variety JS-9560 was taken during kharif season as test crop. Result revealed that Metolachlor 50% EC at 2400 ml/ha treatments as a pre-emergence was found best in reduction of different weedpopulation and found at par with Metolachlor 50% EC at 2000 ml/ha and hand weedingtreatments. In chemical weed control the maximum yield was observed under the treatment Metolachlor 50% EC at 2400 ml/ha which was found at par with Metolachlor 50% EC at 2000 ml/ha. There was no any adverse effect on germination of succeeding wheat crop with the application of Metolachlor 50% EC at all dosages applied to soybean in kharif, 2015. Thus, it can be concluded that Metolachlor 50% EC is safe for succeeding wheat crop.
Keywords: *Soybean, Metolachlor 50% EC, Echinochloaspp, Weed Flora, Yield, Wheat*

Received 14.07.2018 Revised 29.07.2019 Accepted 28.09.2018

How to cite this article:
D K Jajoria, S K Sharma, R Choudhary. Evaluation of Bio-Efficacy and Phytotoxicity of Metolachlor 50% EC Against the Weed Floras in Soybean Crop and Residual Effect on Succeeding Wheat Crop. Adv. Biores., Vol 9 [6] November 2018.96-101.

INTRODUCTION

Soybean is an important oilseed crop of India as it contains 39-43 per cent protein and 20 per cent fat. In India, soybean is grown on 11.60 mha area with 11.50 mt production. Though the area and production of soybean are increasing, the average productivity remained constant during the last decade even after development of high yielding varieties and dissemination of new agro-technologies [1]. One of the major constraints in soybean production is crop-weed competition [2]; being a rainy season crop, as it is heavily infested with grasses, sedges and broadleaved weeds. They fight for food, water, light and space against the soybean crop, thus affect the crop yield ultimately. The loss of soybean yield due to weeds ranges from 35 to 80 percent [3] [4]. Hand weeding is traditional and effective method of weed control, but untimely and continuous rains as well as unavailability of labour during peak period of demand, are main limitations of manual weeding. Under such circumstances, use of effective herbicide gives better and timely weed control [5]. Controlling the weeds in due time is a necessary for improving or maintaining the yield of soybean. Several herbicides have been reported to control weeds in soybean, but none of these can manage all the weeds efficiently. Unavailability of adequate labourers during peak weeding time and difficulty in use of mechanical means for weed management due to rains also add more problems. However, exclusive reliance on chemical herbicides has led to concern about contamination of environment by the pressure of herbicidal residue in soil,

water and plants, shift in weed flora, appearance of resistant weed species, threats to human health, etc. Therefore, need was felt to explore the possibility of new herbicides for effective control of weed in soybean.

MATERIAL AND METHODS

A field experiment was carried out during *Kharif* 2015 at Instructional Farm of Rajasthan College of Agriculture, MPUAT, Udaipur, to study the evaluation of Bio-efficacy and phytotoxicity of metolachlor 50% EC against the weed floras in Soybean crop and residual effect on succeeding wheat crop. The experiment laid out on sandy clay loam soil by adopting randomized block design which included four replications and six treatments. The herbicide used for testing Metolachlor 50% EC is a pre-emergence herbicide and applied at pre-emergence of weeds (two days after sowing) at different dosages i.e. 1600, 2000 and 2400 ml/ha, along with a surfactant (i.e. Mainspread) @ 1.5 ml/L and Ammonium Sulphate @ 2.0 g/l as a tank mix. Pendimethalin 30% EC @ 3300 ml/ha applied as sprayed at same time with a spray volume of 500 L/ha by knapsack sprayer fitted with flat fan nozzle. Hand weeding was done twice at 15 and 30 days after crop sowing. All plots were irrigated after sowing to ensure optimum moisture during the crop germination and at the time of herbicide application. Soybean variety 'JS-9560' was grown at 45 cm row to row and 10 cm plant to plant spacing. The data on weed population and dry weight of weeds/m^2 were recorded at different growth stages crop.

