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Bio-efficacy and phytotoxicity study of 2, 4-D ethyl ester 38% EC in *kharif* rice

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ABSTRACT

An experiment was conducted in the Regional Research Station, Chakdaha of West Bengal during kharif season of 2013 to study the bio-efficacy and phytotoxicity of 2,4-D ethyl ester 38 % EC in rice. The study revealed that the weed density and weed dry weight were found to be lowest in 2,4-D ethyl ester 38% EC @ 3.4 kg a.i ha^{-1} which remained at par with its lower dose of 1.7 kg a.i ha^{-}). The maximum weed control efficiency was recorded in two rounds of hand weeding being, 75.84%, 82.24% and 88.03% at 20, 40 and 60 DAS, respectively. That was at par with application of 2, 4-D ethyl ester 38% EC @ 3.4 kg a.i. ha^{-1}. Unlike weed control efficiency, both the mentioned treatments followed similar trend in registering the grain yield of rice. There was no phytotoxic effect of 2,4-D ethyl ester 38% EC @ 3.4 kg a.i ha^{-1} on the rice crop.

Keywords: Bio-efficacy, butachlor, 2,4-D ethyl ester 38%EC, kharif rice and phytotoxicity

Rice is an important staple food crop for Asia and Indian sub-continent feeding half of the whole world's population., it is the predominant crop grown globally in an area of 161.54 million ha with an annual production of 487.46 million tons and productivity of 4.5 t ha^{-1} for the period of 2017-18 (USDA, 2018). In India, the area, production and productivity of rice are 43.70 million ha, 112.7 million tons and 2.5 t ha^{-1} for the growing period of 2017-18 (https://eands.dacnet). Meanwhile, its production is also affected drastically by the infestation of insect-pests, diseases, weeds etc. Among all, weed causes major hindrance in rice cultivation and leads to reduction in yield, it accounts for about 31.5 % (Bhan *et al*., 1999). In order to reduce its losses weed control measures should be adopted.Traditional way of controlling weed is time consuming and labour intensive venture. Cultivation of rice during kharif season faces problems of weed infestation. Considering all short comings, farmers used to rely mostly upon chemical herbicides to protect the crops from the ravages of weeds. An experiment was conducted at the Regional Research Station of BCKV, Chakdaha, Nadia, West Bengal,that is situated at 23^{0}5.3$^{'}$N latitude and 83^{0}5.3$^{'}$E longitude and 9.75 m above MSL and topography of the area was referred as medium land situation, toevaluate the bio-efficacy and phytotoxicity of 2, 4-D ethyl ester 38%EC in controlling weeds in kharif rice and its effect on the succeeding lathyrus crop.2,4-D ismainly used to control broad leaf weeds and can regulate plant growth.It is well known for its synthetic auxin or auxin mimic property (Tu *et al*., 2001). It can be found in various formulations like esters, acids and severalsalts which vary in their chemical properties, environmental behaviour and toxicity (WHO, 1989). The ester forms of 2,4-D ,when applied, penetrate foliage andkill the target weed by mimicking the plant growth hormone auxin and causes uncontrolled and disorganised plant growth that leads to death of plant. This attributes of 2,4-D let the present authors to carry out trial on the aforementioned objectives.

In 2013, the field experiment was conducted during the kharif season at the Regional Research Station, Chakdaha, BCKV, West Bengal to find out the bio-efficacy and phytotoxicity of 2, 4- D ethyl ester 38% EC in controlling weeds of kharif rice. The experiment was laid out in Randomised block design (RBD) with 9 treatments including control *viz*., T_1- 2, 4 D ethyl ester 38% EC (Nufarm) @ 0.425 kg *a.i.* ha^{-1}, T_2 – 2, 4 D ethyl ester 38% EC (Nufarm) @ 0.850 kg *a.i.* ha^{-1}, T_3 – 2, 4 D ethyl ester 38% EC (Nufarm) @ 1.280 kg*a.i* ha^{-1}, T_4 – 2, 4 D ethyl ester 38%EC (Nufarm) @ 1.700 kg*a.i*.ha^{-1}, T_5 – 2, 4 D ethyl ester 38% EC (Nufarm) @ 3.400 kg *a.i.* ha^{-1}, T_6 – 2, 4 D ethyl ester 38% EC (Commercial) @ 0.850 kg *a.i.* ha^{-1}, T_7 – Butachlor 50%EC @ 1.000 kg *a.i.* ha^{-1}, T_8 – Handweeding (Twice) and T_8 – Unweeded control and the treatments are replicated thrice. The physicochemical properties of the experimental site was sandy loam with slightly acidic in nature (6.6 pH). The weed control parameters were recorded at 20, 40 and 60 DAT. The weed control efficiency is a measure to

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Table 1: Effect of 2, 4 –D ethyl ester on weed density, weed dry weight, weed control efficiency per meter square and yield in *kharif* rice

