Journal of Crop and Weed, 12(2):120-124(2016)

Effect of weed management practices on soil actinomycetes and fungi population under different crops

D. NONGMAITHEM AND D. PAL

Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, Nadia, West Bengal, India

Received:21-06-2016; Revised:14-08-2016; Accepted:25-08-2016

ABSTRACT

Field experiment was carried out during pre-kharif season of 2010 and 2011at the Instructional Farm, BCKV, Mohanpur, Nadia, West Bengal. The experiment was laid in split plot design replicated thrice, keeping three crops under the main plot treatment, C_1: Sesame, C_2: Green gram, C_3: Black gram and nine weed management treatments (W) 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 ha^{-1} at 20 DAS, W_9: Fenoxaprop-p-ethyl 9 EC @ 30 g ha^{-1} at 20 DAS. Results revealed that at the initial period of spraying, the aqueous plant extract treatments resulted in decline in the population of soil micro flora. However, with the advancement of time, there was increase in population in all the weed management treatments except for the chemical herbicide treatments where there was decrease in the population of both the micro flora.

Keywords: Actinomycetes, fungi, hand weeding herbicides, plant extracts

Chemical herbicides have been used as weed killers globally after its introduction. Application in larger quantities has been practiced to suppress or kill the weeds which ultimately get down in the soil. Although herbicides are intended to protect crops from weeds, they may contaminate the soil environment and affect beneficial soil microorganisms resulting in change in the equilibrium of soil system for shorter or longer periods (Cycon and Piotrowska-Seget, 2007). When the herbicides are applied, a large portion of it gets accumulated in the upper layer soil, from 0-15 cm, where the activities of micro-organisms take place (Das and Kole, 2006) and studies have shown that there can be harmful effect of herbicides on growth and activities of microorganisms in soil (Selvamani and Sankaran 1993; El-Ghamry *et al*., 2001)

The growing demand for sustainability in agricultural systems mains in optimization of agricultural resources as well as maintenance of environmental quality (FAO, 1989) and therefore, the ill effects of commercial herbicide use on environment and human health make necessary to diversify weed management options (Duke, 1986). The increasing concern about the toxicity of synthetic herbicides has paved way for searching sustainable and eco-friendly weed management practices which would reduce the harmful effect of synthetic fertilizers. In the search of sustainability, it has been found that plants provide enormous number of biologically active natural compounds and have enormous potential to inspire and influence modern agrochemical research. New herbicidal solutions, or lead compounds for new herbicides can also be extracted from natural compounds from (Duke *et al*., 2000; Vyvyan 2002). A number of classes of allelochemicals causing inhibition of germination and growth of weeds have been identified (Wu *et al*., 1999).

Hence, attempt has been made to study the effect of different plant extracts and chemical herbicides along with conventional practice of hand-weeding on the soil micro flora under different crops.

MATERIALS AND METHODS

Field experiment was carried out during *pre-kharif* season of 2010 and 2011at the Instructional Farm, BCKV, Mohanpur, Nadia, West Bengal. The experiment was laid out 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 per cent (w/v) *Ageratum conyzoides* aqueous extract, W_4: 5 per cent (w/v) *Blumea lacera* aqueous extract, W_5: 5 per cent (w/v) *Ocimum sanctum* aqueous extract, W_6: 5 per cent (w/v) *Physalis minima* aqueous extract, W_7: 5 per cent (w/v) *Amaranthus tricolor* aqueous extract, W_8: Quizalofop-p-ethyl 5 EC @ 50g ha^{-1} at 20 DAS, W_9: Fenoxaprop-p-ethyl 9 EC @ 30 g ha^{-1} at 20 DAS. All the botanical extracts were added with surfactant Tween 80 @ 0.25 per cent and

E-mail: debikanong@gmail.com

applied a day after sowing. The varieties of crops used were: Sesame- Rama (Improved Selection-5), Green gram- Bireswar (WBM – 34-1-1) and Black gram- Sarada (WBU-108). A spacing of 30×10 cm from row to row and plant to plant respectively for all the crops was maintained. The recommended dose of fertilizer for each of the crop in the experiment was applied. The respective dose of each of the crop is given as

Sesame - 30:60:30 kg ha^{-1} N, P_2O_5 and K_2O respectively

Green gram - 20:40:40 kg ha^{-1} N, P_2O_5 and K_2O respectively

Black gram -20:40:40 kg ha^{-1} N, P_2O_5 and K_2O respectively.