The weed count was recorded species wise by using 1 m × 1 m quadrat from each plot and the weeds falling within the frames of the quadrat were counted and the mean values were expressed in number per sq. m. The densities of sedge, broad leaf weeds and grassy weeds were recorded at 45 and 75 days after sowing (DAS). Dry weight of total sedge, broad leaf weeds and grassy weeds were recorded at 45 DAS and 75 DAS and represented in the form of g per sq. m. The data collected on weeds were transformed to square root transformation ($\sqrt{X+1}$) for statistical analysis.

The per cent Weed Control Efficiency (WCE) was calculated at 45 DAS and 75 DAS based on the total dry weight of weed populations using following formula to calculate per cent WCE is as below,

$$\text{WCEZ (\%)} = \frac{\text{WC} - \text{WT}}{\text{WC}} \times 100$$

Where, WC=Weed dry weight in control plot; WT=Weed dry weight in treated plot

Soybean grain yield was recorded at final harvest for all weed management treatments including weedy check and yield was expressed in quintal/ha.

Phytotoxicity observations leaf injury on tips/surface, leaf vein clearing, Necrosis, wilting, epinasty and hyponasty on Soybean crop were recorded at 3, 5, 7, 10 & 15 days after herbicide applications.

Residual effect of herbicide on wheat crop was observed with regard to deformities (epinasty, hyponasty & necrosis), yellowing, stunting and wilting at 10, 20 & 30 DAS and also observed germination percentage of wheat crop. Wheat crop was sown without disturbing the trial plots which was laid down for bio-efficacy and phytotoxicity evaluation of Metolachlor 50% EC in soybean crop.

RESULTS AND DISCUSSION

Major Weed Flora in the Trial Plot

In the experimental plots, the dominant weed floras were *Cyperus*sp. (*C. rotundus* and *C. difformis*) among sedge; *Commelinabenghalensis*; *Digera arvensis*; *Euphorbia hirta*; *Amaranthus viridis* among broad leaf; *Echinochloa sp.*; *Panicum sp.*; *Digitaria sp.*; *Eleusineindica* among grassy weeds.

Weed Population

Data on weed population (in per m^2 area), species wise, which was recorded at 45 and 75 days after sowing of crop, are presented in table no. 1 to 2, respectively, revealed that all the weed management treatments significantly reduced weeds populations as compared to weedy check, when observed at 45 and 75 DAS. However, twice hand weeded plots and Metolachlor 50% EC @ 2400 ml/ha were recorded the numerically lowest weed population of sedge, broad leaf & grassy weeds though statistically on par with Metolachlor 50% EC @ 2000 ml/ha. Weed populations recorded at 45 DAS, Metolachlor 50% EC @ 2400 ml/ha were 0.67, 1.00 & 5.99; Metolachlor 50% EC @ 2000 ml/ha were 0.67, 2.33 & 9.68; Metolachlor 50% EC @ 1600 ml/ha were 5.33, 10.33 & 23.00 respectively of sedge, BLW & grassy. Standard check, Pendimethalin 30% EC @ 3300 ml/ha were recorded 8.00, 12.67 & 28.00 respectively of sedge, BLW & grassy.

Similar trend of weed populations observed at 75 DAS, Metolachlor 50% EC @ 2400 ml/ha were recorded 0.67, 3.34 & 6.67; Metolachlor 50% EC @ 2000 ml/ha were 1.67, 5.33 & 7.66; Metolachlor 50% EC @ 1600 ml/ha were 5.00, 15.00 & 24.00 respectively of sedge, BLW & grassy. Standard check, Pendimethalin 30% EC @ 3300 ml/ha were recorded 9.67, 15.67 & 27.67 respectively of sedge, BLW & grassy. From the

findings, it may be stated that pre- emergence application of metolachlor reduced the density of broad as well as narrow leaved weeds significantly under study [3] [5].

