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Bio-efficacy and phytotoxicity of glufosinate ammonium 13.5% SL on weed flora of tea

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ABSTRACTS

An experiment was conducted at Kamalpur Tea Estate, Birpara, Jalpaiguri, West Bengal during kharif season of 2016 and 2017 to evaluate the bio-efficacy and phytotoxicity of glufosinate ammonium 13.5% SL in tea (Camellia sinensis L.). The experiment was laid out in a randomized block design (RBD) with six treatments and four replications. Axonopus compressus; Eleusine indica; Digitaria sanguinalis; Cyperus aromaticus; Ageratum conyzoides; Borreria hispida; Commelina benghalensis; Scoparia dulcis, Mikania micrantha, Leucas cephalotes and Lindernia crustacean were the major weeds found infesting the tea crop during experimentation. The weed flora in tea were controlled effectively by applying glufosinate ammonium 13.5% SL at dosages varied from 375 g a.i. ha^{-1} to 625g a.i. ha^{-1} along with paraquat dichloride 24% SL @ 1 kg ha-1, which were statistically superior to weedy check. Significant increase in total leaf yield of tea was obtained by application of glufosinate ammonium 13.5% SL at the tested dose ranging from 375 g a.i. ha^{-1} to 625g a.i. ha^{-1}, in comparison to the weedy check and standard check. No phytotoxicity symptoms were observed in any of the doses of glufosinate ammonium 13.5% SL and hence, effective weed management can be done with the use of test herbicide.

Key words: Bio-efficacy, glufosinate ammonium, paraquat dichloride, tea and weed

Tea production in West Bengal is playing great role not only in world tea market but also in contributing substantially to Indian economy and in employment generation (Dhekale *et al*., 2010). When weeds are present in tea graden, may interfere with the growth of tea by competing with light, nutrients and water and thus leading to lowered productivity levels. It interferes with routine operations in tea garden and could also serve as alternate hosts for some tea pests (Wilson, 2005).

Different weed management approaches are advocated for tea crop. But chemical control recorded better over other methods (Ilango *et al.*, 2010; Mirghasemi *et al*., 2012) due to their efficiency, cost effectiveness and ease of operation. So far many herbicides have been recommended for controlling weeds flora in tea after extensive screen trails carried out by different scientists in different tea growing regions. Any recommendation for the release of a particular herbicide for tea is based on its weed control efficacy, weed species resistance, phytotoxicity to tea and its suitability for the types of tea garden. Keeping this in mind, the present experiment was conducted to evaluate the bio-efficacy and phytotoxicity of Glufosinate ammonium 13.5% SL against weed flora in Tea crop.

MATERIALS AND METHODS

A field experiment was conducted at Section no. 2 of the Kamalpur Tea Estate, Birpara, Jalpaiguri (Latitude 26.42° N Longitude 91.87° E) in *kharif* season of 2016 and 2017. The soil pH of the experimental block was 6.60 showing slightly acidic, blackish gray in colour mostly due to high organic matter and poor bases with moderate availability in primary major nutrients. The experiment was laid out in Randomized Block Design with four replications consisting of six treatments *viz*. T_1- Glufosinate Ammonium 13.5% SL @ 375 g *a.i.* ha^{-1}, T_2- Glufosinate Ammonium 13.5% SL @ 500 g *a.i.* ha^{-1}, T_3- Glufosinate Ammonium 13.5% SL @ 625 g *a.i.* ha^{-1},T_4- Paraquat dichloride 24% SL @1000g *a.i.* ha^{-1}, T_5- Hand weeding and T_6- Weedy check. When weeds are at active vegetative growth stage (4-6 leaf), the tested herbicide Glufosinate ammonium 13.5% SL along with standard check Paraquat dichloride 24% SL were sprayed by using Knapsack sprayer with a flood jet nozzle as per the treatments. Hand weeding was taken up twice on 0 and 20 Days after application (DAA).

The observations were recorded on weed density (m^{-2} area) and weed dry weight (g m^{-2}) at 45 DAA and 75 DAA by placing a quadrate of 1 x 1 m randomly in each plot. The data collected on weeds were transformed to square root transformation ["(x +0.5)] for statistical analysis. Weed control efficiency (WCE) was calculated on the basis of data recorded at 45 and 75 DAA of the tested herbicide in tea as per the formula suggested by Mani *et al*. (1976) as follows:

$$\text{Weed Control Efficiency (\%)} = \frac{\text{WDC} - \text{WDT}}{\text{WDC}} \times 100$$

Where, WDC = Weed dry weight in untreated control plot (g m^{-2}); WDT = Weed dry weight in treated plot (g m^{-2})

The observations on the level of phytotoxicity due to application of tested herbicides were recorded on 1, 3, 7, 10 and 15 DAA. The parameters of phytotoxicity on epinasty, hyponasty, vein clearing, necrosis, leaf tip and surface injury and wilting of plants were observed and the following scale was used to assess the phytotoxicity.

