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EFFECT OF DIFFERENT WEED MANAGEMENT PRACTICES ON SOIL BACTERIAL POPULATION UNDER DIFFERENT CROPS

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ABSTRACT

Field experiment was conducted at BCKV, West Bengal to study the effect of nine weed management practices on soil bacterial population in different crops (Sesame, Green gram and Black gram). The study revealed that at 7 DAS, the population of all the soil bacteria were found to reduce from their initial population in all the crops but were found to increase from 15 DAS till 30 DAS where the highest population of all the bacteria was found in black gram crop recording 33.37 CFU $\times 10^4$ g^{-1} of soil in aerobic non-symbiotic nitrogen fixing bacteria, 26.87 CFU $\times 10^4$ g^{-1} of soil in phosphate solubilising bacteria and 72.69 CFU $\times 10^4$ g^{-1} of soil in total bacteria. Among the weed management practices the population of soil bacteria were found to be lowest under chemical herbicide treatment W_8-Quizalofop-p-ethyl @50g a.i ha^{-1} which recorded 13.50 CFU $\times 10^4$ g^{-1} of soil, 6.67 CFU $\times 10^4$ g^{-1} of soil and 31.94 CFU $\times 10^4$ g^{-1} of soil in aerobic non-symbiotic nitrogen fixing bacteria, phosphate solubilising bacteria and total bacteria respectively while hand weeding recorded maximum population at the final stage of observation with 42.50 CFU $\times 10^4$ g^{-1} of soil, 39.50 CFU $\times 10^4$ g^{-1} of soil and 99.00 CFU $\times 10^4$ g^{-1} of soil in aerobic non-symbiotic nitrogen fixing bacteria, phosphate solubilising bacteria and total bacteria respectively. Among the plant extracts (bio-herbicides), *Ageratum conyzoides* extract resulted in maximum population of different soil bacteria. It can, thus, be concluded that the conventional method of hand weeding results in multiplication of useful soil bacteria without hampering the population at all the stages of crop growth. In order to check the declining population under chemical herbicidal treatments, the use of such chemicals at lower doses accompanied by incorporation of hand weeding is to be recommended.

INTRODUCTION

The soil micro-organisms play important role in the soil environment where they act as important regulators of plant productivity, especially in nutrient-poor ecosystems where plant symbionts are responsible for the acquisition of limiting nutrients. Mycorrhizal fungi and nitrogen-fixing bacteria are responsible for an average of between 5-20%, and up to 80% of all nitrogen and up to 75% of phosphorus, that is acquired by plants annually. They also strongly regulate plant productivity, through the mineralization of and competition for, nutrients that sustain plant productivity. However, the environment which they survive and performs enormous role is the only major environmental platform that is subjected to final deposition of all the pesticides including the most widely used pesticides of the world i.e. herbicides. The immediate concern with the use of herbicides has been the minimizing as well as eliminating weed. However, if we take a longer range perspective, their effect on the balance of soil bacterial population which plays an important role in the soil ecosystem where they fulfil a crucial role in nutrient cycling and decomposition (De-Lorenzo *et al.*, 2001) has also to be considered. It is obvious that when herbicides are applied, the possibilities exist that these chemicals may exert certain effects on these micro organisms, (Wardle and Parkinson, 1990; Simon-Sylvestre and Fournier, 1979) and among the different soil micro-organisms the most sensitive microorganisms to herbicides seems to be bacteria including cellulolytic bacteria (Ghinea *et al.*,1998).

On the other hand, the management of weeds has been practiced in different ways apart from use of herbicides alone, such as the conventional practice of hand weeding and in the current trend, with the concept of sustainability of crop production, new technologies of weed management using plant extract has been given emphasis and practiced due to their eco friendliness. Natural compounds from plants can provide potentiality for new herbicidal solutions, or lead compounds for new herbicides (Duke *et al.*, 2000; Viviane 2002).

The present study was, thus, taken up keeping in view the possible effect of these different weed management practices on the potential soil micro-organisms especially soil bacteria in different crops of sesame, green gram and black gram and also the compare the degree of inhibition /activation of such micro organisms by the different methods. The study also aims to study the inter-relation of weed control by different management practices with the soil bacterial population.

