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Evaluation of glyphosate 41% SL to control weeds in tea at *Terai* region of West Bengal

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ABSTRACT

An experiment was conducted in Mathura Tea Garden at Alipurduar which is under Terai agro-climatic zone of West Bengal to evaluate efficacy of Glyphosate 41% SL to control weeds in Tea crop in the year 2015-2016. The design used in the experiment was Randomised Block Design with 8 treatments replicated thrice. The results observed revealed that treatments had no significant effect on the total fungi, bacteria and actinomycetes population in the soil. Despite the given treatments, the data showed rise in their population, even higher than the initial recorded population. It was also observed that Glyphosate 41% SL @3.00 l ha^{-1} recorded the minimum population and dry weight of all categories of weeds. It can also be noted that the maximum weed control efficiency was found in Glyphosate 41% SL @ 3.00 l ha^{-1} at all the observations taken at 15 days interval followed by lower dose of the same and paraquat dichloride 24% SL @4.25 l ha^{-1}. Maximum green leaf yield (12.37 q ha^{-1}) was also recorded with Glyphosate 41% SL @ 3.00l/ha .Besides all these, application of Glyphosate 41% SL at lower and higher doses (2.00 and 6.00 l ha^{-1} respectively) didn't cause any phytotoxic effect on the crop. Hence, it can be concluded that Glyphosate 41% SL@ 3.00 l ha^{-1} could be used for safe and effective control of weed in tea at Terai region of West Bengal.

Keyword **:** Glyphosate 41% SL tea, weeds

Despite India being the second largest tea producer in the world, it ranked fourth in terms of export which reached 256.57 million kg during 2017-2018 and were valued at US $ 785.92 million. In India, tea covers an area of around 599.68 thousand hectares producing 1350.04 million kg (North India-1124.03 and South India-226.01 million kg). In West Bengal, area under tea cultivation is 139.59 thousand hectares and produces 329.70 million kg during (Tea Board India, 2018)

Weeds compete with crops for various factors like sunlight, nutrients, moisture etc. In tea cultivation, weeds are the key pest that is capable of minimizing the productivity of tea as high as 12 to 21 per cent (Ilango *et al.*, 2010). This loss is determined by extent of competition, intensity of growth, weed species, their competitive ability and management practices followed. So, weeds have to be kept in check manually or chemically until the crop canopy is fully capable of suppressing the weeds. But manual and mechanical methods of weed control were expensive and labour intensive. Hence, weed control through chemical herbicide found more favourable by the farmers over other methods (Ilango *et al.*, 2010 and Mirghasemi *et al.*, 2012).

Glyphosate is a herbicide mainly used in agriculture and non-crop area for the management of broad range of weed. The mechanism of glyphosate is that it binds to the enzyme enolpyruvyIshikimate-3-phosphate synthase (EPSPS) after getting absorbed by the plant and block the activity of the enzyme which comes at the shikimic acid pathway and converts simple carbohydrate precursors to aromatic amino acid and many other metabolites. Glyphosate inhibiting the function of shikimic acid pathway leads to a deficiency in aromatics, eventually causing the plants to die by starvation.

MATERIALS AND METHODS

The experiment was conducted in Mathura Tea Garden at Alipurduar which is under Terai agro- climatic zone of West Bengal during 2015-2016. The design used in the experiment was Randomised Block Design consisting of eight treatments replicated thrice. The soil of the experimental site had pH 6.9 (acidic), loamy sand in texture, blackish grey in colour mostly due to the presence of high organic matter and poor bases, rich in available nitrogen, phosphorus and potassium. The mean maximum and minimum temperature were 29.43and 19.41^{o}C respectively and the maximum and minimum relative humidity were found to be 80.67 and 73.13 per cent respectively. The amount of rainfall obtained during the experiment was 1235.5mm. The herbicide was spread using Knapsack Sprayer that has flat fan nozzle which has spray volume of 500 l ha^{-1}. Initial observations was taken before the application of the herbicide and at the interval of 15 days (*i.e.* 15, 30, 45 and 60 DAA) for weed count, weed biomass and weed control efficiency by using the following formula given herewith :

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Table 1: Effect of Glyphosate 41 % SL on soil biological properties

