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Research Article

EFFECTS OF WEED MANAGEMENT ON WEED SEED BANK IN ANAEROBIC CROP ECOSYSTEM IN ALLUVIAL SOIL

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Abstract: A replicated field experiment was conducted in BCKV university instructional farm to quantify the weed management effect on vertical distribution of weedseed bank in aerobic crop ecosystem in the year 2012-13 and 2013-14. The experiment was framed with five weed management treatments in *boro* and *kharif* season. The number of total wed seed bank was highly influenced by weed management treatments. With the beginning of the experiment, around 141.05 numbers of weed seed were present in 0-10 cm soil depth and 56.40 numbers of weed seed in 10-20 cm soil depth. At the end of the experiment, the number of weed seeds was maximum in the control plots as compare to the initial count. The hand weeding treatments recorded minimum numbers of weed seeds of 61.00 and 22.50 in 0 – 10 and 10 – 20 cm soil depth. And the weed seed bank was enriched in *boro* season as compared to the *kharif* season.

Keywords: Weed seedbank, Paddy, Weed management

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Introduction

Weed seedbank is the storage of weed seeds in the soil, which emerge in different flushes to compete with the crops [1]. The seedbank is regarded to as the "dispersal intime" because it provides the same essential benefits to the species as dispersal through space. The weed seed bank is known as the memory of the land, since its species abundance and diversity reflect the previous cropping history [2]. It is the potential key to future weed problem because many weed species can retain their viability and survive in soil for long periods. Among the factors responsible for low crop production, weeds are considered as the major limiting factors [3]. Many weeds grow in the rice field and their distribution is determined by climate, soils and management practices. Weeds compete with rice crops for nutrients, water, light and space. This hampers the crop growth resulting low yield. Weed flora under transplanted condition is very much diverse and consists of grasses, sedges and broad-leaved weeds causing yield reduction of rice crop up to 76 % [4]. Crop yield losses due to weeds mainly depend upon their intensity as well as on type of weed flora. There is a linear correlation between yield loss and population of weeds [5]. Many weed species that occur in rice fields can produce a huge number of small seeds and vegetative propagules as a strategy to survive stresses imposed by control methods [6,7]. After dispersal, seeds may remain on the soil surface or be buried by means of biotic and abiotic agents thus forming a seedbank which becomes the main source of weeds in rice cropping fields. The weed seedbank in the soil is a dynamic system with inputs and outputs. The inputs occur via seed rain as a result of efficient dispersion mechanisms and the outputs by means of germination, predation [8] and decay or seed death [9]. Research on identification and quantification of weed species germinated in the soil seedbank from rice fields were carried out by numerous authors [10,11]. However, due to its ecological and economic importance, the status of the weed seedbank in rice cropping fields needs to be further investigated. Studies on weed seedbank ecology are crucial for improving weed control practices in rice fields. The objective of determining the total number of weed seeds reserve in the soil weed seed bank in rice.

Materials and Methods

The field experiment was conducted in humid subtropics of West Bengal at the Instructional Farm of Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, during *boro* and *kharif* season of 2012-13 and 2013-14. The experimental site is situated at 22.93°N latitude, 88.53°E longitude and at an altitude of 9.75 m above the mean sea level. The experiment was laid out in randomized block design with 5 treatments and 4 replications in the cropping sequence, paddy – paddy. The treatments were as follows- W1: Control, W2: Twice hand weeding at 20 and 40 DAT, W3:Wheel hoeing at 20 and 40 DAT, W4:Pretilachlor 30.7 EC @ 500 g a.i. ha^{-1} at 2 DATfbMW at 40 DAT, W5: Cucumber aqueous extract @ 10 % at 1 DAT fbMW at 40 DAT. Each plot was subjected to the same management regime throughout the year course of the experiments. Fertilizer was applied based on University recommendations, with the same rates applied to all treatments within an experiment. Crops were harvested at maturity. To determine seed bank composition, soil was sampled initial and at harvest. Sampling sites were randomly located within rows. Three cores were collected from each plot at one time sampling. Soil cores (3.5 cm diam.) were divided into 0– 10 cm (D1) and 10 – 20 cm (D2) depths and stored in polyethylene bags at 0°C to prevent germination of seeds before extraction. Air-dry soil was sieved through a 2 mm screen to break up clods and remove large particles of plant residue before seeds were extracted. On an average 100 g soil were extracted individually using the flotation method. After extraction, seeds were air-dried for 12 hours and then placed in envelopes. Later, viable seeds were counted with the aid of a dissecting microscope. Seed counts were expressed as numbers of seeds per mass of soil. The data were subjected to statistical analysis following analysis of variance method. The correlation studies were made to reveal the association among the variables in the investigation [12]. As the error mean squares of the individual experiments were homogenous, combined analysis over the years were done through un-weighted analysis.