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Phytotoxicity rating scale (PRS)

Crop response or Crop injury	Rating
0-0	0
1-10%	1
11-20%	2
21-30%	3
31-40%	4
41-50%	5
51-60%	6
61-70%	7
71-80%	8
81-90%	9
91-100%	10

Yield data of green leaf tea was also recorded month wise from each picking for 3 months and calculated total yield of 3 months from each herbicidal treatments including plots of two hands weeded and untreated weedy check. The data were subjected to statistical analysis by analysis of variance method (Gomez and Gomez, 1984). As the error mean squares of the individual experiments were homogenous, combined analysis over the years were done through unweighted analysis. Here, the interaction between years and treatments were not significant.

RESULTS AND DISCUSSION

Major Weed flora

Weed flora in the experimental field were predominantly consisted of three species of grasses, one species of sedge and seven species of broad leaved weed. The dominant grassy weed species were *Axonopus compressus, Eleusine indica* and *Digitaria sanguinalis* along with one sedge weed i.e. *Cyperus aromaticus*, *Ageratum conyzoides, Borreria hispida, Commelina benghalensis, Scoparia dulcis, Mikania micrantha, Leucas cephalotes* and *Lindernia crustacean* were dominant broad leaf weeds found in the experimental area. Among the grassy weeds *Axonopus compressus* was found most dominant weed followed by *Eleusine indica*, while in case of broad leaf *Ageratum conyzoides* become predominant followed by *Borreria hispida*.

Weeds density and weed biomass

Observations on weed density after 45 and 75 days of application of herbicides clearly indicated that herbicidal treatment was better than weedy check condition in reduction of the weed density for all categories of weeds (Table 1). Twice hand weeded plot recorded lowest total weed population of grassy broad leaf and sedge weeds among all the treatments. Among the herbicidal treatments glufosinate ammonium 13.5% SL @ 625 g a.i. ha^{-1} gave more promising control of weeds (Table 1). This may be due to its herbicidal effect on inhibition of glutamine synthetase leading to a complete breakdown of ammonia metabolism (Hack *et al.*, 1994) though on par with its lower doses @ 500 g a.i. ha^{-1} and 375 g a.i. ha^{-1} at 45 DAA and 75 DAA. Paraquat dichloride 24% SL@ 1000 g a.i. ha^{-1} recorded highest total weed population of grassy and broad leaf weeds as compared to the rest of the herbicides treatment at 45 DAA and 75 DAA though on par with glufosinate ammonium 13.5% SL.

Among the weed management treatments, twice handed weeding was recorded the lowest dry weight of the grassy broad leaf and sedge weeds. Among the herbicidal treatment considerable reduction in dry weight of weed was recorded with glufosinate ammonium 13.5% SL @ 625 g *a.i.* ha^{-1} which was followed by glufosinate ammonium 13.5% SL @ 500 g *a.i.* ha^{-1} and glufosinate ammonium 13.5% SL @ 375 g *a.i.* ha^{-1} though all are statistically at par with standard check. Maximum dry weed biomass was noticed in weedy check, where weeds were not controlled (Table 2).

Weed control efficiency (WCE)

Results revealed that maximum WCE (%) was recorded in twice hand weeding at 45 DAA and 75 DAA which was closely followed by T_3 (glufosinate ammonium 13.5% SL @ 625 g *a.i.* ha^{-1}), T_2 and T_1. Among the different herbicidal weed management treatment, T_4 (Paraquat dichloride 24% SL @ 1000 g *a.i.* ha^{-1}) recorded less WCE for all the observations (Table 4).

Phytotoxicity

No phytotoxicity symptoms regarding epinasty, hyponasty, vein clearing, necrosis, leaf tip and surface injury and wilting of plants were observed on tea due to application of tested herbicides on 1, 3, 7, 10 and 15 DAA (Table 3).

