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EFFICACY OF PETROLEUM ETHER SOLVENT ON *ECHINOCLOA COLONUM AND CRUSGALLI* OVER DIFFERENT EXTRACTS OF *XANTHIUM STRUMARIUM* L. EXTRACT ON TRANSPLANTED RICE

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ABSTRACT
Field experiment conducted during the rainy seasons 2011 and 2012 at the Agricultural Research Farm of the Institute of Agricultural Sciences, Banaras Hindu University, Varanasi to study the efficacy of *Xanthium strumarium* extracts against *echinocloa*weed in transplanted rice. Weeds caused yield losses upto 15 to 76%, so use of Xanthium as a herbicide is a better concept towards weed control.The objective taken here to find out the effect of different rates of *Xanthium strumarium* extract (petroleum ether, methanol and water extract @1000 mg/l, 2000 mg/l and 3000 mg/l respectively) the effect of extracts on growth, yield and nutrient uptake by weed. Result shows significant increase in control of *echinochloa*weed density, increase in plant height, no. of tillers/hill, leaf area index, fresh weight and dry weight of plant including yield attributing characters. The application of petroleum ether extract @ 3000 mg/l of *Xanthium strumarium*was found highest reduction in the density of *echinocloacolonum*and *echinocloacrusgalli*followed by petroleum ether extract @ 2000 mg/l of *Xanthium strumarium* over the two major predominant herbicides of rice i.e. pretilachlor and butachlor.

INTRODUCTION

Weed control in rice is challenging particular in light of profuse weed infestations and escalating price of herbicides where the best alternative is to use weed originated (*xanthium strumarium*) herbicides (Mallikarjun *et al*., 2014). The complex weed flora include grass like *Echinochloa* spp. which compete for space, light and nutrient resulting in 15-76% reduction in grain yield (Singh and Singh, 2011). The stem, leaf and seed parts of the *Xanthium* plants was takenfor observation. The stem, leaf and seed parts of the *Xanthium* contain alkaloids like sesquiterpene lactones, viz. xanthinin; its stereoisomer, xanthumin, xanthatin also known as deacetylxanthin in (Zhang *et al*.,2012)a toxic principle,a sulphated glycoside: xanthostrumarin, atractyloside,carboxyatractyloside; phytosterols, xanthanol, isoxanthanol, xanthinosin. The main toxic compound isolated from the plant has been identified as carboxyatractyloside, a kaurene glycoside previously called xanthostrumarium (Aranjani *et al*., 2012). Besides these, the seeds also contain considerable amount of iodine (Chopra *et al*., 1965). The phytotoxins secreted by *Xanthium strumarium* on germinating seeds of the weed species have some degrees of germination and emergence inhibition or growth injury Upadhyay *et al*.(2006).So,extract of *Xanthium strumarium* having petroleum ether solvent with 3000 ppm showed decease in density of echinochloa, there by increase in growth and yield attributing characters of rice.

Considering this,the present investigation was under taken to find the effect of different rates of *Xanthium strumarium* extract on density of *echinochloa*, plant height, no. of tillers/hill, leaf area index, fresh weight and dry weight of plant including yield attributing characters like panicle/ m^2, chaff / panicle, grain /panicle and panicle length (cm) of rice

MATERIALS AND METHODS

Field experiment was conducted during the rainy season of 2011 and 2012 at the Agricultural Research Farm, Banaras Hindu University, Varanasi to study the efficacy of different rates of *Xanthium strumarium* extract (petroleum ether, methanol and water extract @ 1000 mg/L, 2000 mg/L and 3000 mg/L respectively) against weeds in transplanted rice. The required quantity of herbicide as per treatment was broad casted and sprayed @ 1.5g, 3.0g and 4.5g of the extracts and two chemical herbicides viz.pretilachlor @ 2.7g and butachlor @ 8.1g mixed in 1500 ml of water to make concentration of1000 mg/L,2000 mg/Land 3000 mg/L respectively. For the extraction purpose, *Xanthium strumarium* was collected from Farm and was kept in shade for 70 days until all the moisture was expelled and then grounded separately *viz*. stem, leaf and seed with the help of willey grinder. The final grounded material was mixed (stem + leaf + seed) and used for extraction.

