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Effect of Weed Management Practices on Soil Enzymes Activity in Mustard (*Brassica juncea* (L.) Czerj and Cosson)

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ABSTRACT

Both target species and soil microbial communities are affected by herbicides. These non-target outcomes may have an impact on the functioning of essential soil processes. In this context, the current experiment was conducted with the goal of determining the impact of weed management strategies on mustard soil enzyme activity. A field experiment was conducted on sandy loam soils during the 2020-21 *rabi* season. The study was duplicated three times and employed a randomized Block Design with twelve treatments. Standard statistical approaches were used to assess the data. Higher dehydrogenase activity was observed under oxadiargyl 6 % EC 0.09 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}(7.18 µg TPF g^{-1} soil day^{-1}) and it was found to be on par with oxyfluorfen 23.5 % EC 0.1 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}, pendimethalin 30 % EC 1.0 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}. Similarly, urease activity, acid phosphatase activity and alkaline phosphatase activity were recorded higher with oxadiargyl 6 % EC 0.09 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1} (35.60 µg NH_4-N g^{-1}soil 2 hour^{-1}) and it was on par with oxyfluorfen 23.5 % EC 0.1 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}.

Keywords Acid phosphatase activity, Alkaline phosphatase, Dehydrogenase activity, Urease activity.

INTRODUCTION

Mustard is one of the greatest widely traded oil-rich seed crops in the world. It belongs to the Cruciferae family. It is India's second most significant oilseed crop after groundnut, among the seven edible oilseeds. Mustard seeds have an oil content ranging from 37 to 49% (Bhowmik *et al*. 2014). Northern India uses the oil for human consumption and cooking. Because of their capacity to replenish nutrients to promote plant development, a healthy population of soil microorganisms can help to regulate the ecological system in soil. Any change in their number or activity may have an impact on nitrogen cycling and availability, affecting productivity and other soil processes indirectly (Wang *et al*. 2008).

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Pesticides are the most important anthropogenic variables since they are constantly released into the soil ecosystem. Herbicides are a type of pesticide that consists of chemicals or biological organisms that are used to kill or inhibit undesired plants and foliage. (Cork and Krueger 1992) in order to minimize the cultivation cost as well as to endure high yield. A variety of weedcides have been introduced not only as pre- or post-emergence weed killers, but also as soil residues that are environmentally harmful (Riaz *et al*. 2015). Herbicides have an impact on both target species and soil microbial populations. The performance of critical soil processes may be affected as a result of these non-target consequences. In this context, the current experiment was conducted with the goal of determining the impact of weed control strategies on mustard soil enzyme activity.

MATERIALS AND METHODS

A field trial was conduct throughout *rabi* season 2020-21 at Rajendranagar, Hyderabad. The experimental field's soil had a loamy sand texture and a pH of 7.9 with available nitrogen (223 kg ha^{-1}), available phosphorus (30.87 kg ha^{-1}), available potassium (375.72 kg ha^{-1}) and organic carbon (0.69%), it was medium fertile. Mustard variety NRCHB-101 was sown with seed rate of 4 kg ha^{-1}. The seeds were sown manually with spacing of 40×10 cm. The experiment was placed out in Randomised Block Design replicated thrice with twelve treatments viz., T_1: Pendimethalin 30 % EC 1.0 kg ha^{-1} PE *fb* quizalofop ethyl 5 % EC 0.05 kg ha^{-1} PoE, T_2: Oxadiargyl 6% EC 0.09 kg ha^{-1} PE *fb* quizalofop ethyl 5 % EC 0.05 kg ha^{-1} PoE, T_3: Oxyfluorfen 23.5 % EC 0.1 kg ha^{-1} PE *fb* quizalofop ethyl 5 % EC 0.05 kg ha^{-1} PoE, T_4: Pendimethalin 30 % EC 1.0 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}, T_5: Oxadiargyl 6 % EC 0.09 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}, T_6: Oxyfluorfen 23.5 % EC 0.1 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}, T_7: Pendimethalin 30 % EC 1.0 kg ha^{-1} PE *fb* intercultivation at 30 DAS, T_8: Oxadiargyl 6 % EC 0.09 kg ha^{-1} PE *fb* intercultivation at 30 DAS, T_9 : Oxyfluorfen 23.5 % EC 0.1 kg ha^{-1} PE *fb* intercultivation at 30 DAS, T_{10}: Intercultivation and hand weeding at 15 and 30 DAS (weed free), T_{11}: Intercultivation at 15 and 30 DAS, T_{12}: Unweeded control. Data recored on dehydrogenase activity, Urease activity, acid phosphatase activity and alkaline phosphatase activity. The data was analyzed using standard statistical techniques.