Table-1 *Effect of treatments on total weed seeds density (number 100 g soil*$^{-1}$*) at 0-10 cm and 10-20 cm soil depth in anaerobic crop ecosystem (1*st *year)*

Treatment	*Boro* Paddy (1st year)						*Kharif* Paddy (1st year)					
	Initial			Harvest			Initial			Harvest		
	D1	D2	Mean	D1	D2	Mean	D1	D2	Mean	D1	D2	Mean
W1	142.50	55.50	99.00	157.25	63.00	110.13	162.50	64.75	113.63	181.00	73.50	127.25
W2	135.25	54.50	94.88	133.50	53.50	93.50	120.75	51.25	86.00	118.50	48.50	83.50
W3	144.50	58.00	101.25	134.00	53.75	93.88	124.75	56.50	90.63	119.50	50.00	84.75
W4	141.25	56.50	98.88	135.00	54.50	94.75	127.00	55.25	91.13	120.25	51.00	85.63
W5	141.75	57.50	99.63	134.50	54.25	94.38	122.75	54.25	88.50	118.25	49.25	83.75
Mean	141.05	56.40	98.73	138.85	55.80	97.33	131.55	56.40	93.98	131.50	54.45	92.98
Factor	D	W	D × W	D	W	D × W	D	W	D × W	D	W	D × W
SE(m)	0.696	1.1	1.556	0.664	1.051	1.486	0.835	1.32	1.867	0.632	0.999	1.412
C.D.	2.03	3.21	NS	1.938	3.065	4.334	2.435	3.851	5.446	1.842	2.913	4.12

Table-2 *Effect of treatments on total weed seeds density (number 100 g soil*$^{-1}$*) at 0-10 cm and 10-20 cm soil depth in anaerobic crop ecosystem (2*nd *year)*

Treatment	*Boro* Paddy (2nd year)						*Kharif* Paddy (2nd year)					
	Initial			Harvest			Initial			Harvest		
	D1	D2	Mean	D1	D2	Mean	D1	D2	Mean	D1	D2	Mean
W1	194.25	76.25	135.25	197.00	91.25	144.13	226.00	94.75	160.38	260.75	97.00	178.88
W2	106.00	46.75	76.38	85.50	34.25	59.88	75.75	30.00	52.88	61.00	22.50	41.75
W3	116.75	47.00	81.88	115.25	46.50	80.88	95.25	37.00	66.13	88.25	32.50	60.38
W4	114.50	47.00	80.75	105.00	42.50	73.75	91.75	36.00	63.88	80.50	29.75	55.13
W5	112.75	46.00	79.38	109.50	44.00	76.75	91.50	35.50	63.50	81.50	30.00	55.75
Mean	128.85	52.60	90.73	122.45	51.70	87.08	116.05	46.65	81.35	114.40	42.35	78.38
Factor	D	W	D × W	D	W	D × W	D	W	D × W	D	W	D × W
SE(m)	0.728	1.151	1.628	0.929	1.468	2.076	1.115	1.762	2.492	1.532	2.422	3.425
C.D.	2.124	3.358	4.75	2.709	4.283	6.057	3.252	5.141	7.271	4.468	7.065	9.992