100 g of stem, leaf along with seed *of Xanthium Strumarium of* grounded material was placed inside a thimble made from thick filter paper, which was loaded into the main chamber of the Soxhlet extractor (Kovacs *et al*., 2009).The soxhlet extractor

was placed into a flask containing 1000 mL petroleum ether (60-80ºC) and then fitted with a condenser. The petroleum ether was heated up to 70ºC. The condenser ensures cooling of solvent vapour, and drips back down into the chamber housing the ground *Xanthium strumarium* (stem + leaf + seed). The chamber containing the solid material slowly filled with warm solvent. This cycle was allowed to repeat over 5 hours. In the process mixture of petroleum ether and soluble compound of *Xanthium strumarium* was collected in round bottom flask.

After extraction the solvent was removed, typically by means of a rotary evaporator, yielding 15.5 g extracted material. The non-soluble portion of the extracted solid remained in the thimble and was discarded. Similarly, methanol extraction was done but Water extraction was done by placing 100 g of ground cocklebur. The material was filtered with cotton cloth and filtrate containing plant extract and water was separated by using heater. In this way water was evaporated and plant extract (7.92 g) was left in beaker.

The observations recorded during the course of investigation were tabulated and analyzed statistically to draw a valid conclusion.The data were analyzed as per the standard procedure for "Analysis of Variance" (ANOVA) as described by Gomez and Gomez (1984). The significance of treatments was tested by 'F' test (Variance ratio). Standard error of mean was computed in all cases. The difference in the treatment mean were tested by using Critical Difference (CD) at 5% level of probability where 'F' test showed significant differences among means by the following formula

$$CD = \sqrt{\frac{2 \times \text{error mean sum of square}}{N x}} \; X \text{ (error d.f. 5\%)}$$

RESULTS AND DISCUSSION

Effect of *Xanthium* extracts on *Echinochloa*weed

The application of *Xanthium* extracts was found to exert significant control on monocot weeds. The phytotoxins present in the *Xanthium*has the capacity to choke the various biochemical processes like cell division (inhibiting mitosis and microtubule assembly), protein synthesis (inhibiting the protein synthesis resulting in improper root and shoot development) (Karadjova *et al*., 2000). It was observed that there was a progressive increase in the population of individual

Table 1:Effect of different treatments on density of *Echinochloacolonum*and*Echinochloacrusgalli*/m²

Tr. No	Treatments	Concentration of extract (mg L^{-1})	Density of *Echinochloacolonum*/m² 30 DAT	60 DAT	90 DAT	At harvest	Densityof *Echinochloacrusgalli*/m² 30 DAT	60 DAT	90 DAT	At harvest
T_1	Pretilachlor	900	2	2.33	0	0	2.17	3.17	0	0
T_2	Butachlor	3000	3	4.33	0	0	3.67	4.17	0	0
T_3	Methanol extract of *Xanthium strumarium*	1000	3.83	4.71	0	0	3.67	4.33	0	0
T_4	Methanol extract of *Xanthium strumarium*	2000	3.17	4.17	0	0	3.5	4	0	0
T_5	Methanol extract of *Xanthium strumarium*	3000	2.67	3.67	0	0	3.33	3.83	0	0
T_6	Petroleum ether extract of *Xanthium strumarium*	1000	3	4.5	0	0	3.67	4.17	0	0
T_7	Petroleum ether extract of *Xanthium strumarium*	2000	2.5	3.5	0	0	3.17	3.5	0	0
T_8	Petroleum ether extract of *Xanthium strumarium*	3000	1	1.67	0	0	1.33	2.5	0	0
T_9	Water extract of *Xanthium strumarium*	1000	4.33	5.33	0	0	4.83	5.33	0	0
T_{10}	Water extract of *Xanthium strumarium*	2000	3.17	4.67	0	0	3.83	4.5	0	0
T_{11}	Water extract of *Xanthium strumarium*	3000	3	4.33	0	0	3.67	4.33	0	0
T_{12}	Control	0	5.67	6	0	0	5.83	7	0	0
SEm ±			0.38	0.46	-	-	0.35	0.43	-	-
CD (P = 0.05)			1.11	1.37	-	-	1.05	1.28	-	-

Table 2:Effect of different treatments on plant height, no. of tillers/hill and leaf area index

