https://doi.org/10.29321/MAJ.10.A03137

Madras agric. J. 65 (12) : 787—791. Dec., 1978.

Studies on the Influence of Herbicides on the Rhizosphere Microflora of Cotton

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A field experiment was conducted to find out suitable herbicide for cotton and their effect on soil microflora. Alachlor (2.0 kg/ha), fluometuron (1.5 kg/ha), dichlormate (3.0 kg/ha), dibutalin (2.5 kg/ha), diuron (1.0 kg/ha) and pre-sowing fluchloralin (1.25kg/ha) were the chemicals used as pre emergence. The herbicides were also tested incombination with post-emergence directed application of paraquat. The study revealed that soil microflora were generally influenced by the above herbicides, particularly post-emergence spray of paraquat. Though the microbial population was high in many of the weed control treatments, it had no significant influence on crop growth, uptake of nutrient and yield of seed cotton. The different plant characters and seed cotton yield were not adversely affected by the differences in the microbial population due to the different weed control treatments.

The hazardous effects of several herbicides on soil microorganisms and their activities were reported by Chandra *et al.* (1960), Gupta and Moolani, (1970) and Van Schreven *et al.* (1970). The urea herbicides were noted to be degraded by soil microorganisms (Murray *et al.* 1969). Very little information is available on the population of rhizosphere microflora under the influence of herbicides. The present study was undertaken to find out a suitable herbicides for cambodia cotton and its effect on the principal microorganisms in soil viz. bacteria, actinomycetes and fungi.

MATERIAL AND METHODS

Field investigation was carried out during 1974-75 in the Tamil Nadu Agricultural University Farm, Coimbatore to study the influence of herbicides on the population of soil microflora. The chemical weed control treatments were, peremergence application of alachlor 2.0 kg/ha, fluometuron 1.5 kg/ha, dichlormate 3.0 kg/ha, dibutalin 2.5 kg/ha, diuron 1.0 kg/ha and presowing fluchloralin 1.25 kg/ha. All the herbicides were also tested in combination with post-emergence directed application of paraquat at 0.5 kg/ha on the 15th and paraquat 0.5 kg/ha split application (15 and 30 days). Hand hoeing and weeding combined with paraquat 0.5 kg/ha (15 days) and unweeded control were the other treatments. Cotton (var. MCU. 5) was sown on August, 1974. The gross and net plot sizes were 6.5 and 3 75 respectively. The

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microbial population in soil was assayed by dilution plate method within 48 hours of pre-emergence application of herbicides and before and after the application of paraquat. The soil extract was used for the assay of bacteria, Kuster's agar for actinomycetes and Martin's rose bengal agar was used for the estimation of fungi. The population per g of moisture free soil was calculated as recommended by Katzelson *et al.* (1948).

RESULTS AND DISCUSSION

The results of this experiment are presented in Tables I, II and III.

Fungi: The population of fungi, 48 hr after the application of herbicides was maximum under fluchloralin and it was markedly superior to the other herbicides and untreated control. The untreated control, though inferior to fluchloralin, was significantly superior to dibutalin, fluometuron, diuron and dichlormate. the last two being on par. The fungal population was significantly influenced and it was the highest under alachlor, after fourteen days and before the application of paraquat. Post-emergence application of paraquat increased the fungal population to the maximum in Alachlor plots (T_7) and it decreased to the minimum in fluchloralin plots (Table II).

Actinomycetes: Fluchloralin (6) increased the population of actinomycetes to the maximum and this was closely followed by fluometuron (2) and both were significantly superior to other herbicides as well as untreated plat. Dibutalin (4), dichlormate (3) and diuron (5) were on par but significantly superior to untreated plot. Alachlor (1) recorded the least population and it was distinctly inferior to all the other weed control methods. Before application of paraquat, the population of actinomycetes was maximum under diuron (5) and was significantly superior to others. This was followed by fluchloralin (6) and fluometuron (2) which were on par and significantly superior to alachlor (1), dichlormate (3), dibutalin (4) and untreated control, which are in the descending order. Application of paraquat recorded the maximum population of actinomycets under dichlormate followed by paraquat (T_5). The next superior treatment was paraquat at 15 and 30 days (T_{13}) and are significantly superior to the other weed control methods. The population of actinomycetes was least under hand hoeing and weeding (T_{14}) and the differences are distinct between unweeded control (T_{16}) and hand hoeing and weeding followed by paraquat (T_{15}).

Bacteria: Dibutalin recorded the maximum bacterial population and was markedly superior to the other herbicides and untreated control. This was followed by dichlormate and fluometuron which were on par and distinctly superior to treatment 5, 7, 1 and 6. Fluchloralin recorded the least bacterial population and it was inferior to the other treatments.