RESULTS AND DISCUSSION

Effect on soil dehydrogenase activity (µg TPF g^{-1} soil day^{-1})

At 30 DAS, higher dehydrogenase activity was observed under oxadiargyl 6 % EC 0.09 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1} (7.18 µg TPF g^{-1} soil day^{-1}) and it was found to be on par with oxyfluorfen 23.5 % EC 0.1 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}, pendimethalin 30 % EC 1.0 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}. It

Table 1. Soil dehydrogenase and soil urease activity as influenced by integrated weed management practices in mustard.

Treatments	Soil dehydrogenase		Soil urease activity	
	30 DAS	60 DAS	30 DAS	60 DAS
T_1: Pendimethalin 30 % EC 1.0 kg ha^{-1} PE *fb* quizalofop ethyl 5 % EC 0.05 kg ha^{-1} PoE	3.75	5.25	21.62	33.67
T_2: Oxadiargyl 6 % EC 0.09 kg ha^{-1} PE *fb* quizalofop ethyl 5 % EC 0.05 kg ha^{-1} PoE	3.85	5.65	22.18	34.98
T_3: Oxyfluorfen 23.5 % EC 0.1 kg ha^{-1} PE *fb* quizalofop ethyl 5 % EC 0.05 kg ha^{-1} PoE	3.80	5.43	21.91	34.56
T_4: Pendimethalin 30 % EC 1.0 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}	6.76	9.25	33.30	46.12
T_5: Oxadiargyl 6 % EC 0.09 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}	7.18	9.40	35.60	48.56
T_6: Oxyfluorfen at 23.5 % EC 0.1 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}	7.15	9.32	34.50	47.12
T_7: Pendimethalin 30 % EC 1.0 kg ha^{-1} PE *fb* intercultivation at 30 DAS	4.35	7.19	24.80	38.12
T_8: Oxadiargyl 6 % EC 0.09 kg ha^{-1} PE *fb* intercultivation at 30 DAS	4.90	7.25	25.45	39.56
T_9: Oxyfluorfen 23.5 % EC 0.1 kg ha^{-1} PE *fb* intercultivation at 30 DAS	4.75	7.22	24.95	38.95
T_{10}: Intercultivation and hand weeding at 15 DAS and 30 DAS (weed free)	6.10	8.03	30.55	43.10
T_{11}: Intercultivation at 15 and 30 DAS	5.90	7.82	29.20	42.96
T_{12}: Unweeded control	5.70	7.77	28.12	42.56
SE (m) ±	0.14	0.25	0.81	0.98
CD (p=0.05)	0.44	0.75	2.52	2.95

Table 2. Soil acid and alkaline phosphatase activity (µg PNP g^{-1} soil $hour^{-1}$) as influenced by integrated weed management practices in mustard.