Tr. No.	Treatments	Dosage in litre (formulation/ha)	Population					
			Total bacteria		Total fungi		Actenomycetes	
			Initial	60DAA	Initial	60DAA	Initial	60DAA
T_1	Glyphosate 41% SL (Rainbow)	2.00	42.35	102.31	62.58	97.24	58.63	91.36
T_2	Glyphosate 41% SL (Rainbow)	3.00	42.35	98.23	62.58	94.95	58.63	87.33
T_3	Glyphosate 41% SL (Market sample	2.00	42.35	100.41	62.58	93.21	58.63	89.62
T_4	Glyphosate 41% SL (Market sample	3.00	42.35	92.39	62.58	89.56	58.63	85.59
T_5	Paraquat dichloride 24% SL	4.25	42.35	91.82	62.58	88.36	58.63	82.93
T_6	Untreated control (Weed free)	-	42.35	103.66	62.58	99.62	58.63	92.47
T_7	Untreated control (Weeded)	-	42.35	107.72	62.58	98.25	58.63	95.26
T_8	Glyphosate 41% SL (Rainbow)-phytotoxicity evaluation only	6.00	42.35	90.85	62.58	80.43	58.63	79.77

Table 2: Weed population per m^2 before herbicide spraying

Tr. No.	Treatments	Dosage in litre (formulation ha^{-1})	A	B	C	D
T_1	Glyphosate 41% SL(Rainbow)	2.00	11.90	9.00	7.56	18.67
T_2	Glyphosate 41% SL(Rainbow)	3.00	11.67	8.89	7.44	18.33
T_3	Glyphosate 41% SL (Market sample)	2.00	11.56	8.96	7.89	18.44
T_4	Glyphosate 41% SL (Market sample)	3.00	11.89	9.05	7.78	18.00
T_5	Paraquat dichloride 24%SL	4.25	11.72	8.87	7.67	18.22
T_6	Untreated control (Weed free)	-	11.80	8.96	7.77	17.89
T_7	Untreated control (Weeded)	-	11.89	9.09	7.70	18.67
	SEm (±)		**0.34**	**0.25**	**0.22**	**0.21**
	LSD(0.05)		**NS**	**NS**	**NS**	**NS**

A - *Digera arvensis*, B - *Euphorbia hirta*, C - *Cynodon dactylon* and D - others

Weed Control Efficiency (%) = WDC –WDT/WDC *100

Where WDC – Weed dry weight in untreated plot (control), g/m^2

WDT – Weed dry weight in treated plot, g/m^2

The observation on phytotoxicity parameters namely leaf injury on tips /surface, wilting, clearance of veins, necrosis, hyponasty and epinasty was done visually at 5, 10, 15, 20, 30 and 40 DAA of the tested herbicide.

Effect on biological properties of soil

The application of the testing herbicide Glyphosate 41% SL had no significant effect on the soil biological properties like total bacteria (*Pseudomonas fluorescence, Bacillus* spp.), fungi (*Trichoderma viridiae, Trichoderma hazianum)* and Actenomycetes present in the rhizosphere. Despite the treatment, their population were found to have increased even more than their initial value which is shown in table 1. Similar finding was reported by Poddar *et al.* (2014).

Effect on weed population and weed biomass

During the experiment of the bio-efficacy of Glyphosate 41% SL, the following weed species were observed –*Cynodon dactylon, Imperata cylindrical, Digera arvensis, Ageratum conyzoides, Euphorbia hirta, Digitaria sanguinalis, Borreria hispida, Acalypha indica, Cleome viscose and Cyperus rotundus.*At the initial observation *i.e.* before the application of herbicide, there was uniform density of weed as shown in table 2.

Table 3: Weed population per m² at 15 and 30 DAA

Tr. No.	Treatments	Dosage in liter (formulation/ha)	A		B		C		D	
			15 DAA	30 DAA	15 DAA	30 DAA	15 DAA	30 DAA	15 DAA	30 DAA
T_1	Glyphosate 41% SL(Rainbow)	2.00	2.70	3.80	2.00	3.10	1.56	2.86	2.33	7.11
T_2	Glyphosate 41% SL(Rainbow)	3.00	2.47	3.67	1.89	2.99	1.44	2.64	1.00	2.44
T_3	Glyphosate 41% SL (Market sample)	2.00	2.86	3.66	2.16	3.36	1.59	2.99	1.00	2.11
T_4	Glyphosate 41% SL (Market sample)	3.00	2.59	3.59	1.95	3.05	1.48	2.88	1.22	2.67
T_5	Paraquat dichloride 24%SL	4.25	3.22	4.42	2.87	3.97	2.67	4.27	1.56	3.33
T_6	Untreated control (Weed free)	-	3.80	4.90	2.96	4.26	2.77	4.77	1.67	3.56
T_7	Untreated control (Weeded)	-	3.89	5.19	3.09	4.49	2.77	4.90	1.67	23.56
	S. Em (±)		**0.211**	**0.421**	**0.26**	**0.381**	**0.151**	**0.24**	**0.03**	**0.06**
	LSD(0.05)		**0.613**	**1.225**	**0.70**	**1.134**	**0.434**	**0.71**	**0.09**	**0.17**