Total Dry Weight

The biomass of different broad leaved weed flora in soybean field at all the crop growth season reflect the same trend with those of the biomass of different grass weed flora. Dry weight (in g/m^2) of total grassy, broad leaf weeds and sedges were recorded at 45 DAS & 75 DAS and represented in Table 3. Among the weed management treatments, twice handed weeding was recorded the lowest dry weight of total weeds population irrespective of weed categories sedges, broad leaf, grassy and day of observations. Twice hand weeded treatment on par with Metolachlor 50% EC @ 2400 ml/ha. Metolachlor 50% EC at 2400 ml/ha and 2000 ml/ha were statistically at par with each other and recorded lowest dry weight of total weed populations i.e. 4.67 & 6.09 (at 45 DAS) and 6.23 & 7.65 (at 75 DAS), respectively. Standard check, Pendimethalin 30% EC @ 3300 ml/ha was recorded dry weight of total weed populations, 23.60 and 28.48, respectively at 45 DAS and 75 DAS. Similar work was also reported [6].

Weed Control Efficiency (WCE)

The results indicate that application of herbicides effectively controlled all the species of dominant weeds over weedy check control irrespective of weed categories sedges, broad leaf and grassy (Table-3). Effect of Metolachlor 50% EC applied at 2400 ml/ha and 2000 ml/ha were statistically at par with each other with respect to weed control efficiency and recorded highest 94.0% and 92.2% WCE among herbicides, respectively, at 45 DAS. Lowest dose of Metolachlor 50% EC @ 1600 ml/ha and Pendimethalin 30% EC @ 3300 ml/ha were recorded 70.1% and 69.8% WCE, respectively. Twice hand weeding recorded 94.8% WCE.

Similar trend in WCE due to application of herbicides at 75 DAS. Metolachlor 50% EC applied at 2400 ml/ha and 2000 ml/ha recorded 92.6% and 90.9% WCE among herbicides, respectively. Lowest dose of Metolachlor 50% EC @ 1600 ml/ha and standard check Pendimethalin 30% EC @ 3300 ml/ha recorded 71.7% and 66.1% WCE, respectively. Twice hand weeding was recorded 94.0% WCE. Similar findings were also observed [8] [9].

Table 1. Weed population counted in the different weed management treatments in Soybean at 45 DAS during Kharif- 2015.

Treatment Details	Use Rate (ml/ha)	Weed population/ m^2 at 45 DAS										
		Sedges	BLW					Grassy weeds				
		Cys	*Amv*	*Dia*	*Euh*	*Others*	Total BLW	*Ecs*	*Pas*	*Dis*	*Others*	Total Grassy
Metolachlor 50% EC	1600	5.33	3.00	2.67	1.33	3.33	10.33	7.00	3.33	6.67	6.00	23.00
		(2.52)	(2.00)	(1.92)	(1.53)	(2.08)	(3.37)	(2.83)	(2.08)	(2.77)	(2.65)	(4.90)
Metolachlor 50% EC	2000	0.67	1.00	0.33	0.00	1.00	2.33	2.67	2.67	2.67	1.67	9.68
		(1.29)	(1.41)	(1.15)	(1.00)	(1.41)	(1.82)	(1.92)	(1.92)	(1.92)	(1.63)	(3.27)
Metolachlor 50% EC	2400	0.67	0.67	0.00	0.33	0.00	1.00	2.00	2.33	1.33	0.33	5.99
		(1.29)	(1.29)	(1.00)	(1.15)	(1.00)	(1.41)	(1.73)	(1.82)	(1.53)	(1.15)	(2.64)
Pendimethalin 30% EC	3300	8.00	5.00	3.33	1.67	2.67	12.67	8.67	3.67	8.33	7.33	28.00
		(3.00)	(2.45)	(2.08)	(1.63)	(1.92)	(3.70)	(3.11)	(2.16)	(3.05)	(2.89)	(5.39)
Hand weeding (15 & 30 DAS)	-	0.33	0.00	0.00	0.33	0.00	0.33	2.67	1.67	0.67	0.33	5.34
		(1.15)	(1.00)	(1.00)	(1.15)	(1.00)	(1.15)	(1.92)	(1.63)	(1.29)	(1.15)	(2.52)
Weedy check	-	13.33	11.33	7.67	3.33	4.33	26.66	28.33	8.67	14.00	16.00	67.00
		(3.79)	(3.51)	(2.94)	(2.08)	(2.31)	(5.26)	(5.42)	(3.11)	(3.87)	(4.12)	(8.25)
CD (P=0.05)	-	0.35	0.40	0.80	0.25	0.56	1.10	0.29	0.20	0.85	0.80	1.30

