JOURNAL OF PURE AND APPLIED MICROBIOLOGY, March 2016. Vol. **10**(1), p. 479-483

Allelopathic Effect of Cocklebur Extract on the Fertility Status of Soil in Transplanted Rice by Controlling Weed

Ekta Kumari*, Pravin Kumar Upadhyay, Avijit Sen, Priyankar Raha, Javvadi Padmavathi, Mona Nagargade and Vishal Tyagi

Department of Agronomy, Institute of Agricultural Sciences,
Banaras Hindu University, Varanasi - 221 005, India.

https://doi.org/10.22207/JPAM.10.1.64

(Received: 30 October 2015; accepted: 06 January 2016)

Nutrient status plays a sine quo non role in maintaining the fertility of any soil. All the soil and plant indices are directly or indirectly related to it. In this experiment the use of xanthium is taken as key indicator for not just control over the prominent weeds of rice but this reduction of weed intensity thereby increase the nutrient reserves in the soil. In rice, weed control at early stage is imperative for realizing desired level of productivity. Here extraction from cocklebur is taken as a weed management tool to find out the effect of varying rates of Xanthium strumarium extract through different solvents(petroleum ether, methanol and water extract @1000mg L^{-1},2000mg L^{-1} and 3000mg L^{-1} each respectively) on dry weight of weed, nutrient content and removal by rice plant. The experiment was laid out in a randomized complete block design with twelve treatments replicated thrice on variety HUR 3022 including butachlor, pretilachlor and control. The nutrient availability was measured in terms of its content of the varied treatments and its uptake of nutrient in soil and plant at 30, 60 and 90 days after transplanting and at harvest. The application of petroleum ether extract @ 3000 mg L^{-1} of X. strumarium was found to having higher nutrient status in rice with lower status in weed ultimately controlling the most relative weed of rice i.e. Echinocloa spp. having the nutrient reserves in the soil as well as crop plant.

Keywords: *Xanthium strumarium* extract, petroleum ether, methanol, butachlor, pretilachlor.

Heavy weed infestation leads to jeopardise the nutrient content of soil and crop plant. The most complex and relative weed of rice compete for space, light and nutrient resulting in 15-76% reduction in grain yield (Singh and Singh, 2011). Besides yield reduction, weed also deplete nutrients from the soil to the tune of 11.0, 3.0 and 10.0 kg ha^{-1} of N, P_2O_5 and K_2O respectively (Gautam and Mishra, 2005). *Echinochloa* spp. is one of the most competitive weeds in rice field and very difficult to differentiate from rice in the early stages of its growth.

* To whom all correspondence should be addressed.
E-mail: ekta14.bhu@gmail.com

Cocklebur *i.e. Xanthium strumarium* contains toxic alkaloids contains sesquiterpene lactones, viz. xanthinin; its stereoisomer, xanthumin, xanthatin (deacetylxanthinin)-a toxic principle (Kovacs *et al.*, 2009). A sulphated glycoside- xanthostrumarin, atractyloside, carboxyatractyloside; phytosterols, xanthanol, isoxanthanol, xanthinosin, 4-oxo-bedfordia acid, hydroquinone; xanthanolides, deacetyl xanthumin" an antifungal compound and linoleic acid (Malik *et al*.1992). These compounds present in cocklebur are responsible for knocking down the profuse growth of various weeds of rice. The percent reduction of weed flora increases the efficiency of nutrient in grain (Upadhyay *et al*., 2006). Keeping this in view the following trial was conducted to study its effect on the availability of nutrient content and its uptake in grain and straw of rice

and dry weight of weed in transplanted rice under field condition.

MATERIALS AND METHODS

A field trial was conducted during the rainy seasons of 2011 and 2012 at the Agricultural Research Farm, Banaras Hindu University, Varanasi to study the efficacy of different rates of cocklebur extract (petroleum ether, methanol and water extract @ 1000mg L^{-1}, 2000mg L^{-1} and 3000mg L^{-1} respectively) on relative weed of rice and its nutrient content and depletion in transplanted rice. The soil of the experimental site was gangetic alluvial and sandy clay loam in texture with pH 7.4, 0.38% organic carbon, 179 kg, 18 kg and 199 kg ha^{-1} of available nitrogen, phosphorus and potassium respectively. A uniform fertilizer dose of 120-60-60 kg N, P_2O_5, K_2O ha^{-1} was applied, with half dose of 'N' and entire P and K being applied as basal before transplanting and remaining half dose of N top dressed in two equal splits at 30 DAT and 55 DAT respectively. The required quantity of herbicide as per treatment was broadcasted 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 of 1000 mg L^{-1}, 2000 mg L^{-1} and 3000 mg L^{-1} 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.