Tr. No.	Treatments	Conc.of extract (mgL^{-1})	Plant height (cm) 30 DAT	60 DAT	90 DAT	At harvest	Number of tillers/hill 30 DAT	60 DAT	90 DAT	At harvest	Leaf area index 30 DAT	60 DAT	90 DAT	At harvest
T_1	Pretilachlor	900	50.8	80.1	93.7	92.2	8.57	14.6	16.2	15.7	2.68	6.95	5.24	4.05
T_2	Butachlor	3000	49.1	76.5	92.97	90.5	8.1	14	15	14.8	2.3	6.22	4.81	3.35
T_3	Methanol extract	1000	48.3	75.6	90.1	89.7	7.67	13.7	14.2	14.8	2.12	5.92	5.47	3.03
T_4	Methanol extract	2000	49.4	76.5	93.26	91	8.2	14.2	15.3	15.3	2.29	6.2	4.68	3.31
T_5	Methanol extract	3000	50.2	78.4	93.48	91	8.29	14.3	15.7	15.4	2.54	6.57	4.78	3.95
T_6	Petroleum ether extract	1000	49.4	80	93.32	90	8.3	13.9	14.5	14.6	2.24	6.25	4.69	3.5
T_7	Petroleum ether extract	2000	50.5	78.7	93.55	91.1	8.43	13.4	15.8	15.5	2.65	6.71	5.1	4
T_8	Petroleum ether extract	3000	51.3	80.4	94.5	93.4	8.77	15.2	16.5	16.2	2.94	6.99	5.56	4.08
T_9	Water extract	1000	46.1	75.3	91.45	87.4	6.93	13.2	13.8	13.8	1.96	5.28	3.98	3.01
T_{10}	Water extract	2000	46.2	76.4	91.47	87.4	7.2	13.6	14.5	14.4	2	5.19	4.11	3.05
T_{11}	Water extract	3000	47.1	76.1	90.96	88.9	7.67	13.9	14.7	14.7	2.2	5.82	4.5	3.44
T_{12}	Control	0	45.1	73.8	87.07	87	7.2	13	13.5	13.2	1.77	5.02	4.01	3.01
SEm ±			0.51	0.45	0.44	0.4	0.49	0.39	0.38	0.34	0.52	0.7	0.5	0.37
CD (P = 0.05)			1.49	1.32	0.29	1.17	1.45	1.17	1.12	1	1.52	2.04	0.61	1.08

Table 3: Effect of different treatments onfresh weight and dry weight of plant (g)/hill

Tr. No	Treatments	Concentration of extract (mg L^{-1})	Fresh weight of plant (g)/hill 30 DAT	60 DAT	90 DAT	At harvest	Dry weight of plant (g)/hill 30 DAT	60 DAT	90 DAT	At harvest
T_1	Pretilachlor	900	14.66	73.44	130.82	122.65	5.36	30.57	40.7	40.95
T_2	Butachlor	3000	13.22	68.08	125.47	120.8	4.98	28.25	37.95	38.1
T_3	Methanol extract	1000	13.09	65.24	121.3	120.25	4.67	27.51	36.6	36.97
T_4	Methanol extract	2000	13.8	69.19	127.39	119.23	4.88	29.44	38.19	37.99
T_5	Methanol extract	3000	14.17	71.57	129.17	121.63	5.14	30.04	38.93	38.23
T_6	Petroleum ether extract	1000	13.8	70.55	126.4	120.27	4.89	27.59	37.19	38.12
T_7	Petroleum ether extract	2000	14.21	72.98	129.54	121.82	5.24	30.55	39.23	39.79
T_8	Petroleum ether extract	3000	15.98	74.93	133.18	122.91	5.56	32.76	42.55	43.1
T_9	Water extract	1000	11.79	62.56	122.18	120.38	4.69	26.88	36.71	36.93
T_{10}	Water extract	2000	12.55	63.22	122.26	120.82	4.82	27.59	36.79	36.98
T_{11}	Water extract	3000	13.09	67.52	123.82	120.9	4.9	28.2	37.41	37.89
T_{12}	Control	0	11.67	60.77	121.48	117.3	4.33	25.67	36.48	36.55
SEm ±			0.58	0.75	0.95	0.16	0.16	0.46	0.89	0.73
CD (P = 0.05)			1.72	2.2	2.78	0.48	0.48	1.35	2.61	2.18

Table 4:

Tr. No.	Treatments	Conc.of extract (mgL^{-1})	Yield attributing characters Panicle/ m^2	Chaff / panicle	Grain /panicle	Panicle length (cm)
T_1	Pretilachlor	900	268.20	4.14	154.50	23.38
T_2	Butachlor	3000	262.52	4.48	152.29	22.48
T_3	Methanol extract	1000	261.09	4.57	149.53	25.52
T_4	Methanol extract	2000	264.14	4.28	152.56	22.53
T_5	Methanol extract	3000	265.35	4.29	152.93	22.62
T_6	Petroleum ether extract	1000	260.35	4.48	150.63	26.10
T_7	Petroleum ether extract	2000	267.96	4.23	153.47	22.85
T_8	Petroleum ether extract	3000	269.02	3.97	155.24	24.13
T_9	Water extract	1000	259.46	4.76	147.30	21.38
T_{10}	Water extract	2000	261.22	4.65	150.90	21.74
T_{11}	Water extract	3000	262.49	4.61	152.18	22.04
T_{12}	Control	00	260.83	4.47	146.30	21.45
SEm ±		0.60	0.19	0.83	0.73	
CD (P = 0.05)			1.76	0.56	2.45	2.14