Method of botanical plant extraction

Aqueous extracts were prepared by following the procedure of Cheema and Khaliq (2000). Leaves of plants were collected from BCKV campus. After collection, leaves were dried in shade at room temperature for a week and later dried at 40^0C in oven for 48 hours and grounded to powder. The dried powder material was soaked in water in the ratio 1:20 (w/v) for 24 hours and then the water extracts were collected by running through sieves. The filtrates were boiled at 100^0C for reducing the volume (3 litres). The final extract was left to stand at 4^0C for 30 minutes and then filtered.

Collection of soil sample

Soil samples were collected from the upper layer (0-3 cm) (Saeki and Toyota, 2004) at different dates, before spraying as initial, 7, 15 and 30 DAS. The samples were then properly tagged, sealed.

Table 1: Effect of treatments on population of fungi (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	54.04	53.70	53.87	39.70	40.44	40.07	49.52	48.96	49.24	68.07	64.56	66.31
C_2	53.41	54.07	53.74	45.89	45.26	45.57	56.89	52.44	54.67	75.30	70.00	72.65
C_3	54.30	51.85	53.07	48.67	44.30	46.48	59.52	53.41	56.46	76.81	69.11	72.96
SEm(±)	**0.357**	**0.728**	**0.405**	**1.000**	**0.603**	**0.584**	**0.603**	**0.341**	**0.347**	**1.724**	**1.020**	**1.002**
LSD (0.05)	**NS**	**NS**	**NS**	**3.925**	**2.367**	**1.903**	**2.369**	**1.339**	**1.130**	**6.769**	**4.006**	**3.267**
Weed management (W)												
W_1	54.56	52.67	53.61	56.00	53.00	54.50	58.78	55.78	57.28	63.56	58.89	61.22
W_2	52.89	51.22	52.06	55.11	51.44	53.28	57.78	54.00	55.89	96.11	91.56	93.83
W_3	53.78	53.00	53.39	38.33	37.78	38.06	54.78	49.89	52.33	92.67	88.22	90.44
W_4	52.89	53.56	53.22	36.44	35.22	35.83	53.11	49.00	51.06	85.56	80.11	82.83
W_5	54.22	54.67	54.44	39.22	36.89	38.06	56.11	51.11	53.61	88.56	84.00	86.28
W_6	54.56	53.33	53.94	34.78	34.67	34.72	52.44	47.22	49.83	82.78	75.67	79.22
W_7	54.11	53.56	53.83	32.33	31.22	31.78	50.56	45.33	47.94	78.44	71.11	74.78
W_8	53.89	53.67	53.78	54.33	54.78	54.56	55.56	55.11	55.33	35.00	29.78	32.39
W_9	54.33	53.22	53.78	56.22	55.00	55.61	58.67	57.00	57.83	37.89	31.67	34.78
SEm(±)	**1.168**	**0.726**	**0.688**	**0.744**	**0.896**	**0.582**	**1.195**	**0.981**	**0.773**	**1.677**	**1.941**	**1.282**
LSD (0.05)	**NS**	**NS**	**NS**	**2.114**	**2.549**	**1.635**	**3.398**	**2.788**	**2.170**	**4.768**	**5.518**	**3.600**

Microbial Population :

For the counting of microbial population, the enumeration was done on agar plates which were incubated at 30^0C, containing appropriate media which followed serial dilution technique and pour plate method. The counts were taken at 3rd day of incubation. Actinomycetes population was counted using Jensen's agar medium (Jensen, 1930). The population of fungi was estimated on Martin's Rose Bengal agar medium (Martin, 1950). After allowing for development of discrete actinomycetes and fungal colonies during incubations under suitable conditions, the colonies were counted. All the data obtained were subjected to analyses following the method detailed by Panse and Sukhatme, 1978.

RESULTS AND DISCUSSION

Soil microflora population under crops

It can be seen from table 1 and 2 that the population of soil micro flora increased gradually from 7 DAS till the final stage of observation as recorded among the crops. The population of both the micro flora showed slight decrease at 7 DAS with respect to the initial. The establishment of the crop seedlings as well as weeds at this stage might have led to unavailability of nutrients for the multiplication of microflora. However, after the crop establishment, the population of micro-flora