Results and Discussions

The total number of weed seeds (Number 100 g soil^{-1}) as recorded in the 1st year is presented in the [Table-1]. The results revealed that the weed seeds at initial stage at the start of the experiment were counted from different depth of under soil surface and maximum weed seeds were present at a depth of 0-10 cm, *i.e.*, 141.05 and minimum was 56.40 in 10-20 cm soil depth. The decreasing trend in weed seeds density in the different soil depths were observed in all the treatments with the advancement of the observation periods from initial to harvest except the control plots. The data presented in [Table-1] revealed that at 0-10 cm (D1) soil depth, at initial stage of the 1st year *boro* paddy, significantly lesser weed seeds (135.25 and 54.50 per 100 g soil at D1 and D2, respectively) were obtained in W2 treatment followed by W4. While at harvest, W2 recorded significantly lesser weed seeds of 133.50 and 53.50 per 100 g soil at D1 and D2, respectively which is statistically at par with the treatment W4 (135.00 and 54.50 per 100 g soil at D1 and D2, respectively). While the highest weed seeds (mean value of 110.13 per 100 g soil) were recorded in the control plots as compared to initial count. From the 1st year data of *kharif* paddy [Table-1], it is very imperative to note that at initial count, the control plots registered the maximum weed seeds in D1 and D2 soil depths *i.e.*, 162.50 and 64.75 per 100 g soil, respectively. While in both the soil depths, treatment receiving twice hand weeding at 20 and 40 DAT (W2) recorded lowest weed seeds 120.75 and 51.25 per 100 g soil at 0-10 and 10-20 cm soil depth, which was statistically at par with the treatment W5. Similar trends were recorded at harvest also in *kharif* paddy. It is evident from the data [Table-2] that in *boro* paddy, the treatment receiving twice hand weeding at 20 and 40 DAT (W2) showed the significantly minimum weed seeds density (mean value of 76.38 and 59.88) at initial and harvest respectively; which was followed by Cucumber aqueous extract @ 10 % at 1 DAT fb mechanical weeding at 40 DAT (W5) (mean value of 79.38) at initial and 73.75 (mean value) at harvest. But the weedy check plots recorded the increase in weed seeds density in 2nd year over 1st year of study. The significant effect of different weed management practices on weed seeds density at 0-10 and 10-20 cm soil depth was found in the *kharif* paddy [Table-2]. At initial count, the treatment receiving twice hand weeding at 20 and 40 DAT (W2) recorded lowest weed seeds (75.75 and 30.00 per 100 g soil of D1 and D2 respectively) mean value of 52.88 followed by W5(mean value of 63.50). While the control plots registered the maximum weed seeds in D1 and D2 soil depths *i.e.*, 226.00 and 94.75 per 100 g soil, respectively. Whereas at harvest as compare to initial count, W2 resulted less weed seeds (mean value of 41.75) in both the depths followed by W4(mean value of 55.13). While at harvest, the control plots registered maximum value of 260.75 and 97.00 weed seeds per 100 g soil in 0-10 and 10-20 cm soil depth. Around 60% of total weed seeds is found between 0 and 10 cm soil depth, and weed seed concentration decreases logarithmically with soil depth in any cropping sequence [13, 14]. The largest numbers of weed seeds in the study were found at the 0–10 cm soil depth and lowest was found in 10–20 cm, which is a characteristic of vertical distribution of soil seed bank [15]. The position of a seed within the soil profile and in relation to other seeds in the seed bank could affect its ability to germinate and emerge. Seeds had much lower emergence from greater depths (3.6 to 7 cm) over a range of 20 species with the greatest effect on seeds of smaller weight [16].The use of herbicides can also influence the species composition of the seed bank, and may increase or decrease it, depending on the chemicals used [17] and they can also cause species shifting [18]. In general, it can be said that interaction among herbicides, land preparation and cultural practice like hand weeding, mechanical weeding have altered the size and nature of seed banks. When herbicide use was discontinued for 2 years and weeds were controlled by cultivation only, the seed bank was approximately 25 times greater than where herbicide use and cultivation were continued. This study was carried out in order to understand the weed seedbank of anaerobic crop ecosystem to improve weed management program.

Application of research: From the experiment it was found that, the density of the soil weed seedbank was approximately three times higher in the upper surface of the soil than lower surface. There was a continuous reduction in the numbers of weed seed bank where repeated weed management practices are adapted over the time. The information available from our findings may be used to predict future weed infestation and could lead to construct successful and improved weed management strategies.

Research Category: Agronomy

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Study area / Sample Collection: Instructional Farm of Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia

Cultivar / Variety / Breed name: Nil

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