MATERIALS AND METHODS

Field experiment was conducted at the Instructional Farm, Jaguli, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur and West Bengal during pre-kharif season of 2010 and 2011. The experiment was conducted in split plot design replicated thrice, keeping the crops (C) under the main plot treatment, C_1: Sesame, C_2: Green gram, C_3: Black gram and nine weed management treatments (W) allocated in the sub-plot

treatments. W_1: Untreated control, W_2: Hand Weeding at 20 DAS, W_3: 5% (w/v) *Ageratum conyzoides* aqueous extract, W_4: 5 % (w/v) *Blumea lacera* aqueous extract, W_5: 5% (w/v) *Ocimum sanctum* aqueous extract, W_6: 5 % (w/v) *Physalis minima* aqueous extract, W_7: 5% (w/v) *Amaranthus tricolor* aqueous extract, W_8: Quizalofop-p-ethyl 5 EC @ 50g a.i. ha^{-1} at 20 DAS, W_9: Fenoxaprop-p-ethyl 9 EC @ 30 g a.i. ha^{-1} at 20 DAS. All the botanical extract treatments were applied as pre-emergence at 1 DAS and added with surfactant Tween 80 @ 0.25%. Each aqueous extracts were prepared by soaking the dried powder leaves in distilled water in the ratio 1:20 (w/v) for 24 hours as a technique followed by Cheema and Khaliq (2000). Soil samples were collected from the rhizosphere of the crops from a depth of 0-3 cm (Saeki and Toyota, 2004) before spraying as initial and at 7, 15, 30 DAS.

The enumeration of microbial population was conducted following serial dilution technique and pour plate method (Pramer and Schmidt, 1965). Jensen's agar medium (Jensen, 1930) was used for counting aerobic non-symbiotic nitrogen fixing bacteria. Total numbers of phosphate solubilising micro organisms were estimated in Pikovskaia's agar medium (Pikovskaia, 1949). For counting total number of viable bacteria, Thornton's agar medium (Thorton, 1922) was used. All the data obtained from the above experiments were subjected to statistical analyses as per the method detailed by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

The population of aerobic non-symbiotic nitrogen fixing bacteria under different crops showed no significant difference at initial and at 7DAS while it showed significant difference from 15 DAS. The population of phosphate solubilising bacteria and total bacteria showed significant difference only at 30 DAS and were not significant from initial till 15 DAS. It can be noted that the population of soil micro- organisms (bacteria) increased with the advancement of crop growth stage. The soil micro flora population under different crops were found to decrease from the initial population at the early stage of observation *i.e.*, at 7 DAS. The probable reason might be due to the derivation of available nutrients for the emergence of the crop seedlings as well as establishment of weeds. However, after the establishment of crops, the population of micro-flora becomes stable and started to increase with time.

The highest population of aerobic non-symbiotic nitrogen fixing bacteria, phosphate solubilising bacteria and total bacteria were found to be highest under black gram crop recording 33.37 CFU $\times$ 10^4 g^{-1} , 26.87 CFU $\times 10^4$ g^{-1} and 72.69 CFU $\times$ 10^4 g^{-1} of soil respectively at 30 DAS which was followed by green gram and sesame. This result may be related to the higher weed control efficiency under black gram crop (36.22%) compared to the lower weed control efficiency of green gram (32.36%) and sesame (27.72%) which is shown in Table 4 that has resulted to more conservation of nutrients for the growth and multiplication of the soil bacterial population while the higher weed density in sesame might have resulted in more competition of nutrients between weeds and soil micro-organisms. The population of aerobic non-symbiotic nitrogen fixing bacteria, phosphate solubilising bacteria and total bacteria was respectively 24.18%, 19.58% and 9.89 % higher than under sesame crop indicating better response of aerobic non-symbiotic nitrogen fixing bacteria under black gram crop. The higher weed population in sesame compared to black gram and green gram is due to the non-smothering nature of the crop resulting in higher weed density while the crop stature of both the pulse crops from 15 DAS helps in the smothering of the weeds thus resulting in lower weed density. Ghosh *et al*. (2007) also expressed similar opinions. Among the two legume crops, dry weights of the categories of weeds were found to be lower in black gram than green gram. The reason might be due to more branched stature of this crop compared to green gram resulting in denser canopy which resulted in higher suppression of weeds. Ali (1988) also expressed the weed smothering potential of black

