

UNDER DENSE COTTON (*GOSSYPIUM SPECIES*) PLANTING THE IMPACT OF HERBICIDES APPLICATION ON SOIL MICROORGANISMS

Abstract

At Cotton Research Station, Dr. P.D.K.V. Akola, an experiment was carried out in the field during the rainy season of 2017–2018. The texture of the soil was clayey. The impact of pre- and post-emergence herbicides on soil microorganisms in HDPS cotton fields. According to the treatments, herbicides were used. At 30 and 100 days after cotton was sown, soil samples were taken before and after herbicide application. These samples were then used to estimate the populations of bacteria, actinomycetes, and fungi using the serial dilution method. The average number of bacteria, actinomycetes, and fungal colony forming units per gram of soil was calculated. Three replications of the randomized block design experiment with eight treatment combinations were completed. Pre-emergence pendimethalin application at 1.25 kg a.i. ha⁻¹ fb hoeing at 30 DAS and one-handed weeding at 45 DAS were the treatments. Pre-emergence spray of pendimethalin fb quizalofop-, pendimethalin fb pyriproxyfen sodium at 2-4 leaf weed stage, pendimethalin fb tank mix of quizalofop-ethyl + pyriproxyfen sodium sprayed on weed at 2-4 leaf weed stage, weed free check and weedy check. The variety AKH-081 was sown on BBF (1.66 lakh plant population) in the third week of July with the specified fertilizer and plant protection measures, at a spacing of 60 cm x 10 cm. After applying herbicides, the microbiological count was done. Herbicide use has a detrimental impact on the number of rhizospheric microorganisms for up to 30 days. Herbicide-treated soil had fewer bacteria, actinomycetes, and fungi overall than untreated soil. However, 100 days after HDPS was sown, the microbial count was

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larger than it had been. It suggests that the agroecosystem of HDPS cotton may not be impacted by the use of herbicides.

Keywords: Herbicides, Soil microorganism, HDPS, Cotton

I. INTRODUCTION

Throughout the whole vegetative and early reproductive stages of cotton, weeds sprout quickly and grow quickly, competing with the crop for nutrients, moisture, sunlight, and space. Weeds lower the photosynthetic efficiency, dry matter production, and its distribution to economically advantageous areas, which in turn diminishes the crop's sink capacity and leads to a poor yield. Specifically, 37% of losses are attributable to weeds, 29% are attributable to insects, 22% are attributable to illnesses, and 12% are attributable to other factors. However, India uses fewer herbicides than other countries, with a usage rate of 23% for herbicides, 59.9% for insecticides, 16.9% for fungicides, and 0.2% for other pesticides. Cotton experiences severe weed competition right after emergence because it is a slow-growing crop (Chaugule and Khare, 1961). Therefore, the choice of any weed management method is heavily influenced by its efficiency and cost. The use of pre- and post-emergence herbicides would increase farmer acceptance of herbicidal weed control, which would not alter current agronomic techniques but would enable total weed control. .

It is extremely concerning that pesticide residues in soil could directly affect soil microorganisms. Herbicides are believed to have no significant or long-term impact on microbial communities when used at the usual field recommended rates. Depending on the application rates and the type of herbicide used, it has been found that some microorganisms were able to breakdown the herbicide while others were negatively impacted (Sebiomo et al., 2011). Therefore, the chemical (type and concentration), microbial species, and environmental factors all affect the effects of herbicides on microbial growth, whether they are stimulating or depressed (Zaine et al., 2013). Studies on the residual effects of pesticides on soil microorganisms are frequently conducted in small-scale soil microcosm experiments that can be accurately evaluated at larger scales (Benton et al., 2007). Higher resolution of the ecotoxicological effects of chemicals in soil environments is provided by microcosms containing soil microfauna of field communities (Parmelee et al., 1993). Soil microorganisms can help us understand the potential responses of soil microbes to herbicides since the exact assessment of the potential non-target effects of herbicides on soil microorganisms in cotton fields is of developing importance. The goal of the study was to examine how regularly used herbicides affected the communities of bacteria, fungi, and actinomycetes in soil microcosms from cotton fields.

II. MATERIALS AND METHODS

Dr. P.D.K.V. Akola's Cotton Research Station hosted a field experiment during the 2017–2018 wet season. The soil had a clayey texture and reacted naturally. The soil has 4.70 g kg⁻¹ of organic carbon, a pH of 8.9, an EC of 0.30, and 225, 14.4, and 342 kg ha⁻¹ of accessible N, P, and K, respectively. Eight treatment combinations were used in the experiment, which was run in three replications using a randomized block design. The treatments were pendimethalin 38.7 EC PE @ 1.25 kg a.i. ha⁻¹ fb hoeing at 30 DAS and one hand weeding at 45 DAS, quizalofop-ethyl 10 EC @ 0.075 kg a.i. ha⁻¹ POE 20-25 DAS (2-4 leaf weed stage) fb hoeing at 45 DAS, pyriithiobac sodium 10 EC @ 0.075 kg a.i. ha⁻¹ POE 20-25 DAS (2-4 leaf weed stage) fb hoeing at 45 DAS, pendimethalin 38.7 EC PE @ 1.25 kg a.i. ha⁻¹ fb quizalofop-ethyl 10 EC @ 0.075 kg a.i. ha⁻¹ POE 20-25 DAS (2-4 leaf weed stage), pendimethalin 38.7 EC PE @ 1.25 kg a.i. ha⁻¹ fb pyriithiobac sodium 10 EC @ 0.075 kg a.i. ha⁻¹ POE 20-25 DAS (2-4 leaf weed stage), pendimethalin 38.7 EC PE @ 1.25 kg a.i. ha⁻¹

