ournal of crop and weed 2(1) : 15-19 (2006)

Impact of integrated weed management on soil micro-flora in sesame (*Sesamum indicum L.*)

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ABSTRACT

A field experiment carried out during summer' 2000 and 2001 at Kalyani 'C' block farm, Bidhan Chandra Krishi Viswavidyalaya, West Bengal in new alluvial soil to evaluate the impact of IWM on soil micro flora in sesame resulted higher population and vigorous growth of weeds in weedy check plots which reflected the maximum dry weight of weeds and lower yield of sesame. The dominant weed species in the experimental field were *Cynodon dactylon, Echinochloa colona, Digitaria sanguinalis, Cyperus rotundus, Digera arvens* and *Physalis minima.* Hand weeding alone or in combination with herbicide controlled the weeds successfully. Net return increased with increasing levels of irrigation due to the higher seed yield. Fluchloralin application alone as pre-emergence or in combination with hand weeding at 35 DAS resulted an initial decrease in population at 3 DAA due to toxic effect of the chemical which gradually recovered at 30 DAA. The interaction of three irrigations with weedy check recorded the maximum number of both beneficial non-symbiotic N-fixing bacteria and P-solubilising bacteria at 3 DAA than that of the other treatment combination.

Key words : Sesame, Weed, Irrigation, Yield, Micro-flora.

Sesame is the second important oilseed crop in West Bengal next to rapeseed and mustard. But the necessity of increasing the sesame production as well as productivity is urgently required. Extension of acreage is ruled out, in view of the pressure of demand; development of technology or judicious management of present inputs is the only way to cope up with this problem. Although very little special care has been taken for increasing sesame production, it has been proved that weed management and lack of irrigation cause major set back of sesame production. Sesame faces serious weed competition due to slow initial growth of crop (Guar and Tomar, 1978). Now-a-days, indiscriminate use of pesticides badly affects the environment including soil micro-flora. With this view, a field investigation was carried out to evaluate the impact of Integrated Weed Management on soil micro-flora in sesame.

MATERIALS AND METHODS

A field experiment was carried out on sesame during summer' 2000 and 2001 at Kalyani 'C' block farm, Bidhan Chandra Krishi Viswavidyalaya, West Bengal in new alluvial soil having a pH of 6.9, organic carbon 0.53%, total nitrogen 0.055% and available phosphorus and potassium of 23.17 and 135.64 kg ha^{-1}, respectively. The experiment was laid out in a split plot design with three irrigation treatments in main plots (I_1: one irrigation at flowering, I_2: two irrigations at flowering and capsule development stage, I_3: three irrigations at branching, flowering and capsule development stage) and four weed management treatments in sub plots (W_0: weedy check, W_1: two hand weedings at 15 and 35 days after sowing (DAS), W_2: fluchloralin @ 0.75 kg ha $^{-1}$at 3 DAS, W_3: fluchloralin @ 0.75 kg ha $^{-1}$at 3 DAS + hand weeding at 35 DAS). Sesame cv. *Rama* was grown with all recommended package of practices other than water and weed management. Pre-emergence application of fluchloralin was done in optimum soil moisture condition and incorporated it into the soil in inter row zone. 0.5 x 0.5 m^2 quadrate was used twice randomly in each plot to record weeds for their dry weight at 25, 50 and 75 DAS and was converted into g m^{-2}. The enumeration of microbial population was done on agar plate containing appropriate media following serial dilution technique and pour plate method (Parmer and Schmidt, 1965). Jensen's agar medium (Jensen, 1930) and Pikovskaia's agar medium were used for counting aerobic non-symbiotic nitrogen fixing bacteria and phosphate solubilising bacteria, respectively. Production economics under different treatments were calculated on the basis of current price during the period of investigation.

RESULTS AND DISCUSSION

Effect on weeds

The dominant weed species in the experimental field were *Cynodon dactylon, Echinochloa colona, Digitaria sanguinalis, Cyperus rotundus, Digera arvens* and *Physalis minima.* The higher population and vigorous growth of weeds in weedy check plots reflected the maximum dry weight of weeds. Hand weeding alone or in combination with herbicide controlled the weeds successfully (Table 1). Pre-emergence application of fluchloralin had a good control of weed flora in early stage but it failed to give satisfactory result at the later stage due to its less persistence. Singh *et al.* (2001) also opined that pre-plant incorporation of fluchloralin followed by one manual weeding at 3 weeks after sowing gave higher weed control efficiency. Integration of fluchloralin as pre-emergence application with one hand weeding at 35 DAS provided as good result as hand weeding twice. The maximum total dry weight of weeds was associated with weedy check at the highest level of irrigation closely followed by other two levels.