Table 1: Effect of treatments on population of aerobic non-symbiotic nitrogen fixing bacteria (CFU $\times$ 10^4 g^{-1} of soil)

Treatment	Initial			7 DAS			15 DAS			30 DAS		
	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled
Crops (C)												
C_1	15.07	14.96	15.02	13.67	13.52	13.59	15.11	15.52	15.31	21.85	28.74	25.30
C_2	15.52	15.93	15.72	12.33	14.48	13.41	17.07	18.56	17.81	31.67	33.41	32.54
C_3	15.26	14.33	14.80	14.15	14.67	14.41	17.33	18.26	17.80	32.56	34.19	33.37
S.EM(±)	0.410	0.389	0.283	0.527	0.316	0.307	0.453	0.183	0.244	0.333	0.303	0.225
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	1.777	0.720	0.796	1.307	1.190	0.734
Weed management (W)												
W_1	15.78	15.78	15.78	16.56	18.00	17.28	18.00	19.89	18.94	22.33	24.44	23.39
W_2	15.33	15.00	15.17	16.11	16.78	16.44	16.33	19.22	17.78	40.33	44.67	42.50
W_3	14.67	14.33	14.50	11.56	12.22	11.89	16.56	16.44	16.50	37.33	41.67	39.50
W_4	15.00	15.00	15.00	11.11	11.78	11.44	15.78	15.56	15.67	34.11	39.00	36.56
W_5	15.33	15.11	15.22	12.56	13.00	12.78	17.22	17.22	17.22	36.22	41.22	38.72
W_6	15.56	15.44	15.50	10.56	11.11	10.83	15.11	15.33	15.22	32.11	35.33	33.72
W_7	15.56	15.22	15.39	9.89	10.33	10.11	13.67	14.00	13.83	29.89	31.00	30.44
W_8	15.44	15.11	15.28	16.22	17.33	16.78	17.56	19.22	18.39	12.33	14.67	13.50
W_9	14.89	14.67	14.78	15.89	17.44	16.67	18.33	20.11	19.22	13.56	17.00	15.28
S.EM(±)	0.594	0.562	0.409	0.471	0.587	0.376	0.736	0.561	0.463	0.651	0.444	0.394
LSD (P=0.05)	NS	NS	NS	1.340	1.670	1.057	2.092	1.596	1.299	1.852	1.264	1.107

C_1: Sesame, C_2: Green gram, C_3: Black gram, W_1: Untreated control, W_2: Hand weeding at 20 DAS; W_3: 5% (w/v) *Ageratum conyzoides* aqueous extract, W_4: 5% (w/v) *Blumea lacera* aqueous extract; W_5: 5% (w/v) *Ocimum sanctum* aqueous extract, W_6: 5% (w/v) *Physalis minima* aqueous extract; W_7: 5% (w/v) *Amaranthus tricolor* aqueous extract; W_8: Quizalofop-p-ethyl @50g a.i ha^{-1}, W_9: Fenoxaprop-p-ethyl @ 30g a.i. ha^{-1}; NS: Non-significant

Table 2: Effect of treatments on population of phosphate solubilising bacteria (CFU × 10^4 g^{-1} of soil)

Treatment	Initial			7 DAS			15 DAS			30 DAS		
	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled
Crops (C)												
C_1	14.04	12.63	13.33	11.81	10.78	11.30	16.22	14.59	15.41	23.11	20.11	21.61
C_2	14.85	13.41	14.13	13.37	12.37	12.87	16.44	14.56	15.50	27.37	23.44	25.41
C_3	13.26	13.37	13.31	12.48	13.89	13.19	16.63	15.70	16.17	28.52	25.22	26.87
S.EM(±)	0.389	0.387	0.274	0.623	0.786	0.501	0.557	0.272	0.310	0.335	0.191	0.193
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.317	0.749	0.629
Weed management (W)												
W_1	13.44	13.33	13.39	17.00	15.89	16.44	17.67	18.44	18.06	22.67	20.00	21.33
W_2	14.00	13.11	13.56	16.33	15.00	15.67	18.89	17.78	18.33	41.22	37.78	39.50
W_3	13.56	12.56	13.06	10.22	10.67	10.44	16.22	14.00	15.11	37.56	32.33	34.94
W_4	13.56	13.11	13.33	9.78	10.11	9.94	15.11	13.44	14.28	30.00	26.00	28.00
W_5	14.22	12.78	13.50	10.89	11.56	11.22	17.44	14.89	16.17	31.89	28.00	29.94
W_6	14.89	13.11	14.00	9.56	9.44	9.50	14.56	13.11	13.83	28.22	25.56	26.89
W_7	14.11	13.33	13.72	8.44	9.11	8.78	14.11	12.44	13.28	27.00	24.33	25.67
W_8	14.44	13.00	13.72	15.00	13.78	14.39	16.22	14.22	15.22	8.44	4.89	6.67
W_9	14.22	13.89	14.06	15.78	15.56	15.67	17.67	16.22	16.94	10.00	7.44	8.72
S.EM(±)	0.421	0.386	0.286	0.466	0.370	0.298	0.414	0.522	0.333	0.601	0.348	0.347
LSD (P=0.05)	NS	NS	NS	1.326	1.051	0.835	1.178	1.484	0.935	1.710	0.989	0.975