fbquizalofop-ethyl 10 EC @ 0.060 kg a.i.ha⁻¹ + pyriithiobac sodium 10 EC POE @ 0.062 kg a.i.ha⁻¹ POE (tank mix) (2-4 leaf weed stage), weed free check and weedy check. The crop was planted on BBF in the third week of July with a gross plot size of 6.0 m by 4.8 m and harvested in the fourth week of December. The crop was fertilized with a uniform dose of 60 kg N + 30 kg P₂O₅ + 30 kg K₂O ha⁻¹.

Each plot's composite soil samples were taken both prior to sowing and during blooming, and they were then used to estimate the populations of bacteria, actinomycetes, and fungi using the serial dilution method. In an autoclave, the medium were prepared and sterilized. For the purpose of determining the gravimetric moisture, the soil samples were kept in the oven simultaneously. In order to make serial dilutions up to 10⁻⁸, a 1 g soil sample was placed in 10 ml of sterilized water, swirled well, and then measured (Wollum, 1982; Dingra and Sinclair, 1995). To check the growth of fungi, Rose Bengal was added to Potato Dextrose Agar (PDA) medium after the serially diluted supernat (0.5 ml) of 10⁴ was obtained and dispersed over in petriplates.

The serially diluted supernat (0.5 ml) of 10⁶ was taken with pipette and spread over in to petriplates with Munairs and Kenknight medium.

To check the development of bacteria, antifungal natamycin was added to the Nutrient Agar (NA) medium after the serially diluted supernat (0.5 ml) of 10⁷ was obtained and scattered around in the petriplates. The colony counter was used to count the fungus, actinomycetes, and bacteria that had formed on the poured plates (PDA, Munairs and Kenknight, and NA) after they had been incubated at 28 ± 1 for 72 hours.

III. RESULTS AND DISCUSSION

The findings show that, when compared to untreated (Control) soil, herbicides (pendimethalin, quiozalofop ethyl, and pyriithiobac sodium) significantly reduced the quantity of bacteria, actinomycetes, and fungus in soil within the first few days after application. Herbicide use resulted in a decrease in colonies. The outcomes are shown in table 1.

Tables 1 show the total population of bacteria, fungus, and actinomycetes that were enumerated both before and after the use of herbicides. The type of herbicides and the days following and before herbicide application were found to significantly affect the population of bacteria (Table 1). In terms of herbicides, pendimethalin 38.7 EC PE @ 1.25 kg a.i.ha⁻¹ fbquizalofop-ethyl 10 EC @ 0.060 kg a.i.ha⁻¹ + pyriithiobac sodium 10 EC POE @ 0.062 kg a.i.ha⁻¹ POE (tank mix) was followed by pendimethalin 38.7 EC PE @ 1.25 kg a.i. The highest bacteria population was in the weedy check before spraying (18.67 CFU g⁻¹ soil), and all other treatments were on par with it. However, the population was also found to be significantly influenced by the application of the herbicides, with the lowest population of bacteria being found in pendimethalin 38.7 EC PE @ 1.25 kg a.i.ha⁻¹ fbquizalofop-ethyl 10 EC @ 0.060 kg a.i. Because there was no pesticide application, the population grew in the weedy check (24.53 CFU g⁻¹ soil) and was comparable to the weed free check (23.33 CFU g⁻¹ soil). The bacterial population enumerated before and after the administration of herbicides showed significant variations as well. Due to competitive pressure, a toxic effect, and various persistence times of the treated herbicides in various soil settings, the total bacterial population decreased. The influence exerted by herbicides on treatments and it affectson the

actinomycetes population after spraying. Among the herbicides, pendimethalin 38.7 EC PE @ 1.25 kg a.i.ha⁻¹ fbpyrithiobac sodium 10 EC @ 0.075 kg a.i.ha⁻¹ POE 20-25 DAS applied soils had significantly lower populations (7.97 CFU g⁻¹ soil) and at par with pendimethalin 38.7 EC PE @ 1.25 kg a.i.ha⁻¹ fbquizalofop-ethyl 10 EC @ 0.060 kg a.i.ha⁻¹ + pyrithiobac sodium 10 EC POE @ 0.062 kg a.i.ha⁻¹ POE (tank mix) (7.84 CFU g⁻¹ soil) and higher population recorded with weedy check (14.07 CFU g⁻¹ soil) at par with weed free check (13.33 CFU g⁻¹ soil) followed by pendimethalin 38.7 EC PE @ 1.25 kg a.i. ha⁻¹ fb hoeing at 30 DAS and one hand weeding at 45 DAS (9.67 CFU g⁻¹ soil). In before spraying the actinomycetes population was maximum in weedy check and at par with all treatments.