The bacterial population was maximum under diuron before application of paraquat and markedly superior to the other weeding methods. Dichlormate recorded the least population and distinctly inferior to all the herbicides

TABLE I. Effect of herbicides on population of microflora

Weed control treatments		Fungi 10^4/g		Actinomycetes 10^4/g		Bacteria 10^6/g	
		*	**	*	**	*	**
Alachlor	(Al)	9.65	36.77	3.06	1.22	10.62	62.03
Fluometuron	(Fm)	9.47	18.95	4.46	2.00	13.48	56.33
Dichlormate	(Dc)	8.44	10.99	3.76	0.81	13.60	25.78
Dibutalin	(Db)	9.67	9.86	3.86	0.64	15.99	62.03
Diuron	(Du)	9.06	22.57	3.72	3.30	11.48	59.61
Fluchloralin	(Fc)	16.34	16.95	4.92	2.34	9.87	61.16
Untreated	(C)	12.74	20.15	3.40	0.32	10.77	57.29
SE (1—6)		0.31	2.30	0.09	0.25	0.19	5.19
CD (P=0.05)		0.87	6.58	0.24	0.72	0.56	14.84
S.ED (7 Vs other))		0.37	2.82	0.10	0.31	0.24	6.36
C.D. (P=0.05)		0.76	5.70	0.21	0.62	0.48	12.86

* Within 48 hours of application

** 14 days after application of pre-emergence and pre-sowing herbicides and before application of paraquat

and untreated control. The differences between treatments 4, 1, 6, 7 and 2 are not distinct and were on par. Application of paraquat markedly increased the bacterial population as evidenced from the highest population under paraquat at 15 and 30 days (T_{13}). This was followed by T_{11}, T_{10}, T_8 and T_7 which were also significantly and indepently superior to the other weed control methods. The population of bacteria was least under dichlormate and significantly inferior to all the weed control methods.

From the observations made on microbial population, it may be seen that fluchloralin increased the population of fungi initially (within 48 hours of application) but markedly decreased after paraquat application. The fungal population was found to be maximum under alachlor before application of paraquat. Dichlormate alone increased the population of actinomycetes but it reduced the population of bacteria after addition of paraquat. Split application of paraquat increased the population of bacteria and actinomycetes. Similar increases in population of bacteria and actinomycetes after the application of paraquat were reported by Camper *et al.* (1973).

TABLE II. Effect of herbicides on population of microflora*

Weed control treatments		Fungi	Actinomycetes	Bacteria
		10^4/g	10^4/g	10^6/g
T_1	(Al)	29.39	1.56	63.65
T_2	(Fm)	13.03	2.48	54.05
T_3	(Dc)	13.37	1.15	3.93
T_4	(Db)	13.94	1.04	62.73
T_5	(Du)	21.58	2.08	92.41
T_6	(Fc)	10.47	2.60	52.42
T_7	(Al+Pa)	48.49	9.37	77.60
T_8	(Fm+Pa)	29.34	5.38	64.58
T_9	(Dc+Pa)	19.39	18.52	120.23
T_{10}	(Db+Pa)	28.18	9.20	47.51
T_{11}	(Du+Pa)	18.69	8.68	143.54
T_{12}	(Fc+Pa)	4.22	8.39	61.28
T_{13}	(Pa+Pa)	10.73	16.61	173.61
T_{14}	(HW)	23.14	0.23	60.53
T_{15}	(HW+Pa)	15.04	0.41	51.56
T_{16}	(C)	15.91	0.35	37.32
S.E.		4.63	0.27	1.01
C.D. (P=0.05)		1.82	0.76	2.92

* After application of paraquat at 15 days of crop growth

Correlation study was made to find out the relationship between the total population of microflora (fungi, actinomycetes and bacteria) under different weed control treatments and the plant height at 45 days, number of bolls per plant, dry matter of crop at 45 days, nutrient uptake (N, P and K) by crop at 45 days and seed cotton yield (Table III). The correlation coefficients were not significant. The different plant characters and seed cotton yield were not affected by the microbial population. From this, it can be inferred that at the recommended heribicidal doses, the changes in the population of microflora did not have any adverse effect on the plant characters, nutrient uptake and seed cotton yield.

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TABLE III. Correlation coefficients for relationship between microbial population and plant characters and seed cotton yield

Correlation between X	Y	Correlation coefficient 'r'
Microbial population	Seed cotton yield	0.2823 N.S.
-do-	Plant height at 45 days	—0.0347 N.S.
-do-	Number of bolls	0.1792 N.S.
-do-	Dry weight of crop at 45 days	—0.1491 N.S.
-do-	Uptake of nitrogen at 45 days	—0.0271 N.S.
-do-	Uptake of phosphorus at 45 days	—0.2937 N.S.
-do-	Uptake of potassium at 45 days	—0.1353 N.S.

N.S. Not significant

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