Soxhlet was used as extraction apparatus.100 g of stem+leaf+seed of *X. 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. The soxhlet extractor was placed into a flask containing 1000 ml petroleum ether (60-80°C) and then fitted with a condenser. The petroleum ether was heated up to 70°C. The solvent vapour travels up a distillation arm, and floods into the chamber housing the thimble of solid material. The condenser ensures cooling of solvent vapour, and drips back down into the chamber housing the ground *X. strumarium* (stem+leaf+seed).The chamber containing the solid material slowly filled with warm solvent. Some of the desired compound were dissolved in the warm solvent. When the Soxhlet chamber was almost full, the chamber was automatically emptied by a siphon side arm, with the solvent running back down to the distillation flask. This cycle was allowed to repeat over 5 hours. In the process mixture of petroleum ether and soluble compound of *X. strumarium* was collected in round bottom flask (Karadjova *et al*., 2000).

Table 1. Effect of different treatments on density of *Echinochloa sp.* (pooled data of 2011 and 2012)

Tr. No.	Treatments	Concentration of extract (mg L^{-1})	Density of *Echinochloa colonum* m^{-2}			
			30 DAT	60 DAT	90 DAT	At harvest
T_1	Pretilachlor	900	3.85	2.77	2.04	0
T_2	Butachlor	3000	3.65	4.97	1.00	0
T_3	Methanol extract of *Xanthium strumarium*	1000	3.99	4.89	1.17	0
T_4	Methanol extract of *Xanthium strumarium*	2000	3.68	4.38	1.55	0
T_5	Methanol extract of *Xanthium strumarium*	3000	2.99	3.97	1.10	0
T_6	Petroleum ether extract of *Xanthium strumarium*	1000	3.34	4.82	0.85	0
T_7	Petroleum ether extract of *Xanthium strumarium*	2000	2.69	3.87	1.56	0
T_8	Petroleum ether extract of *Xanthium strumarium*	3000	1.11	1.88	1.12	0
T_9	Water extract of *Xanthium strumarium*	1000	4.61	5.69	1.11	0
T_{10}	Water extract of *Xanthium strumarium*	2000	3.39	4.80	1.95	0
T_{11}	Water extract of *Xanthium strumarium*	3000	3.45	4.81	1.79	0
T_{12}	Control	00	5.99	6.54	1.26	0
SEm ±			0.51	0.49	0.337	-
CD (P = 0.05)			1.24	1.41	0.700	-

After extraction the solvent was removed, typically by means of a rotary evaporator, yielding 4.56 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 (equal proportion of stem, leaf and seed) in beaker of 1000 ml of water boiled by heater for an hour. 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.

RESULTS AND DISCUSSION

The nutrient content of soil is found to be decreased in the weed plant compared to the crop plant. The weed usually causes maximum damage to rice than most of other pests and diseases unless

Table 2. Effect of different treatments on dry weight of weeds in (g)/m² (pooled data of 2011 and 2012)