Tea leaf yield

The highest green tea leaf yield was obtained always with twice hand weeding. All the herbicidal treatments containing glufosinate ammonium at different doses in this experiments recorded the significant increase in green tea leaf yield with respect to paraquat dichloride 24% SL @ 1000 g *a.i.* ha^{-1} in the month of September to November which had ultimately been reflected in the total green tea leaf. Similar observations were reported by Patra *et al*. (2016). All the weed management treatments gave higher green tea leaf yield compared to weedy check (Table 4).

From the results of present study it can be concluded that, weed flora in tea were controlled effectively by applying glufosinate ammonium 13.5% sl at dose rate from 375 g *a.i.* ha^{-1} to 625 g *a.i.* ha^{-1}, which were found to be superior to the weedy check and paraquat dichloride 24% SL @ 1000 g *a.i.* ha^{-1}.

Table 1: Total weed density (m^{-2} area) at 45 DAA and 75 DAA of herbicidal treatments in tea (pooled)

Treatments	Total weeds density m^{-2} area at 45 and 75 DAA					
	Grassy		BLW		Sedge	
	45 DAA	75 DAA	45 DAA	75 DAA	45 DAA	75 DAA
T_1: Glufosinate ammonium 13.5% SL (UPL) @ 375 g *a.i.* ha^{-1}	3.47 (11.55)	3.66 (12.89)	3.19 (9.66)	3.44 (11.33)	1.96 (3.33)	2.15 (4.11)
T_2: Glufosinate ammonium 13.5% SL (UPL) @ 500 g *a.i.* ha^{-1}	3.14 (9.33)	3.31 (10.44)	2.88 (7.78)	3.22 (9.89)	1.81 (2.78)	2.10 (3.89)
T_3: Glufosinate ammonium 13.5% SL (UPL) @ 625 g *a.i.* ha^{-1}	2.95 (8.22)	3.24 (10.00)	2.66 (6.55)	3.15 (9.45)	1.65 (2.22)	2.04 (3.67)
T_4: Paraquat dichloride 24% SL@ 1000 g *a.i.* ha^{-1}	3.98 (15.34)	3.98 (15.34)	3.69 (13.11)	3.98 (15.34)	2.22 (4.44)	2.68 (6.67)
T_5: Hand weeding	2.57 (6.11)	2.93 (8.11)	2.30 (4.77)	2.95 (8.22)	1.39 (1.44)	1.78 (2.67)
T_6: Weedy check	5.47 (29.37)	6.19 (37.78)	5.13 (25.82)	5.99 (35.44)	3.19 (9.67)	3.98 (15.33)
SEm (±)	**0.27**	**0.22**	**0.18**	**0.25**	**0.19**	**0.14**
LSD (0.05)	**0.80**	**0.65**	**0.55**	**0.74**	**0.57**	**0.42**

Note: Values in the parentheses are original which were subjected to ("X + 0.5) transformations
BLW: broad leaf weed; DAA: days after application

Table 2: Total weed dry weight at 45 DAA and 75 DAA of herbicidal treatments in tea (pooled)

Treatments	Dry weight of total weeds (g m^{-2}) at 45 and 75 DAA					
	Grassy		BLW		Sedge	
	45 DAA	75 DAA	45 DAA	75 DAA	45 DAA	75 DAA
T_1: Glufosinate ammonium 13.5% SL (UPL) @ 375 g *a.i.* ha^{-1}	2.17 (4.23)	2.73 (6.95)	2.29 (4.73)	2.84 (7.55)	1.22 (1.00)	1.63 (2.15)
T_2: Glufosinate ammonium 13.5% SL (UPL) @ 500 g *a.i.* ha^{-1}	1.98 (3.41)	2.46 (5.56)	2.08 (3.81)	2.66 (6.59)	1.09 (0.69)	1.51 (1.79)
T_3: Glufosinate ammonium 13.5% SL (UPL) @ 625 g *a.i.* ha^{-1}	1.87 (3.01)	2.36 (5.06)	1.93 (3.21)	2.50 (5.75)	1.09 (0.69)	1.32 (1.25)
T_4: Paraquat dichloride 24% SL@ 1000 g *a.i.* ha^{-1}	2.47 (5.61)	3.43 (11.25)	2.63 (6.42)	4.18 (16.95)	1.22 (0.98)	2.18 (4.25)
T_5: Hand weeding	1.80 (2.75)	2.32 (4.90)	1.83 (2.84)	2.37 (5.14)	0.91 (0.32)	1.28 (1.15)
T_6: Weedy check	4.87 (23.26)	5.85 (33.75)	5.28 (27.35)	6.22 (38.25)	2.26 (4.60)	2.78 (7.25)
SEm (±)	**0.22**	**0.20**	**0.18**	**0.36**	**0.08**	**0.25**
LSD (0.05)	**0.65**	**0.60**	**0.55**	**1.10**	**0.25**	**0.75**