The number of fungi The fungus population counted before and after herbicide administration showed considerable variations. Prior to spraying, the population was at its highest level under quizalofop-ethyl 10 EC@ 0.075 kg a.i. ha⁻¹ POE 20-25 DAS (2-4 leaf weed stage). fbhoeing at 45 DAS (10.70 CFU g⁻¹ soil) and at par with T3, T6, and T8, with T7, T1, T5, and T4 coming in second and third. Because there was no pesticide treatment prior to spraying, the population was larger. The population of fungi was influenced after spraying and decreased the population of fungi due to herbicide application as compared to before spraying observed under the pendimethalin 38.7 EC PE @ 1.25 kg a.i.ha⁻¹ fbquizalofop-ethyl 10 EC @ 0.060 kg a.i.ha⁻¹ + pyrithiobac sodium 10 EC POE @ 0.062 kg a.i.ha⁻¹ POE (tank mix) (8.00 CFU g⁻¹ soil) and at par with T₂ (8.20 CFU g⁻¹ soil).

IV. CONCLUSION

It can be concluded that pendimethalin 38.7 EC PE @ 1.25 kg a.i.ha⁻¹ fbquizalofop-ethyl 10 EC @ 0.060 kg a.i.ha⁻¹ + pyrithiobac sodium 10 EC POE @ 0.062 kg a.i.ha⁻¹ POE (tank mix) has an inhibitory effect on the total counts of microorganisms like bacteria, actinomycetes and fungi in the soil upto 30days and higher colony count observed under the weedy check treatment. However, microbial count was higher over initial at 100 days after sowing of HDPS. It indicates that herbicidal application may not affect agroecosystem of HDPS cotton. It might be due to high density planting as cotton plant population 14 plants / m² and canopy growth of cotton plant covers soil in during 45-50 DAS.

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UNDER DENSE COTTON (*GOSSYPIMUM SPECIES*) PLANTING THE IMPACT OF HERBICIDES APPLICATION ON SOIL MICROORGANISMS**Table 1:** Microbial count (cfu g⁻¹ soil) at before spraying, 30 days after sowing and 100 days after sowing as influenced by different treatments.

Treatments	Microbial count								
	Bacteria (X 10 ⁷ cfu g ⁻¹ soil)			Actinomycetes (X 10 ⁶ cfu g ⁻¹ soil)			Fungi (X 10 ⁴ cfu g ⁻¹ soil)		
	Before spraying	After spraying (At 30 DAS)	At 100 Days	Before spraying	After spraying (At 30 DAS)	At 100 Days	Before spraying	After spraying (At 30 DAS)	At 100 Days
T ₁ – pendimethalin 38.7 CS PE @ 1.25 a.i. kg /ha+ IC + HW	18.81	14.00	19.25	9.07	9.67	12.14	9.50	8.47	9.52
T ₂ – Quizalofop ethyl 10 EC@ 0.075kg a.i. /ha POE 20-25 DAS + IC	17.53	13.67	18.85	9.67	7.07	11.45	10.70	8.20	10.87
T ₃ – Pyriithiobac sodium 10 EC 0.075 kg a.i./ ha POE 20-25 DAS + IC	18.17	12.33	18.66	8.13	8.33	11.55	10.43	8.22	11.04
T ₄ – Pendimethalin 38.7 CS PE @ 1.25 kg + Quizalofop ethyl 10 EC@ 0.075kg a.i. /ha POE 20- 25 DAS	18.40	13.00	18.42	8.67	8.15	11.04	8.87	7.14	9.07
T ₅ – Pendimethalin 38.7 CS PE +Pyriithiobac sodium 10 EC @ 0.075 kg a.i./ ha POE 20-25 DAS	16.67	12.00	17.05	10.17	7.97	11.29	9.33	6.48	10.34
T ₆ – Pendimethalin 38.7 CS PE @ 1.25 kg +Tank mix of Quizalofop ethyl 10 EC@ 0.060kg a.i. /ha + Pyriithiobac sodium 10 EC @ 0.075 kg a.i./ ha POE	18.00	10.00	18.16	9.93	7.84	11.19	10.67	8.00	10.55
T ₇ – Farmer practice (2 Hoeing/b2 Weeding)	17.33	23.33	19.18	9.33	13.33	12.33	9.83	14.27	10.12

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T ₈ – Weedy check	18.67	24.53	18.90	10.35	14.07	12.03	10.50	13.67	10.66
GM	17.95	15.36		9.41	9.55		9.98	9.30	