Tr. No.	Treatments	Concentration of extract (mg L^{-1})	dry weight of weeds (g) m-2 (total) 30 DAT	60 DAT	90 DAT	At harvest
T_1	Pretilachlor	900	22.69	42.35	4.97	3.51
T_2	Butachlor	3000	23.97	44.90	5.11	4.21
T_3	Methanol extract of *Xanthium strumarium*	1000	24.19	46.56	6.24	5.59
T_4	Methanol extract of *Xanthium strumarium*	2000	23.97	43.33	5.10	4.21
T_5	Methanol extract of *Xanthium strumarium*	3000	23.89	43.19	5.01	4.13
T_6	Petroleum ether extract of *Xanthium strumarium*	1000	24.51	45.68	6.24	3.53
T_7	Petroleum ether extract of *Xanthium strumarium*	2000	22.83	42.52	4.97	3.51
T_8	Petroleum ether extract of *Xanthium strumarium*	3000	22.42	40.21	4.09	3.24
T_9	Water extract of *Xanthium strumarium*	1000	25.17	49.86	6.44	5.71
T_{10}	Water extract of *Xanthium strumarium*	2000	24.56	47.18	6.46	5.69
T_{11}	Water extract of *Xanthium strumarium*	3000	24.19	44.64	5.13	4.22
T_{12}	Control	00	25.83	50.86	7.37	5.78
SEm ±			0.39	0.83	0.34	0.30
CD (P = 0.05)			1.29	2.41	1.01	0.91

Table 3. Effect of different treatments on N content, its uptake by grain and straw (pooled data of 2011 and 2012)

Tr. No.	Treatments	Concentration extract of (mgL^{-1})	N Content (%) Grain	Straw	N Uptake(kg ha^{-1}) Grain	Straw
T_1	Pretilachlor	900	1.20	0.73	58.54	42.86
T_2	Butachlor	3000	1.22	0.70	56.14	40.24
T_3	Methanol extract of *Xanthium strumarium*	1000	1.20	0.68	51.56	37.73
T_4	Methanol extract of *Xanthium strumarium*	2000	1.22	0.71	54.29	39.56
T_5	Methanol extract of *Xanthium strumarium*	3000	1.24	0.73	54.41	40.72
T_6	Petroleum ether extract of *Xanthium strumarium*	1000	1.21	0.74	55.17	39.81
T_7	Petroleum ether extract of *Xanthium strumarium*	2000	1.22	0.75	58.19	42.60
T_8	Petroleum ether extract of *Xanthium strumarium*	3000	1.26	0.80	59.99	45.58
T_9	Water extract of *Xanthium strumarium*	1000	1.19	0.69	51.66	37.03
T_{10}	Water extract of *Xanthium strumarium*	2000	1.20	0.70	52.33	38.76
T_{11}	Water extract of *Xanthium strumarium*	3000	1.22	0.73	52.94	39.71
T_{12}	Control	00	1.18	0.65	49.56	35.51
SEm ±		0.06	0.03	0.92	1.19	
CD (P = 0.05)			0.03	0.01	2.76	3.57

other pests occur in epidemic form. That is why weeds are called "silent –killer." The application of *Xanthium* extracts was found to exert significant control on monocot weeds. The increase in weed density was mainly due to non-synchronous behaviour of weed seed germination and their wide periodicity under field conditions. The decrease in weed density of *Echinochloa colonum* was found to be highest by 3000 mg L^{-1} followed by 2000 mg L^{-1} and next to this is by 1000 mg L^{-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). It is evident from the Table 2 that the dry weight of weeds was maximum in untreated control and minimum in petroleum ether @ 3000 mg L^{-1}. The nutrient removal is the function of weed dry matter accumulation and the treatments which produced lower weed dry matter recorded lower nutrient depletion accordingly. Similar results were reported by Ghanshyam *et al*. (2008).

Table 4. Effect of different treatments on P content and its uptake by grain and straw (pooled data of 2011 and 2012)

Tr. No.	Treatments	Concentration extract of (mgL^{-1})	P Content (%)		P Uptake(kg ha^{-1})	
			Grain	Straw	Grain	Straw
T_1	Pretilachlor	900	0.23	0.089	10.94	5.02
T_2	Butachlor	3000	0.22	0.087	10.20	4.86
T_3	Methanol extract of *Xanthium strumarium*	1000	0.18	0.083	8.95	4.47
T_4	Methanol extract of *Xanthium strumarium*	2000	0.20	0.084	9.34	4.55
T_5	Methanol extract of *Xanthium strumarium*	3000	0.22	0.085	9.81	4.68
T_6	Petroleum ether extract of *Xanthium strumarium*	1000	0.21	0.084	9.58	4.64
T_7	Petroleum ether extract of *Xanthium strumarium*	2000	0.23	0.088	10.97	4.99
T_8	Petroleum ether extract of *Xanthium strumarium*	3000	0.26	0.090	11.62	5.19
T_9	Water extract of *Xanthium strumarium*	1000	0.21	0.083	8.97	4.39
T_{10}	Water extract of *Xanthium strumarium*	2000	0.20	0.085	9.01	4.51
T_{11}	Water extract of *Xanthium strumarium*	3000	0.22	0.086	9.55	4.68
T_{12}	Control	00	0.17	0.078	8.26	4.24
SEm ±		0.06	0.001	0.24	0.30	
CD (P = 0.05)			0.012	0.003	0.72	0.87