Table 3: Phytotoxicity effect of glufosinate ammonium 13.5% SL on tea plants (pooled)

Treatments	Mean observations recorded after 1, 3, 7, 10 and 15 DAA					
	Leaf injuryon tips/ surface	Wilting	Necrosis	Vein clearing	Epinasty	Hyponasty
T_1: Glufosinate ammonium 13.5% SL (UPL) @ 375 g *a.i.* ha^{-1}	0	0	0	0	0	0
T_2: Glufosinate ammonium 13.5% SL (UPL) @ 500 g *a.i.* ha^{-1}	0	0	0	0	0	0
T_3: Glufosinate ammonium 13.5% SL (UPL) @ 625 g *a.i.* ha^{-1}	0	0	0	0	0	0
T_4: Paraquat dichloride 24% SL@ 1000 g *a.i.* ha^{-1}	0	0	0	0	0	0
T5: Hand weeding	0	0	0	0	0	0
T_6: Weedy check	0	0	0	0	0	0

Table 4: Effect of different herbicide treatments on weed control efficiency (%) in tea garden and green leaf yield (q ha^{-1}) of tea (pooled)

Treatments	Weed control efficiency (%)						Green tea leaf yield (q ha^{-1})			
	Grassy		BLW		Sedge					
	45 DAA	75 DAA	45 DAA	75 DAA	45 DAA	75 DAA	September	October	November	Total
T_1	81.81	79.41	82.71	80.26	78.26	70.34	11.56	10.35	7.60	29.51
T_2	85.34	83.53	86.07	82.77	85.00	75.31	12.83	11.76	8.28	32.87
T_3	87.06	85.01	88.26	84.97	85.00	82.76	13.70	12.70	9.65	36.05
T_4	75.88	66.67	76.53	55.69	78.70	41.38	9.45	9.13	7.70	26.28
T_5	88.18	85.48	89.62	86.56	93.04	84.14	13.85	12.93	9.85	36.63
T_6	0.00	0.00	0.00	0.00	0.00	0.00	9.15	8.56	6.60	24.31
SEm (±)							**0.71**	**0.56**	**0.32**	**1.19**
LSD (0.05)							**2.15**	**1.70**	**0.95**	**3.60**

Higher total leaf yield of tea was also obtained by application of glufosinate ammonium 13.5% SL at dose rate from 375 g *a.i.* ha^{-1} to 625 g *a.i.* ha^{-1}. No phytotoxicity symptoms were noticed for any of the doses of glufosinate ammonium 13.5% SL. So, it can be used safely at the recommended rate in tea for effective weed management.

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REFERENCES

Dhekale, B. S., Sahu, P. K., Vishwajith, K. P., Mishra, P. and Noman, Md. 2010. Modeling and forecasting of tea production in West Bengal. *J. Crop and Weed*, **10** : 94-103.

Gomez, K. A. and Gomez, A. A. 1984. Statistical Procedures for Agricultural Research, 2nd Edn., Singapore, John Wiley and Sons.

Hack, R., Ebert, E., Ehling. G. and Leist, K. H. 1994. Glufosinate ammonium—some aspects of its mode of action in mammals. *Food Chem. Toxicol.*, **32** : 461-70.

Ilango, R. V. J., Saravanan, M., Parthibaraj, R. and Kumar, P. M. 2010. Evaluation of Excel Mera-71 weed control in tea fields. Newsletter - UPASI Tea Research Foundation, **20**: 1.

Mani, V. S. Chakraborty, T. K. and Gautam, K. C. 1976. Double hedge weed killers in peas. *Indian Farm.*, **26**: 80-83.

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. Agril. Crop Sci.*, **4**: 1817-20.

Patra, P. S., Paul, T., Tamang, A., Choudhury, A. and Biswas, M. 2003. Evaluation of bio-efficacy and phytotoxicity of glufosinate ammonium 13.5%SL in tea (*Camellia sinensis* L.). *American J. Res. Comm.*, **4**: 103-15.

Wilson, S. W. 2005. Keys to the families of Flugoromorpha with emphasis on plant hoppers of potential economic importance in the Southeastern United States (Hemiptera: Auchenorhyncha). *Florida Entomol.*, **88**:464-81.