Yield of sesame

Hand weeding alone or in combination with herbicide showed very little crop-weed competition throughout the growth period which is very clear from the better yield values, whereas weedy check recorded the minimum (Table 1). Hand weeding and fluchloralin + hand weeding, provided 29.6% higher seed yield over weedy check and fluchloralin + hand weeding recorded 8.6% higher seed yield over fluchloralin alone due to less competition of weeds with the crop at later stage of growth. Maliwal and Rathore (1994) also obtained the highest seed yield of sesame with application of fluchloralin + one hand weeding.

Production economics

The net return increased with increasing levels of irrigation due to the higher seed yield values. Maximum net return was obtained (Rs. 6391 only) from combined weed management treatment (W_3). Instead of hand weeding treatment the fluchloralin (W_2 – H) treatment recorded Rs. 291 only less net return than H + HW. This treatment, further, recorded Rs. 361 more return than two hand weedings treatments showing its economic advantage over the traditional mechanical method (Table 1). The benefit cost ratio indicated similar trend as observed in case of net return.

Soil micro-flora

Unweeded control treatments showed gradual increase in soil micro-flora from initial to last date of observation, probably due to the some allelochemicals secretion from some weed flora present in the field (Table 2). Fluchloralin application alone or in combination with hand weeding at 35 DAS there was an initial decrease in population at 3 DAA due to toxic effect of the chemical but this gradually recovered at 30 DAA. Both the beneficial non-symbiotic N-fixing bacteria and P-solubilising bacteria recorded more population, providing the less harmful effect of this chemical in soil. The interaction of three irrigations with weedy check recorded the maximum number of both beneficial non-symbiotic N-fixing bacteria and P-solubilising bacteria at 3 DAA than that of the others due to the reason that no toxic chemicals along with sufficient moisture levels helped to increase both the micro-flora population in comparison to other treatment combinations (Table 3).

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Table 1 Effect of levels of irrigation and weed management treatments on weed dry weight and yield of sesame

Treatment	Dry weight of weeds (g m^{-2})									Seed yield (kg ha^{-1})			Net Return (Rs. ha^{-1})			B : C ratio		
	25 DAS			50 DAS			75 DAS											
	2000	2001	Pooled	2000	2001	Pooled	2000	2001	Pooled	2000	2001	Pooled	2000	2001	Mean	2000	2001	Mean
I_1	2.32	2.64	2.48	6.38	6.26	6.32	9.37	9.41	9.39	642	619	630	4702	4604	4653	0.70	0.68	0.69
I_2	2.41	2.79	2.60	6.83	6.47	6.65	9.85	10.17	10.01	670	689	680	5259	5647	5453	0.76	0.82	0.79
I_3	3.86	3.42	3.64	9.52	8.42	8.97	12.15	14.07	13.11	732	747	740	6117	6437	6277	0.87	0.91	0.89
S. Em (±)	0.35	0.20	0.30	0.62	0.72	0.67	0.52	0.68	0.89	9	10	10						
C.D. (P=0.05)	1.37	0.78	0.89	2.43	2.83	1.99	2.04	2.69	2.64	30	43	40						
W_0	9.07	9.65	9.36	24.98	22.70	23.84	29.52	32.34	30.93	530	550	540	3522	3702	3612	0.59	0.61	0.60
W_1	0.27	0.29	0.28	0.50	0.38	0.44	3.13	3.19	3.16	755	764	760	5616	5862	5739	0.71	0.75	0.73
W_2	1.06	0.90	0.98	4.42	4.72	4.57	6.19	6.43	6.31	679	722	700	6102	6098	6100	0.96	0.96	0.96
W_3	1.07	0.97	1.02	0.42	0.42	0.42	3.00	2.92	2.96	763	756	760	6316	6466	6391	0.86	0.88	0.87
S. Em (±)	0.21	0.28	0.24	1.11	1.75	1.35	0.98	1.18	1.01	51	40	40						
C.D. (P=0.05)	0.65	0.86	0.68	3.42	5.39	3.82	3.02	3.64	2.86	150	112	130						