C_1: Sesame, C_2: Green gram, C_3: Black gram, W_1: Untreated control, W_2: Hand weeding at 20 DAS; W_3: 5% (w/v) *Ageratum conyzoides* aqueous extract, W_4: 5% (w/v) *Blumea lacera* aqueous extract; W_5: 5% (w/v) *Ocimum sanctum* aqueous extract, W_6: 5% (w/v) *Physalis minima* aqueous extract; W_7: 5% (w/v) *Amaranthus tricolor* aqueous extract; W_8: Quizalofop-p-ethyl @50g a.i ha^{-1}, W_9: Fenoxaprop-p-ethyl @ 30g a.i. ha^{-1}; NS: Non-significant

Table 3: Effect of treatments on population of total bacteria (CFU × 10^4 g^{-1} of soil)

Treatment	Initial			7 DAS			15 DAS			30 DAS		
	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled
Crops (C)												
C_1	39.04	40.37	39.70	35.63	39.00	37.31	38.37	42.44	40.41	62.85	68.15	65.50
C_2	39.07	40.41	39.74	34.89	39.78	37.33	38.93	44.19	41.56	70.48	72.22	71.35
C_3	39.78	39.30	39.54	36.30	39.52	37.91	39.48	44.59	42.04	71.22	74.15	72.69
S.EM(±)	0.319	0.416	0.262	0.874	0.154	0.444	0.244	0.777	0.407	1.458	0.399	0.756
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	5.725	1.565	2.465
Weed management (W)												
W_1	40.22	40.33	40.28	40.56	44.11	42.33	42.44	48.22	45.33	65.00	74.11	69.56
W_2	39.33	39.33	39.33	40.22	42.33	41.28	41.67	47.11	44.39	97.56	100.44	99.00
W_3	38.89	39.44	39.17	31.11	36.00	33.56	41.67	44.33	43.00	82.44	88.33	85.39
W_4	38.44	39.56	39.00	31.78	35.78	33.78	36.67	39.11	37.89	77.00	79.00	78.00
W_5	39.67	40.11	39.89	32.11	36.22	34.17	39.00	41.33	40.17	82.44	82.56	82.50
W_6	39.78	40.89	40.33	32.33	35.67	34.00	34.89	38.89	36.89	74.89	76.67	75.78
W_7	40.22	40.00	40.11	33.78	35.89	34.83	32.89	38.22	35.56	71.22	73.00	72.11
W_8	37.78	40.56	39.17	38.78	44.22	41.50	40.44	47.33	43.89	30.56	33.33	31.94
W_9	39.33	40.00	39.67	39.78	44.67	42.22	40.67	49.11	44.89	32.56	36.11	34.33
S.EM(±)	0.505	0.524	0.364	0.786	0.607	0.497	0.979	0.691	0.599	1.284	0.991	0.811
LSD (P=0.05)	NS	NS	NS	2.236	1.725	1.394	2.784	1.964	1.682	3.651	2.817	2.276

C_1: Sesame, C_2: Green gram, C_3: Black gram, W_1: Untreated control, W_2: Hand weeding at 20 DAS; W_3: 5% (w/v) *Ageratum conyzoides* aqueous extract, W_4: 5% (w/v) *Blumea lacera* aqueous extract; W_5: 5% (w/v) *Ocimum sanctum* aqueous extract, W_6: 5% (w/v) *Physalis minima* aqueous extract; W_7: 5% (w/v) *Amaranthus tricolor* aqueous extract; W_8: Quizalofop-p-ethyl @50g a.i ha^{-1}, W_9: Fenoxaprop-p-ethyl @ 30g a.i. ha^{-1}; NS: Non-significant

gram where the crop has been reported to smother weed flora appreciably by 20-45% when intercropped with cereals and consequently minimizing weed control cost.