Table 2: Effect of treatments on population of actinomycetes (CFU×10^5 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	42.56	41.00	41.78	41.07	36.41	38.74	48.04	45.04	46.54	56.07	53.37	54.72
C_2	43.96	39.96	41.96	43.70	38.15	40.93	51.67	48.26	49.96	59.48	58.93	59.20
C_3	42.04	40.70	41.37	41.33	40.61	40.97	54.11	50.74	52.43	64.33	59.11	61.72
SEm(±)	**0.765**	**0.405**	**0.433**	**0.839**	**0.880**	**0.608**	**0.222**	**0.346**	**0.206**	**0.426**	**0.610**	**0.372**
LSD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**0.871**	**1.359**	**0.670**	**1.674**	**2.395**	**1.214**
Weed management (W)												
W_1	42.33	40.44	41.39	47.56	38.59	43.07	55.22	50.44	52.83	55.33	59.00	57.17
W_2	41.56	39.78	40.67	46.44	39.36	42.90	52.67	49.78	51.22	73.56	71.78	72.67
W_3	41.78	40.44	41.11	38.00	37.70	37.85	56.89	54.89	55.89	71.00	68.89	69.94
W_4	41.89	41.56	41.72	38.22	34.70	36.46	46.56	42.78	44.67	65.00	62.11	63.56
W_5	41.89	41.00	41.44	39.78	38.48	39.13	57.33	53.44	55.39	68.11	64.78	66.44
W_6	44.44	40.67	42.56	37.78	35.81	36.79	45.33	41.00	43.17	62.67	58.78	60.72
W_7	44.00	41.22	42.61	36.78	35.81	36.29	44.89	40.44	42.67	61.33	56.33	58.83
W_8	42.78	40.11	41.44	48.22	42.59	45.40	49.89	49.44	49.67	39.78	34.44	37.11
W_9	45.00	39.78	42.39	45.56	42.48	44.02	52.67	49.89	51.28	42.89	38.11	40.50
SEm(±)	**1.424**	**0.428**	**0.743**	**0.617**	**1.387**	**0.759**	**0.925**	**0.813**	**0.616**	**0.480**	**0.773**	**0.455**
LSD (0.05)	**NS**	**NS**	**NS**	**1.755**	**3.945**	**2.131**	**2.630**	**2.311**	**1.728**	**1.364**	**2.198**	**1.277**

Table 3: 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			
	Grass	Sedge	Broad leaved weeds	Grass	Sedge	Broad leaved weeds	WCE (%) at 30 DAS
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
SEm(±)	**0.078**	**0.050**	**0.034**	**0.094**	**0.284**	**0.030**	**NA**
LSD (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
SEm(±)	**0.093**	**0.073**	**0.043**	**0.210**	**0.318**	**0.120**	**NA**
LSD (0.05)	**0.246**	**0.204**	**0.119**	**0.589**	**0.893**	**0.338**	**NA**

Note: *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*

increased gradually. At 30 DAS, among the three crops, black gram recorded significantly highest population of actinomycetes (61.72 CFU × $10^5 g^{-1}$ of soil) followed by green gram (59.20 CFU × $10^5 g^{-1}$ of soil) while population under sesame recorded lowest value (54.72 CFU × $10^5 g^{-1}$ of soil). There was gradual increase in the population of fungi from 7 DAS, till the final stage of observation where highest population was recorded under black gram (72.96 CFU × $10^4 g^{-1}$ of soil) followed by green gram and sesame. This might be due to the indirect effect of higher weed control efficiency recorded under black gram (36.22 %) as shown in table 3, which resulted in conservation of more nutrients for the growth and multiplication of the soil micro flora.