Note : A - *Digera arvensis*, B - *Euphorbia hirta*, C - *Cynodon dactylon* and D - others DAA : Days after application

Table 4: Weed population per m² at 45 and 60 DAA

Tr. No.	Treatments	Dosage in litre (formulation/ha)	A		B		C		D	
			45DAA	60 DAA	45 DAA	60 DAA	45 DAA	60 DAA	45 DAA	60 DAA
T_1	Glyphosate 41% SL(Rainbow)	2.00	5.70	7.39	5.07	7.21	4.36	6.13	9.22	11.67
T_2	Glyphosate 41% SL(Rainbow)	3.00	5.07	6.73	4.79	6.32	4.04	5.63	3.22	3.89
T_3	Glyphosate 41% SL (Market sample)	2.00	6.06	8.24	5.56	7.94	4.99	6.67	3.00	3.67
T_4	Glyphosate 41% SL (Market sample)	3.00	5.49	7.12	5.05	6.89	4.28	6.04	3.44	4.22
T_5	Paraquat dichloride 24%SL	4.25	6.02	7.93	6.07	8.06	6.17	8.29	4.11	5.11
T_6	Untreated control (Weed free)	-	6.22	8.58	6.06	8.92	6.47	9.01	4.33	5.33
T_7	Untreated control (Weeded)	-	7.39	9.02	7.49	9.56	7.01	10.23	28.89	33.78
	S. Em (±)		**0.441**	**0.511**	**0.193**	**0.562**	**0.111**	**0.721**	**0.05**	**0.06**
	LSD(0.05)		**1.293**	**1.492**	**0.559**	**1.653**	**0.321**	**2.082**	**0.15**	**0.18**

Note : A - *Digera arvensis*, B - *Euphorbia hirta*, C - *Cynodon dactylon* and D - others DAA : Days after application

Table 5: Weed biomass (g) per m^2 at 15 and 30 DAA

Tr. No.	Treatments	Dosage in litre (formulation/ha)	A		B		C		D	
			15DAA	30 DAA	15 DAA	30 DAA	15 DAA	30 DAA	15 DAA	30 DAA
T_1	Glyphosate 41% SL(Rainbow)	2.00	2.88	3.30	1.42	2.43	1.53	2.66	1.02	2.32
T_2	Glyphosate 41% SL(Rainbow)	3.00	2.10	3.09	1.33	2.35	1.40	2.52	0.88	1.79
T_3	Glyphosate 41% SL (Market sample)	2.00	2.35	3.36	1.55	2.56	1.78	2.90	1.51	2.72
T_4	Glyphosate 41% SL (Market sample)	3.00	2.24	3.25	1.45	2.47	1.69	2.71	1.00	2.19
T_5	Paraquat dichloride 24%SL	4.25	2.84	3.86	1.66	2.68	2.27	3.40	1.60	2.87
T_6	Untreated control (Weed free)	-	3.11	4.14	1.73	2.73	2.38	3.43	2.01	3.15
T_7	Untreated control (Weeded)	-	11.46	12.39	5.94	7.00	6.68	8.81	8.13	9.38
	SEm (±)		**0.122**	**0.135**	**0.072**	**0.211**	**0.044**	**0.167**	**0.04**	**0.07**
	LSD(0.05)		**0.345**	**0.386**	**0.204**	**0.608**	**0.130**	**0.493**	**0.120**	**0.20**

Note : A - *Digera arvensis*, B - *Euphorbia hirta*, C - *Cynodon dactylon* and D - others DAA : Days after application