Values are means of four replications. Figures in parenthesis indicate square root (√x+1) transformed value.
DAS= Days after sowing; BLW= Broad leaf weeds;
Cys: Cyperus sp. (C. rotundus and C. difformis); Cob: Commelina benghalensis; Dia: Digera arvensis; Euh: Euphorbia hirta; Amv: Amaranthus viridis; Ecs: Echinochloa sp.; Pas: Panicum sp.; Dis: Digitaria sp.; Eli: Eleusine indica

Grain Yield

All the weed management methods gave significantly higher grain yield of soybean over weedy check (Table-4). However, among the treatments, twice hand weeding and application of Metolachlor 50% EC @ 2400 and 2000 ml/ha found to be at par with each other but they were significantly superior over

Metolachlor 50% EC @ 1600 and Pendimethalin 30% EC @ 3300 ml/ha. Application of Metolachlor 50% EC @ 2400 and 2000 ml/ha increased the grain yield overMetolachlor 50% EC @ 1600 ml/ha by 17.42 and 10.78 per cent and over Pendimethalin 30% EC @ 3300 ml/ha by 19.35 and 12.59 per cent, respectively. From the results, it may be expressed that higher weed infestation was responsible for lower seed yield of the soybean during rainy season. This was quite clear from the seed yield recorded under weedy check in crop plant which faced the tremendous competition with vigorous weed infestation. Similar observations were also reported by [2]. Twice hand weeding at 15 and 30 DAS reduced the weed infestation most efficiently throughout the growing period of the crop and as a consequence it produced the maximum seed yield of rainy season soybean [10]. Similar observations were also recorded [3][8].

Residual Effect on Succeeding Crop

After harvesting of soybean the wheat was grown as succeeding crop to find out the residual effect of herbicide on wheat. No significant difference in terms of% germination & plant vigours of wheat at 10, 20 and 30 DAS were found which indicate that application of different doses does not have any significant residual effect on wheat.

Table 2. Weed population counted in the different weed management treatments in Soybean at 75 DAS during Kharif- 2015.

Treatment Details	Use Rate (ml/ha)	Weed population/ m² at 45 DAS										
		Sedges	BLW					Grassy weeds				
		Cys	*Amv*	*Dia*	*Euh*	*Others*	Total BLW	*Ecs*	*Pas*	*Dis*	*Others*	Total Grassy
Metolachlor 50% EC	1600	5.00	6.33	4.33	1.67	2.67	15.00	7.33	4.67	6.33	5.67	24.00
		(2.45)	(2.71)	(2.31)	(1.63)	(1.92)	(4.00)	(2.89)	(2.38)	(2.71)	(2.58)	(5.00)
Metolachlor 50% EC	2000	1.67	1.00	2.67	0.33	1.33	5.33	2.33	2.00	2.33	1.00	7.66
		(1.63)	(1.41)	(1.92)	(1.15)	(1.53)	(2.52)	(1.82)	(1.73)	(1.82)	(1.41)	(2.94)
Metolachlor 50% EC	2400	0.67	0.67	1.33	0.67	0.67	3.34	2.00	1.67	1.67	1.33	6.67
		(1.29)	(1.29)	(1.53)	(1.29)	(1.29)	(2.08)	(1.73)	(1.63)	(1.63)	(1.53)	(2.77)
Pendimethalin 30% EC	3300	9.67	6.33	5.67	1.67	2.00	15.67	9.67	3.33	6.00	8.67	27.67
		(3.27)	(2.71)	(2.58)	(1.63)	(1.73)	(4.08)	(3.27)	(2.08)	(2.65)	(3.11)	(5.35)
Hand weeding (15 & 30 DAS)	-	1.33	1.33	0.33	0.33	0.00	1.99	3.00	1.33	0.67	1.33	6.33
		(1.53)	(1.53)	(1.15)	(1.15)	(1.00)	(1.73)	(2.00)	(1.53)	(1.29)	(1.53)	(2.71)
Weedy check	-	14.67	15.67	8.33	2.00	3.67	29.67	28.00	6.67	12.67	16.33	63.67
		(3.96)	(4.08)	(3.05)	(1.73)	(2.16)	(5.54)	(5.39)	(2.77)	(3.70)	(4.16)	(8.04)
CD (P=0.05)	-	0.50	0.25	0.66	0.30	0.48	1.50	0.20	0.38	0.40	0.64	1.20