Soil microflora population under weed management treatments

Among the weed management treatments at 7 DAS, plant extract treatments showed decrease in population of actinomycetes and fungi with respect to the initial. This might be due to the inhibition or suppression of micro flora by the allelochemicals present in the plant extracts. However, *Ocimum sanctum* extract treatment recorded highest population (39.13 CFU × $10^5 g^{-1}$ of soil) among the plant extract treatments which was statistically *at par* with *Ageratum conyzoides* extract treatment (37.85 CFU × $10^5 g^{-1}$ of soil) while lowest population was observed in *Amaranthus tricolor* extract treatment (36.29 CFU × $10^5 g^{-1}$ of soil). The population in control, hand weeding and chemical herbicide treatments showed slight increase in population since there was no treatment application at this stage that the micro flora continued to breed in natural condition. The same trend was observed in the case of fungi population. At 15 DAS, increase in the population of microflora in all the treatments was observed. It was observed that at 30 DAS, the population of actinomycetes and fungi showed increment with respect to the initial in all the treatments except for the herbicides treatments. At this stage, highest population of actinomycetes and fungi was obtained in hand weeding treatment which might be due to the conserved nutrients for the growth and multiplication of micro flora. Ghosh *et al* (2003) also expressed similar views. The aerated condition due to physical modification in hand weeding also accentuated the multiplication process. Among the plant extract treatments, *Ageratum conyzoides* extract treatment recorded highest population of actinomycetes (69.94 CFU × $10^5 g^{-1}$ of soil) and fungi (90.44 CFU × $10^4 g^{-1}$ of soil). With respect to the plant extract treatment, population in *Ageratum conyzoides* extract, *Ocimum sanctum* extract and *Blumea lacera* extract showed higher number than *Physalis minima* extract and *Amaranthus tricolor* extract though the difference was not remarkable. This may be directly proportional to the degree of weed control due to which the comparatively lower weed control efficiency in *Physalis minima* and *Amaranthus tricolor* extract treatments recorded more weeds resulting in the competition for nutrients between weeds and soil micro flora, ultimately recording lesser population of soil micro flora. In actinomycetes, Quizalofop-p-ethyl and Fenoxaprop-p-ethyl caused respectively 25.29 per cent and 21.02 per cent decrease in population compared to that observed at 15 DAS, while 41.46 per cent and 39.86 per cent reduction was recorded respectively in the case of fungi. This might be due to the toxic effect of the applied chemical herbicides. It may be noted that the effect of herbicides on the soil micro-flora are usually found to be most active immediately after application, when their concentration in soil is highest which was also supported by the findings of Radivojevic *et al.* (2004). Untreated control recorded lowest population of soil micro flora, though the population showed increase in number from the initial. Lower population might be due to the exhaustion of nutrients through uncontrolled weeds resulting in lowest population.

It can be noted from the experiment that even with higher weed control efficiency obtained under herbicide treatments, there is a negative effect on decreasing the population of beneficial soil microflora. Thus, with the use of easily available plant extracts, which has proved its efficiency in controlling weeds and at the same time conserving and increasing the soil microflora may be further studied. In the experiment, the plant extract of *Ageratum conyzoides* showed promising result among the plant extracts used.

REFERENCES

Cheema, Z. A. and A. Khaliq. 2000. Use of sorghum allelopathic properties to control weeds in irrigated wheat in a semi-arid region of Punjab. *Agric. Ecosyst. Env.,* **79** : 105–12

Cycon, M. and Piotrowska-Seget, Z. 2007. Effect of selected pesticides on soil microflora involved in organic matter and nitrogen transformations: pot experiment. *Polish J. Ecol*. **55**: 207-20

Das, A.C. and Kole, S.C. 2006. Effect of some root associative bacteria on germination of seeds, nitrogenase activity and dry matter production by rice plants. *J. Crop Weed*, **2**: 47-1

Duke, R. 1986. Naturally occurring chemical compounds as herbicides. *Rev. Weed Sci*., **2**: 17–65

Duke, S.O., Romagni, J.G. and Dayan, F.E. 2000. Natural products as sources for new mechanisms of herbicidal action. *Crop Prot.,* **19**: 583–89

El-Ghamry, A.M., Huang, C.Y. and Xu, J.M. 2001. Combined effect of two sulfonylurea herbicides on soil microbial biomass and N mineralization. *J. Env. Sci*., **13**: 311-17

FAO, 1989. Sustainable agricultural production: implication for international agricultural research. Technical Advisory Committee, CGIAR, FAO research and technical paper No 4. Rome Italy

Ghosh, R. K., Saha, S. and Ghosh, P. 2003. Effect of herbicides on potato tuber yield and microbial population. *Indian J. Weed Sci.*, **35** : 289-90

Jensen, H. L. 1930. Azotobacteriance. *Bacteriol. Rev.*, **189** : 195-14

Martin, J. 1950. Use of acid, rose Bengal and streptomycin in the plate method for estimating soil fungi. *Soil Sci.*, **69** : 215-32

Panse, V. G. and Sukhatme, P. V. 1978. *Statistical Methods for Agricultural Workers*, ICAR. New Delhi: pp 232

Radivojevic, L., Santric, L., Stankovic, K. R. and Janjic, V. 2004. Herbicides and soil microorganisms. *Biljni Lekar Plant Doctor*, **32** : 475-78

Selvamani, S. and Sankaran, S. 1993. Soil microbial population as affected by herbicides. *Madras Agric. J*., **80**: 397-99

Vyvyan, J.R. 2002. Allelochemicals as leads for new herbicides and agro-chemicals. *Tetrahedron*., **58**: 1631–36

Wu. H., Pratley, J., Lemerle, D. and Haig, T. 1999. Crop cultivars with allelopathic capability. *Weed Res.*, **39**: 171–80