Table 5. Effect of different treatments on K content and its uptake by grain and straw (pooled data of 2011 and 2012)

Tr. No.	Treatments	Concentration extract of (mgL^{-1})	K Content (%)		K Uptake(kg ha^{-1})	
			Grain	Straw	Grain	Straw
T_1	Pretilachlor	900	0.29	2.01	15.71	115.62
T_2	Butachlor	3000	0.31	2.00	13.92	111.80
T_3	Methanol extract of *Xanthium strumarium*	1000	0.28	1.96	12.35	105.64
T_4	Methanol extract of *Xanthium strumarium*	2000	0.30	2.01	13.35	108.94
T_5	Methanol extract of *Xanthium strumarium*	3000	0.31	2.03	14.14	111.71
T_6	Petroleum ether extract of *Xanthium strumarium*	1000	0.33	1.98	14.79	109.49
T_7	Petroleum ether extract of *Xanthium strumarium*	2000	0.32	2.03	15.49	115.30
T_8	Petroleum ether extract of *Xanthium strumarium*	3000	0.37	2.08	14.52	120.02
T_9	Water extract of *Xanthium strumarium*	1000	0.29	1.96	12.87	103.68
T_{10}	Water extract of *Xanthium strumarium*	2000	0.30	1.97	12.89	104.61
T_{11}	Water extract of *Xanthium strumarium*	3000	0.31	1.99	13.02	108.26
T_{12}	Control	00	0.25	1.94	11.98	103.88
SEm ±		0.03	0.04	1.66	1.33	
CD (P = 0.05)			0.06	0.09	3.44	2.75

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:

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

REFERENCES

1. Gautam, K.C.,Mishra, J.S. Problem, Prospects and new approaches in weed management. *Pest Information.*, 2005; **21**: 7-19.
2. Kovacs, A., Vasas, P., Forgo, B., Rethy, I., Zupko, J., Hohmann, J.,. Xanthanolides with antitumouractivity from Xanthium italicum. *Zeitschrift fur Naturforschung C*, 2009; **64**: 343–349.
3. Malik, R.S., Yadav, S.K., Malik, R.K., Panwar, R.S. Effects of herbicides and fertilizer levels on weed control and nutrient uptake by wheat and associated weeds. *Ind J Weed Sci.,* 1995; **27**: 164-166.
4. Upadhyay, R.K., Sen, A., Raha, P. Kaushal, R.P. Herbicidal effect of *Xanthium strumarium* extract on *Parthenium hysterophorus*. *Crop Research*, 2006; **32** (3): 349-351.
5. Karadjova, O., Velcheva, N., Atanassov, N., Velichkova, M., Tsankova, E., Trendafilova, A. Insecticidal and acaricidal activity of some chloroform extracts from Asteraceae plants in laboratory conditions. *Rasteniev Dni-Nauki*. 2000; **37**(6): 393-399.
6. Shranappa, Munegowda, M.K., Maharudrappa, K. Efficacy of herbicides on weed management in drill sown rice (*Oryza Sativa*). *Mysore Journal of Agricultural Sciences*., 1994; **28**(1): 8-13.
7. Ghanshyam, P. Gupta, S. Effect of seed rate, spacing and herbicide use on weed management in direct seeded upland rice (*Oryza sativa*). *Indian Journal of Weed Science*., 2008; **40**(1&2):11-15.

Books:

1. Singh, Y., Singh, V.P., Singh J. Field Crops Research, 2011; **121**: 1, 64-74.
2. Gomez, K.A. Gomez, A.A. Statistical Procedure for agricultural research. John Willey and Sons, New York. 2nd ed. 1984; pp 68.