Treatments	Dosekg *a.i.*ha^{-1}	Weed density (gm^{-2})			Weed dry weight production(gm^{-2})			Weed control efficiency(%)			Phytotoxicity			Yield
		20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	7DAA	14DAA	21DAA	
2,4-D (EE) 38% EC (Nufarm)	0.425	3.24	12.11	22.32	2.43	12.15	25.79	18.46	9.73	9.73	0	0	0	2.41
2,4-D (EE) 38% EC (Nufarm)	0.850	3.00	10.42	19.47	1.40	7.29	13.57	53.02	45.84	52.50	0	0	0	3.74
2,4-D (EE) 38% EC(Nufarm)	1.280	2.96	9.27	18.57	1.37	6.48	12.87	54.03	51.86	54.95	0	0	0	3.66
2,4-D (EE) 38% EC(Nufarm)	1.700	2.84	8.45	18.52	1.27	5.42	12.47	57.38	59.73	56.35	0	0	0	3.72
2,4-D (EE) 38% EC(Nufarm)	3.400	2.46	6.46	18.47	0.89	4.56	11.54	70.13	66.12	59.61	0	0	0	3.77
2,4-D (EE) 38% EC(commercial)	0.850	3.00	11.47	20.41	1.68	8.24	14.62	43.62	38.78	48.83	0	0	0	3.65
Butachlor 50% EC	1.000	3.11	11.57	20.42	1.72	8.27	16.11	42.28	38.56	43.61	0	0	0	3.54
Handweeding (twice)	-	1.11	4.59	15.79	0.72	2.39	3.42	75.84	82.24	88.03	0	0	0	3.84
Unweeded control	-	5.47	26.12	39.40	2.98	13.46	28.57	0.00	0.00	0.00	0	0	0	1.96
SE (d)		**0.21**	**1.06**	**1.16**	**0.13**	**0.68**	**1.43**	-	-	-	-	-	-	**0.45**
LSD (0.05)		**0.45**	**2.24**	**2.46**	**0.28**	**1.45**	**3.02**	-	-	-	-	-	-	**0.95**

*Note: *DAS- days after sowing; **DAA- days after application*

determine how effectively an herbicide can control the weed and is calculated by Kondap and Upadhyay (1985).

Weed control efficiency (WCE) = x – y/ x ×100

Where,

x - Dry weight of weeds in the control plot; and

y – Dry weight of weeds in the treated plot.

The phytotoxicity of the treated herbicide at different doses was observes at 7, 14 and 21 days after application of the herbicide.

The result obtained showed that the treatment had significant effect on controlling almost all kind of weeds preferably @ 1.700 to 3.4 kg ha^{-1}. The number of weed recorded per meter square at 20, 40 and 60 DAS has found to be least with the treatment T_5 (2, 4-D ethyl ester 38% EC @ 3.4 kg *a.i.* ha^{-1}) which remained at par with T_4 (2, 4- D ethyl ester 38% EC @ 1.7 kg *a.i.* ha^{-1}) but found superior to other treatments except handweeding twice. Among all the treatments, the maximum density was recorded withcontrol treatment at all the observations taken.This finding was already reported by Sarkar *et al*. (2017) and Nagaraju and Kumar (2009).

The dry weight taken at 20, 40 and 60 DAS were significantly affected by the treated herbicide 2, 4- D ethyl ester 38% EC. The weed dry weight was recorded highest with T_9 (unweeded control) as maximum weed count was recorded with this treatment and least weed dry weight (0.72g, 2.39g and 3.42g m^{-2} at 20, 40 and 60 DAS, respectively) was recorded with treatment T_8 (handweeding twice) followed by the treatment T_5 (2, 4-D ethyl ester 38% EC @ 3.4 kg *a.i.* ha^{-1})which remained at par with T_4 (2, 4-D ethyl ester 38% EC @ 1.7 kg *a.i.* ha^{-1}) and found superior to the other treatments as shown in table- 1. Heisnam *et al*. (2015), also reported that application of 2, 4 –D ethyl ester 30% EC can significantly decreased the dry weight of all weed species found. The same result was reported by Sarkar *et al*. (2017) and Biswas *et al.* (2016).

As the given treatment significantly affect the weed density, and weed dry weight per meter square that leads to effect on respective weed control efficiency. The maximum weed control efficiency (75.84%, 82.24% and 88.03% at 20, 40 and 60 DAS, respectively) was recorded with T_8 (hand weeding twice) which was followed by T_5 (2, 4-D ethyl ester 38% EC @ 3.4 kg *a.i.* ha^{-1}) and which remained at par with 2, 4-D ethyl ester 38% EC @ 1.700 kg *a.i.* ha^{-1}. The weed control efficiency of the aforesaid treatment was found to be superior to other treatments. The least weed control efficiency was recorded with unweeded control plot. The same was also concluded by Biswas *et al.* (2016).

The maximum yield of 3.84 t ha^{-1} was recorded with handweeding twice (Table 1).Since all the treatment are

on par except T_1 and T_2, there was no significant difference. However, handweeding twicewas followed by 2, 4-D ethyl ester 38% EC @ 3.4 kg *a.i*. ha^{-1} (3.77 t ha^{-1}) and found superior to others treatments. Lowest yield was recorded with unweeded control (1.96 t ha^{-1}). Subramanian and Mohamed (1987), Dutta *et al.* (2017) and Nagaraju and Kumar (2009) also reported that application of 2, 4 –D ethyl ester could increase yield.

After 7, 14 and 21 days of herbicide application, observations on visual phytotoxicity viz. Leaf injury, vein clearing, epinasty, hyponasty, scorching and necrosiswas recorded. There were no such symptoms among the different treatments as well as even at the highest dose of 2, 4-D ethyl ester 38% EC @3.400 kg *a.i*.ha^{-1}.

The experiment conducted inferred that 2, 4-D ethyl ester 38% EC @ 3.4 kg *a.i*.ha^{-1} (T_5) and 2, 4- D ethyl ester 38% EC @ 1.7 kg *a.i*.ha^{-1} (T_4) has resulted in effective control of weed resulted in least weed density, weed dry weight and higher weed control efficiency and was observed with zero phytotoxicity on visual scoring but was found comparatively lesser with handweeding twice.

In case of yield parameters and yield, T_5(2, 4-D ethyl ester 38%EC @3.4 kg *a.i*. ha^{-1} resulted better yield parameters and yield which is found lesser than hand weeding twice that was remained on par with aforesaid treatment.

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