Table 2 Effect of levels of irrigation and weed management treatments on the population of beneficial micro-flora

Treatment	Non-symbiotic N-fixing bacteria (CFU x 10^4 g of dry soil)						P-solubilising bacteria (CFU x 10^5 g of dry soil)					
	2000			2001			2000			2001		
	Initial	3 DAA	30 DAA	Initial	3 DAA	30 DAA	Initial	3 DAA	30 DAA	Initial	3 DAA	30 DAA
Irrigation												
I_1	39.15	26.18	45.98	25.73	25.83	48.03	11.78	14.25	20.95	17.45	22.90	25.60
I_2	37.38	23.90	44.30	28.78	30.48	50.03	14.65	15.23	22.30	15.30	19.33	27.08
I_3	37.78	20.13	73.85	27.83	28.58	74.55	9.25	16.35	51.70	20.85	25.35	56.05
S Em (±)	0.69	1.22	3.99	1.03	0.89	2.11	0.25	0.15	1.07	0.88	1.07	1.13
C.D. (P=0.05)	NS	NS	15.66	NS	3.49	8.28	0.98	0.59	4.20	3.45	4.20	4.43
Weed management												
W_0 – WC	38.60	34.87	74.40	30.07	47.00	67.87	11.87	23.30	39.07	18.43	32.37	46.93
W_1 – HW	36.80	32.23	56.30	24.87	40.87	60.00	10.67	19.93	33.53	18.27	30.97	40.07
W_2 – H	38.27	12.90	44.93	23.87	12.30	52.53	11.00	9.13	27.47	17.07	15.17	29.00
W_3 – H + HW	38.73	13.60	43.20	30.97	13.00	49.73	14.03	8.73	26.53	17.70	11.60	28.97
S Em (±)	1.29	1.22	1.02	1.26	1.10	1.22	0.59	0.58	1.05	1.02	1.09	1.42
C.D. (P=0.05)	NS	3.62	3.03	3.74	3.27	3.62	1.75	1.72	3.12	NS	3.24	4.22

Table 3 Interaction effect of levels of irrigation and weed management treatments on the population of beneficial micro-flora

Treatment	Non-symbiotic N-fixing bacteria (CFU x 10^4 g of dry soil)						P-solubilising bacteria (CFU x 10^5 g of dry soil)					
	2000			2001			2000			2001		
	Initial	3 DAA	30 DAA	Initial	3 DAA	30 DAA	Initial	3 DAA	30 DAA	Initial	3 DAA	30 DAA
I_1 WC	36.30	35.00	64.50	25.70	42.20	57.20	11.80	23.00	26.60	17.90	31.80	33.90
HW	36.00	32.50	46.40	25.60	34.70	48.70	10.60	19.40	21.10	18.00	30.20	27.60
H	39.70	18.20	42.00	23.40	9.80	41.50	11.00	6.70	17.90	15.20	16.10	20.20
H + HW	44.60	19.00	31.00	28.20	16.60	44.70	13.70	7.90	1.8.20	18.70	13.50	20.70
I_2 WC	38.60	38.30	62.20	29.20	51.50	59.70	14.90	21.90	28.00	15.90	27.50	37.50
HW	36.20	35.00	45.90	26.40	47.80	51.60	13.50	19.40	25.70	16.10	26.00	31.10
H	37.30	11.30	37.90	26.90	10.70	46.60	13.60	10.60	19.10	15.30	13.60	19.20
H + HW	37.40	11.00	31.20	32.60	11.90	42.20	16.60	9.00	16.40	13.90	10.20	20.50
I_3 WC	40.90	31.30	96.50	35.30	47.30	86.70	8.90	25.00	62.60	21.50	37.80	69.40
HW	38.20	29.20	76.60	22.60	40.10	89.70	7.90	21.00	53.80	20.70	36.70	61.50
H	37.80	9.20	54.90	21.30	16.40	59.50	8.40	10.10	45.40	20.70	15.80	47.60
H + HW	34.20	10.80	67.40	32.10	10.50	62.30	11.80	9.30	45.00	20.50	11.10	45.70
S Em (±)	2.24	2.11	1.77	2.18	1.90	2.11	1.02	1.01	1.81	1.77	1.89	2.46
C.D. (P=0.05)	NS	NS	5.26	NS	5.64	NS	NS	NS	NS	NS	NS	NS