Table 6: Weed biomass (g) per m^2 at 45 and 60 DAA

Tr. No.	Treatments	Dosage in litre (formulation/ha)	A		B		C		D	
			45DAA	60 DAA	45 DAA	60 DAA	45 DAA	60 DAA	45 DAA	60 DAA
T_1	Glyphosate 41% SL(Rainbow)	2.00	3.30	10.91	2.43	8.25	2.66	8.91	2.32	8.15
T_2	Glyphosate 41% SL(Rainbow)	3.00	3.09	10.79	2.35	7.85	2.52	8.76	1.79	7.55
T_3	Glyphosate 41% SL (Market sample)	2.00	3.36	11.53	2.56	8.65	2.90	9.15	2.72	8.71
T_4	Glyphosate 41% SL (Market sample)	3.00	3.25	11.53	2.47	8.31	2.71	9.03	2.19	8.01
T_5	Paraquat dichloride 24%SL	4.25	3.86	12.08	2.68	9.05	3.40	10.05	2.87	9.11
T_6	Untreated control (Weed free)	-	4.14	13.55	2.73	10.34	3.43	10.72	3.15	10.32
T_7	Untreated control (Weeded)	-	12.39	19.55	7.00	14.95	8.81	15.23	9.38	14.74
	SEm (±)		**0.135**	**0.132**	**0.211**	**0.145**	**0.167**	**0.183**	**0.07**	**0.19**
	LSD(0.05)		**0.386**	**0.383**	**0.608**	**0.402**	**0.493**	**0.524**	**0.20**	**0.56**

Note : A - *Digera arvensis*, B - *Euphorbia hirta*, C - *Cynodon dactylon* and D - others DAA : Days after application

Table 7: Weed control efficiency (%) per m² at 15 and 30 DAA

Tr. No.	Treatments	Dosage in litre (formulation/ha)	A		B		C		D	
			15 DAA	30 DAA	15 DAA	30 DAA	15 DAA	30 DAA	15 DAA	30 DAA
T_1	Glyphosate 41% SL(Rainbow)	2.00	80.10	73.37	76.09	65.48	77.10	69.81	87.45	75.27
T_2	Glyphosate 41% SL(Rainbow)	3.00	81.68	75.06	77.61	66.62	79.04	71.40	89.18	80.92
T_3	Glyphosate 41% SL (Market sample)	2.00	79.49	72.88	73.91	63.64	73.35	67.08	81.43	71.00
T_4	Glyphosate 41% SL (Market sample)	3.00	80.45	73.77	75.59	64.91	74.70	69.24	87.70	76.65
T_5	Paraquat dichloride 24%SL	4.25	75.22	69.18	72.05	61.93	66.02	61.41	80.32	69.40
T_6	Untreated control (Weed free)	-	72.86	66.59	70.88	61.22	64.37	61.07	75.28	66.42
T_7	Untreated control (Weeded)	-	-	-	-	-	-	-	-	-

Note : A - *Digera arvensis*, B - *Euphorbia hirta*, C - *Cynodon dactylon* and D - others DAA : Days after application

Table 8: Weed control efficiency (%) per m² at 45 and 60 DAA

Tr. No.	Treatments	Dosage in litre (formulation/ha)	A		B		C		D	
			45 DAA	60 DAA	45 DAA	60 DAA	45 DAA	60 DAA	45 DAA	60 DAA
T_1	Glyphosate 41% SL(Rainbow)	2.00	56.42	44.19	59.13	44.82	53.29	41.50	57.27	44.71
T_2	Glyphosate 41% SL(Rainbow)	3.00	60.72	44.81	60.70	47.49	54.62	42.58	64.22	48.78
T_3	Glyphosate 41% SL (Market sample)	2.00	56.04	41.02	56.73	42.14	51.79	39.92	53.67	40.91
T_4	Glyphosate 41% SL (Market sample)	3.00	57.56	42.05	58.48	44.41	52.78	40.71	58.55	45.66
T_5	Paraquat dichloride 24%SL	4.25	52.88	38.21	52.21	39.47	47.13	34.01	51.44	38.20
T_6	Untreated control (Weed free)	-	47.25	30.69	46.59	30.84	44.63	29.61	46.81	29.99
T_7	Untreated control (Weeded)	-	-	-	-	-	-	-	-	-

Note : A - *Digera arvensis*, B - *Euphorbia hirta*, C - *Cynodon dactylon* and D - others DAA : Days after application

Table 9: Green leaf yield (q ha^{-1})

Tr. No.	Treatment	Dosage in litre (formulation ha^{-1})	Green Leaf Yield (q ha^{-1})
T_1	Glyphosate 41% SL(Rainbow)	2.00	11.29
T_2	Glyphosate 41% SL(Rainbow)	3.00	12.37
T_3	Glyphosate 41% SL(Market sample)	2.00	10.78
T_4	Glyphosate 41% SL(Market sample)	3.00	11.34
T_5	Paraquat dichloride 24 % SL	4.25	10.49
T_6	Untreated control (Weed free)	-	10.81
T_7	Untreated control (Weeded)	-	8.92
	SEm(±)		**0.344**
	LSD(0.05)		**1.018**

However, among all the treatments, Glyphosate 41% SL @ 3.00 l ha^{-1}(rainbow) recorded minimum population of all the weed species and weed biomass taken at 15,30,45 and 60 DAA which remained at par with Glyphosate 41%SL @ 3.00 l ha^{-1} (market sample). It has been shown in table 3, 4. 5 and 6. Bhowmick (2010) also reported the effective control of glyphosate on wide spectrum of weeds.