The weed management treatments had significant effects on the population of aerobic non-symbiotic nitrogen fixing bacteria, phosphate solubilising bacteria and total bacteria at all the dates of observations except at initial since no treatments were given at this stage and the population of these micro-organisms remained more or less equal in the field. However, from 7 DAS, due the application of treatments in some plots, the effect showed significant difference in the bacterial population. At this stage, plant extract treatments (W_3 to W_7) recorded lower population compared to the initial population which might be due to the inhibition or suppression of micro flora by the allelochemicals present in the botanical plant extracts. Bowers *et al*. (1976) reported that procene I and procene II are the major constituents of leaves and flower of *Ageratum conyzoides* that possess biological activities which were found to be responsible for growth suppression of weeds. Silva *et al*. (1999) reported that *Ocimum sanctum* contains a strong-scented volatile oil composed primarily of terpenoids particularly eugenol, thymol, and estragole, which are responsible for allelopathic potential, though the exact components vary widely. Rashmi *et al*. (1995) reported the presence of two new glycosides, the triterpenoid glycoside (19 alpha -hydroxy-12-ene-24,28-dioate 3-O- beta -D-xylopyranoside) and the phenol glycoside (2-isoprenyl-5-isopropylphenol 4-O- beta -D-xylopyranoside) in *Blumea lacera* which are found to have allelopathic potential.

Table 4: Effect of treatments on dry weight of weeds (g m^{-2}) and weed control efficiency (%) at 15 and 30 DAS (pooled)

Treatments	At 15 DAS			At 30 DAS			Weed control efficiency (%) at 30 DAS
	Grass	Sedge	Broad leaved weeds	Grass	Sedge	Broad leaved weeds	
Crops (C)							
C_1	3.74	4.54	3.51	7.01	9.24	4.00	27.72
C_2	3.63	4.58	3.60	6.33	7.84	3.39	32.36
C_3	3.52	4.47	3.53	5.70	5.70	3.31	36.22
S.EM(±)	0.078	0.050	0.034	0.094	0.284	0.030	NA
LSD (P=0.05)	NS	NS	NS	0.307	0.928	0.097	NA
Weed management treatments (W)							
W_1	4.55	5.37	5.08	8.69	12.00	5.17	-
W_2	4.37	5.37	4.92	3.63	2.54	1.71	69.73
W_3	2.88	3.33	2.14	6.62	7.40	3.38	32.59
W_4	2.95	3.48	2.29	6.99	9.14	3.60	23.29
W_5	2.73	3.58	2.26	6.18	8.22	3.98	28.67
W_6	3.13	4.04	2.37	7.31	10.04	4.41	15.14
W_7	3.21	4.20	2.45	7.89	10.58	4.70	9.44
W_8	4.33	5.73	5.23	5.14	4.58	2.67	52.14
W_9	4.50	5.65	5.18	4.67	3.82	2.47	57.87
S.EM(±)	0.093	0.073	0.043	0.210	0.318	0.120	NA
LSD (P=0.05)	0.246	0.204	0.119	0.589	0.893	0.338	NA

C_1: Sesame, C_2: Green gram, C_3: Black gram, W_1: Untreated control, W_2: Hand weeding at 20 DAS; W_3: 5% (w/v) *Ageratum conyzoides* aqueous extract, W_4: 5% (w/v) *Blumea lacera* aqueous extract; W_5: 5% (w/v) *Ocimum sanctum* aqueous extract, W_6: 5% (w/v) *Physalis minima* aqueous extract; W_7: 5% (w/v) *Amaranthus tricolor* aqueous extract; W_8: Quizalofop-p-ethyl @50g a.i ha^{-1}, W_9: Fenoxaprop-p-ethyl @ 30g a.i. ha^{-1}; NS:Non-significant, NA: Not analysed