Values are means of four replications. Figures in parenthesis indicate square root (√x+1) transformed value.
DAS= Days after sowing; BLW= Broad leaf weeds;
Cys: Cyperus sp. (C. rotundus and C. difformis); Cob: *Commelina benghalensis*; Dia: *Digera arven*sis; Euh: *Euphorbia hi*rta; Amv: *Amaranthus viridis*; Ecs: *Echinochloa* sp.; Pas: Panicum sp.; Dis: Digitaria sp.; Eli: *Eleusine indica*.

Table 3. Weeds total dry weight and Weed control efficiency (WCE) from different weed management treatments in Soybean at 45 & 75 DAS during Kharif- 2015.

Treatment Details	Use Rate (ml/ha)	Weeds total dry weight (g/ m²)									
		45 DAS					75 DAS				
		Sedges	BLW	Grassy	Total	% WCE	Sedges	BLW	Grassy	Total	% WCE
Metolachlor 50% EC	1600	2.60	8.60	12.20	23.40	70.1	2.80	9.25	11.70	23.75	71.7
Metolachlor 50% EC	2000	0.55	2.54	3.00	6.09	92.2	1.45	2.80	3.40	7.65	90.9
Metolachlor 50% EC	2400	0.26	1.46	2.95	4.67	94.0	1.10	1.78	3.35	6.23	92.6
Pendimethalin 30% EC	3300	3.20	9.40	11.00	23.60	69.8	4.67	12.15	11.66	28.48	66.1
Hand weeding (15 & 30 DAS)	-	0.18	0.45	3.47	4.10	94.8	0.65	0.75	3.60	5.00	94.0
Weedy check	-	11.20	38.00	29.00	78.20	0.0	12.45	41.20	30.25	83.90	0.0
CD (P=0.05)	-	1.70	2.10	1.50	4.10	-	1.50	1.80	1.20	5.50	-

Values are means of four replications.
DAS= Days after sowing; BLW= Broad leaf weeds; WCE= Weed control efficiency.

Table 4. Grain yield of Soybean from different weed management treatments during Kharif- 2015.

No.	Treatment Details	Use Rate (ml/ha)	Grain yield(Q/ha)
1	Metolachlor 50% EC	1600	14.29
2	Metolachlor 50% EC	2000	15.83
3	Metolachlor 50% EC	2400	16.78
4	Pendimethalin 30% EC	3300	14.06
5	Hand weeding (15 & 30 DAS)	-	17.47
6	Weedy check	-	0.64
	CD (P=0.05)		1.95

Values are means of four replications.

Table 5. Residual effect of different treatments on succeeding crop Wheat (Rabi 2015-16).