Effect on weed control efficiency

The species wise weed control efficiency (WCE) was also recorded at 15, 30, 45 and 60 DAA and has been presented in table 7 and 8. It was found that the maximum weed control efficiency was recorded by Glyphosate 41 % SL @ 3.00 l ha^{-1} at all the observation as compared to other treatments followed by lower dose of Glyphosate 41 % SL and Paraquat Dichloride 24 % SL @ 4.25 l ha^{-1}. Bhattacharrya *et al.* (2003) reported that higher weed control efficiency with higher dose of glyphosate herbicide. Many other authors also reported the same (Ghosh *et al*., 2007; Magambo and Kilavuka, 1982)

Effect on green leaf yield (q ha^{-1})

The testing herbicide had significant effect on the green leaf yield of tea. Maximum green leaf yield (12.37 q ha^{-1}) was obtained with the application of Glyphosate 41 % SL @3.00 l ha^{-1} (rainbow) which was followed by Glyphosate 41 % SL @ 3.00 l ha^{-1}(market sample) having 11.34 q ha^{-1}. All the chemicals recorded higher green leaf yield over control (8.92q ha^{-1}) as shown in table 9.

Phytotoxicity effect on tea

Application of testing herbicide (Glyphosate 41 % SL) showed on phytotoxic effect like leaf injury on tips or surface, wilting, clearance of veins, necrosis,

Table 10: Phytotoxicity effect of glyphosate 41 % SL on tea Crop

Treatments	Scoring at DAA																													
	Leaf injury on tips/ surface					Wilting					Clearance of veins					Necrosis					Hyponasty					Epinasty				
	5	10	15	20	30	40	5	10	15	20	30	40	5	10	15	20	30	40	5	10	15	20	30	40	5	10	15	20	30	40
Glyphosate 41 % SL @ 2.00 l ha^{-1}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glyphosate 41 % SL @ 3.00 l ha^{-1}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glyphosate 41 % SL @ 6.00 l ha^{-1}	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0

Note: Based on 0-10 scale (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%

hyponasty and epinasty which was visually observed at 5, 10, 15, 20, 30 and 40 DAA of the tested herbicides. There was no effect on tea crop and its quality which was also reported by Mirghasemi *et al*. (2012).

From the experiment conducted at the Mathura Tea Garden, Alipurduar, it can be concluded that the testing herbicide Glyphosate 41 % SL effectively minimized both monocot and dicot weed infestation and there was no phytotoxic effect on the crop even at higher dose (i.e. 6.00 l ha^{-1}). No long term adverse effect of the tested herbicide was seen on the microbial population of the experimental area. Henceforth, it can be concluded that the tested herbicide is safe for the management of the weeds in its critical infestation period.

REFERENCES

Bhattacharrya, S. P., Saha, S., Ghosh, R.K. and Karmakar, A. J. 2003. Bio efficacy of Mon-78135 on tea (*Camellia sinensis* L.). *Environ. Ecol.*, **2**1(2): 377-79.

Bhowmick, P.C. 2010. Current status of herbicide resistant weeds around the Globe. *J. Crop & Weed*, **6**:33-43.

Ghosh, R.K., Mondal, S.S. and Maiti, S. 2007. Modern Weed Science, Manual. Published from BCKV, Funded by ICAR.

Ilango, R.V.J. 2003. Evaluation of Carfentrazone-ethyl for control of weeds in tea (Camellia spp. L.). *Indian J. Weed Sci*., **35** (3/4):296-97.

Magambo, M.J.S. and Kilavuka, C.L.1982. Effect of glyphosate on shoot growth of tea. Trop. *Pest Manage*., **28** (3): 315-16.

Mirghasemi, S.T., Daneshian, J. and Baghestani, M.A. 2012. Investigating of increasing glyphosate herbicide efficiency with nitrogen in control of tea weeds. Int. *J. Agri. Crop Sci*., **4** (24):1817-20.

Poddar, R., Bera, S., Ghosh, R.K. and Pal, D. 2014. Efficacy of ammonium salt of Glyphosate 71 % SG on weed management in cotton and its influence on soil micro flora. *J. Crop & Weed*. **10**(1):147-51.

Tea Board India, 2018. *http://www.indiatea.org*