Choudhury *et al*. (2005) reported three new physalins and a new withanolide from the whole plant of *Physalis minima*, along with three known physalins: physalin H, isophysalin B, and 5 beta, 6 beta-epoxyphysalin B. Tudor and George (1984) reported the presence of fatty acids and sterols of *Amaranthus tricolor* through gas chromatography. The action of the different allelochemicals present in the plant extracts which resulted in weed suppression might be the main reason for causing reduction of the micro-organisms. However, the population were found to increase after 7DAS till 30 DAS. This increase under botanical extract treatments might be attributed to the subsiding nature of the alleleochemicals along with the production of some energy in the breaking down process which may serve as growth promoting factor where highest value was recorded in *Ageratum conyzoides* extract treatment recording 39.50 CFU $\times$ 10^4 g^{-1}, 34.94 CFU $\times$ 10^4 g^{-1} and 85.39 CFU $\times$ 10^4 g^{-1} of soil in aerobic non-symbiotic nitrogen fixing bacteria, phosphate solubilising bacteria and total bacteria respectively.

The highest population of these bacterial populations in this treatment among the botanical plant extract treatments at the final stage of observation might also be related to the higher weed control efficiency (32.59%) resulting in higher population of aerobic non-symbiotic nitrogen fixing bacteria, phosphate solubilising bacteria and total bacteria by 40.78%, 38.95% and 18.54% respectively than the untreated control treatment.

The control treatment showed gradual increase in the population till 30 DAS, though the increment is at slow pace. At 7 DAS, the population hand weeding treatment and the two chemical herbicides showed slight increase in population compared to the initial population since there were no treatment applications till 20 DAS that the micro-flora population continued to breed in natural condition.

At 30 DAS, both the chemical herbicidal treatments (Quizalofop-p-ethyl) and (Fenoxaprop-p-ethyl) showed sudden decrease in population at 30 DAS compared to that observed at 15 DAS and even from the initial value after the application at 20 DAS. In aerobic non symbiotic nitrogen fixing bacteria, the decrease was found to be 26.59 % by W_8 treatment and 20.50 % by W_9 treatment from that observed at 15 DAS. Phosphate solubilising bacteria observed a higher percentage of reduction (56.18 %) in W_8 treatment from 15 DAS, while W_9 treatment recorded a reduction of 48.52 %. This indicates higher sensitivity of phosphate solubilising bacteria on quizalofop-p-ethyl and fenoxaprop-p-ethyl herbicide. Total bacteria population witnessed 27.23 % and 23.52 % reduction by treatments W_8 and W_9 from the population recorded in 15 DAS. The decrease in the population of micro flora might be due to the toxic effect of the applied chemical herbicides. It may be noted that the effects of herbicides on the soil micro-flora are normally most severe immediately after application, when their concentration in soil is highest which was also supported by the findings of Radivojevic *et al*. (2004). Even though the herbicidal treatments brought higher weed control efficiency, it could not increase the micro flora population due to the strong chemicals that the bacterial population decreased to a great extent. Among the two herbicides, quizalofop-p-ethyl resulted in more decrease of the bacterial population than that of fenoxaprop-p-ethyl which might be due to the more toxic effect of this herbicide or due to lesser weed control efficiency (52.14 %) as compared to fenoxaprop-p-ethyl (57.87%) resulting in more weed density and ultimately leads to competition of soil resources between weeds and micro organisms.

At 30 DAS, hand weeding treatment recorded significantly highest micro flora population which might be due to the conserved nutrients for the growth and multiplication of these

bacterial populations. Ghosh *et al*. (2003) also expressed similar views. The aerated condition due to physical modification in hand weeding also accentuated the multiplication process.

Thus, from the study it may be noted that weed management practices directly or indirectly brings in the microbial community structure. The chemical herbicidal treatment that serves a good weed management practice may on the other hand brings loss in the soil bacterial population which has immense role in maintaining soil health. Thus, the idea of using herbicides alone for weed control should be opted with incorporation of hand weeding where the dose of these herbicides can be reduced. The plant extract treatments for weed management has great potentiality as some plant extracts bring weed reduction compared to control and at the same time increases the soil bacterial population. The plant extract of *Ageratum conyzoides* showed promising result in the study.

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