Treatment Details	Use Rate (ml/ha)	Germination (%)	Deformities*			Stunting			Wilting			Yellowing		
			10 DAS	20 DAS	30 DAS	10 DAS	20 DAS	30 DAS	10 DAS	20 DAS	30 DAS	10 DAS	20 DAS	30 DAS
Metolachlor 50% EC	1600	93.9	0	0	0	0	0	0	0	0	0	0	0	0
Metolachlor 50% EC	2000	93.7	0	0	0	0	0	0	0	0	0	0	0	0
Metolachlor 50% EC	2400	94.2	0	0	0	0	0	0	0	0	0	0	0	0
Pendimethalin 30% EC	3300	94.1	0	0	0	0	0	0	0	0	0	0	0	0
Hand weeding (15 & 30 DAS)	-	94.8	0	0	0	0	0	0	0	0	0	0	0	0
Weedy check	-	94.6	0	0	0	0	0	0	0	0	0	0	0	0
CD (P=0.05)	-	NS	-	-	-	-	-	-	-	-	-	-	-	-

Values are means of four replications. NS=Non significant.
* Deformities consists epinasty, hyponasty and necrosis.

CONCLUSION

Metolachlor 50% EC at dosages rate 2000 ml/ha treatments as a pre-emergence was found best for effectively control of grassy, broad leaf weeds as well as Sedges, which resulted higher grain yield in comparison to the weedy check, standard check and Pendimethalin 30% EC @ 3300 ml/ha. Metolachlor 50% EC at all dosages did not cause phyto-toxicity to soybean plants.

Based on above findings it can be concluded that use of Metolachlor 50% EC at dosages rate 2000 ml/ha could be used safely to control of weed complex in soybean and better yield of crop. There is no any adverse effect on germination of succeeding wheat crop with the application of Metolachlor 50% EC at all dosages applied previously in *Kharif*, 2015 soybean. Thus, it can be concluded that Metolachlor 50% EC is also safe for succeeding wheat crop.

REFERENCES

1. Anonymous, (2016). Vital Agricultural Statistics. 2014-15. A publication of Directorate of Agriculture, Government of Rajasthan, Jaipur.
2. Vollmann, J., Wagentristl, H. and Hartl, W. (2010). The effects of simulated weed pressure on early maturity soybean. European Journal of Agronomy, 32: 243-48.Bhowmik, M.K. and Mandal, B.K. (2001). Biotechnological approaches to the management of weeds in Indian agriculture. Science and Culture, 67: 275-80.
3. Dubey, M.P., Singh, R., Tiwari, U.K., Kunnvanshi, S.M., Goswami, S.R. and Jain, S.K. (2000). Response of Soybean and associated weeds to pre-emergence application of chlorimuron ethyl and Metolachlor. Indian Journal of Weed Science, 32(3&4): 153-155.
4. Mishra, Pratiksha. Singh, Harvir. Babu, Subhash. and Pal. Suresh (2013). Bio-efficacy of some early post-emergence herbicides in soybean (*Glycine max* L.) Annals of Agricultural Research. New Series. 34 (1): 81-87.
5. Moguloju, M., Venkata Ramana and Y. S. Parameswari, (2012), Effect of pre-emergence herbicides on weed control, seed yield and returns of soybean (*Glycine max*), Crop Research, 44(3), 314-317.
6. Kushwah, S.S. and Vyas, M.D. (2006). Efficacy of herbicides against weeds in rainfed soybean [*Glycine max* (L.) Merrill] under Vindhyan Plateau of Madhya. Indian Journal of Weed Science, 38: 62-64.
7. Meena DS, Ram B and Jadon CK. 2009. Effect of integrated weed management on growth and productivity of soybean. Indian Journal of Weed Science, 41(1&2): 93-95.
8. Kundu, R., Brahmachari, K., Bera, P.S., Kundu, C.K. and Roychoudhury, S. (2011). Bioefficacy of imazethapyr on the

predominant weeds in soybean. Journal of Crop and Weed, 7(2):173-178.
9. Jha, A.K. and Soni., M. (2013). Weed management by sowing methods and herbicides in soybean. Indian Journal of Weed Science. 45 (4):250-252.
10. Habimana S., Kalyana Murthy, K. N., Shankarlingappa, B. C., Devendra, R., Sanjay, M. T. and Ramachandra, C., (2013), Effect of pre and post-emergence herbicides on weed dynamics, growth and yield of soybean (*Glycine Max* L.), Advances in Applied Science and Research. 4(4), 72-75.