weed species as well as total weeds upto 60 days of crop growth. This increase in weed density was mainly due to non-synchronous behaviour of weed seed germination and their wide periodicity under field conditions (Nibret *et al.*, 2011). The decrease in weed density of*Echinochloacolonum*was found to be highest by 3000 mg/l followed by 2000 mg/L and next to this is by 1000 mg/L (Table 1). Various physiological and biochemical processes were involved but it is presumably the increased osmotic gradient which is increased by the presence of solute in the solution (Shranappa *et al.*,1994, Divya *et al*., 2012).

Effect of *Xanthium* extracts on height of plant

The plant height increased consistently with the advancement of crop age and reached its maximum at 90 DAT and thereafter a slight reduction was observed. The treatments significantly influenced the plant height at all the stages of crop growth. The data clearly shows that maximum plant height was recorded with the application of petroleum ether extract @ 3000 mg L^{-1} although it remained at par with pretilachlor and petroleum ether extract @ 2000 mg L^{-1}(Table 2).

Effect of *Xanthium* extracts on tillers/hill of plant

The weed management treatments significantly differed among themselves with respect to tiller production at different stages of observation (Table 2). A perusal of data clearly indicated that application of petroleum ether extract @ 3000 mg L^{-1} was most effective in producing higher number of tillers/hill but remained at par with pretilachlor at 30 days after transplanting. Similar results were observed at 60, 90 DAT and at harvest.

Effect of *Xanthium* extracts on leaf area index of plant

Screening of data clearly revealed that maximum value of leaf area index in general was noted at 60 DAT as compared to 30 DAT and 90 DAT. Petroleum ether extract @ 3000 mg L^{-1} proved most instrumental in producing maximum Leaf area index which was significantly superior to all the treatments and statistically at par with pretilachlor @ 900 mg L^{-1}, petroleum ether extract @ 2000 mg L^{-1} at all crop growth stages *i.e.* at 60, 90 DAT and at harvest (Table 2).

Effect of *Xanthium* extracts on fresh wt. and dry wt. of plant

The fresh weight of crop found to be maximum with the application of petroleum ether extract @ 3000 mg L^{-1} was at par with pretilachlor @ 900 mg L^{-1}, petroleum ether extract @ 2000 mg L^{-1} at all crop growth stages *i.e.* at 60,90 DAT and at harvest (Table 3).

The perusal of data indicates that in general there was an

increasing dry weight of plant with advancement of crop age irrespective of treatments. Petroleum ether extract @ 3000 mg L^{-1} applied for weed control in rice produced significantly higher crop dry matter at all the stages of growth while it remained at par with application of pretilachlor and petroleum ether extract @ 2000 mg L^{-1}.

Effect of *Xanthium* extracts on Yield

Number of Panicles per square meter

Data pertaining to herbicidal effect of *X. strumarium* on number of panicles m^{-2} have been presented in Table 4. Petroleum ether extract @ 3000 mg L^{-1} recorded higher number of panicles m^{-2} but remained at par with application of pretilachlor and petroleum ether extract @ 2000 mg L^{-1}. Quite expectedly untreated control recorded the minimum number of panicles m^{-2} among all the weed management treatments.

Number of grains per panicle

A critical study of the data on the weed management on number of grains $panicle^{-1}$ has been presented in Table 4 The data revealed that the maximum grains $panicle^{-1}$ was recorded with the application of petroleum ether extract @ 3000 mg L^{-1} which was significantly superior to other herbicidal treatments, but at par with pretilachlor, petroleum ether extract of *X. strumarium* @ 2000 mg L^{-1}. However, all the herbicidal treatments recorded more number of grains per panicle than untreated control.

Panicle length

The data on panicle length (cm) are presented in table 4. Data showed that application of petroleum ether extract @ 3000 mg L^{-1} recorded maximum panicle length (24.13 cm) but was at par with pretilachlor and petroleum ether extract @ 2000 mg L^{-1}. The length of panicle was found to be minimum in control (21.45).

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