Treatments	Acid phosphatase activity		Alkaline phosphatase activity	
	30 DAS	60 DAS	30 DAS	60 DAS
T_1: Pendimethalin 30 % EC 1.0 kg ha^{-1} PE *fb* quizalofop ethyl 5 % EC 0.05 kg ha^{-1} PoE	52.5	97.9	72.1	113.2
T_2: Oxadiargyl 6 % EC 0.09 kg ha^{-1} PE *fb* quizalofop ethyl 5 % EC 0.05 kg ha^{-1} PoE	55.5	102.2	74.8	118.0
T_3: Oxyfluorfen 23.5 % EC 0.1 kg ha^{-1} PE *fb* quizalofop ethyl 5 % EC 0.05 kg ha^{-1} PoE	53.9	98.7	73.6	116.6
T_4: Pendimethalin 30 % EC 1.0 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}	73.6	118.9	87.8	140.8
T_5: Oxadiargyl 6 % EC 0.09 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}	76.5	122.1	91.5	146.9
T_6: Oxyfluorfen at 23.5 % EC 0.1 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}	74.2	120.1	89.9	143.6
T_7: Pendimethalin 30 % EC 1.0 kg ha^{-1} PE *fb* intercultivation at 30 DAS	59.6	114.5	75.7	132.9
T_8: Oxadiargyl 6 % EC 0.09 kg ha^{-1} PE *fb* intercultivation at 30 DAS	62.1	116.7	77.2	135.2
T_9: Oxyfluorfen 23.5 % EC 0.1 kg ha^{-1} PE *fb* intercultivation at 30 DAS	60.9	115.9	76.8	133.8
T_{10}: Intercultivation and hand weeding at 15 DAS and 30 DAS (weed free)	69.5	118.2	81.3	139.9
T_{11}: Intercultivation at 15 and 30 DAS	68.9	117.9	79.8	137.4
T_{12}: Unweeded control	66.2	117.2	78.4	136.2
SE (m) ±	1.22	2.92	1.96	4.79
CD (p=0.05)	3.68	8.79	5.98	14.42

might be due to the dehydrogenase activity inhibition by herbicidal treated plots compared to non-herbicidal treated plots. At 60 DAS similar trend was observed but the higher dehydrogenase activity was recorded compared to 30 DAS. It might be due to herbicide residues less at 60 DAS.

Effect on soil urease activity (µg NH_4-N g^{-1}soil 2 $hour^{-1}$)

Urease activity significantly inclined by different weed management practices Table 1. Urease activity was recorded higher at 30 DAS with oxadiargyl 6 % EC 0.09 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1} (35.60 µg NH_4-N g^{-1}soil 2 $hour^{-1}$) and it was on par with oxyfluorfen 23.5 % EC 0.1 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}, pendimethalin 30 % EC 1.0 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}. At 60 DAS similar trend was observed but higher urease activity was recorded compared to 30 DAS. Higher urease activity it might be due to improved soil biological activity (Dick 1984).

Effect on soil acid and alkaline phosphatase activity (µg PNP g^{-1} soil $hour^{-1}$)

Data on acid phosphatase activity and alkaline phosphatase activity presented in Table 2. Significantly higher acid phosphatase activity was recorded with oxadiargyl 6 % EC 0.09 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1} (122.1 µg PNP g^{-1} soil $hour^{-1}$) and it was found to be on par with oxyfluorfen 23.5 % EC 0.1 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}, pendimethalin 30 % EC 1.0 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}. Alkaline phosphatase activity was higher than acid phosphatase. This is owing to the soil's alkaline pH, which encourages strong alkaline phosphatase activity. Higher alkaline phosphatase activity was recorded with oxadiargyl 6 % EC 0.09 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1} (146.9 µg PNP g^{-1} soil $hour^{-1}$) and it was found to be on par with oxyfluorfen 23.5 % EC 0.1 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}. Higher phosphatase activity might be due to higher organic matter content of straw mulch. Because of which phosphatase activity can be considered to be a good catalogue of the quality and quantity of organic matter (Vanaarle and Plassard 2010).

On the basis of the above-mentioned findings, it may be inferred that, soil enzymes activity higher under oxadiargyl 6 % EC 0.09 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1} and it was found to be on par with oxyfluorfen 23.5 % EC 0.1 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}, pendimethalin 30 % EC 1.0 kg ha^{-1} PE *fb* straw mulch 5 t ha^{-1}.

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