Effect of Different Doses of Pendimethalin on Microbial Activities and Nodulation in Chickpea

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Contents

Abstract

Field trial was conducted at research farm of weed science research center, Parbhani, in split plot design with an objective to study the effect of herbicides on biochemical activities and nodulation in chickpea (maize-chickpea cropping system) during 2012–2013.The soil of experimental plot was black cotton soil with medium fertility and pH 7.9, EC 0.32 dsm^{-1}, and OC 0.57%. The treatments comprised of four weed control measures (weedy check, mechanical weeding, weed free, and pendimethalin 1.0 kg ha^{-1}). The soil samples were collected from rhizospheric soil from each plot at 30, 50 DAS and at harvest of crop and were analyzed for soil microbial biomass carbon and basal soil respiration and number of nodules and nodule dry matter. The results revealed that there were nonsignificant variations observed due to various treatments in affecting soil physicochemical properties of soil at various crop growth stages. Highest microbial population, microbial biomass carbon, and basal soil respiration were recorded in mechanical weeding, whereas lower activities were recorded in pendimethalin applied plots at 1.0 kg ha^{-1} at 30 DAS. These values were enhanced at harvest.

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Application of pendimethalin1.0 kg ha^{-1} did not influence nodal count and nodal dry matter significantly.

Keywords
Pendimethalin · Effect · Physicochemical properties of soil · Soil microflora · Chickpea

12.1 Introduction

Soil microbial populations are immersed in a framework of interactions known to affect plant fitness and soil quality. They are involved in fundamental activities that ensure the stability and productivity of both agricultural systems and natural ecosystems. The soil samples were collected from the rhizospheric layer of plant from herbicide-treated plots; it is to be used for all the microbial and biochemical analysis. It is to be collected at three stages of crop growth, viz., maximum vegetative growth stage (30 DAS), flowering stage (60 DAS), and at harvest. The soil samples were analyzed for following observations: pH, EC and organic carbon, microbial biomass carbon, basal soil respiration, total number of "N" fixers, total number of "P" solubilizers, nodule numbers, nodule dry matter, and the percent root colonization by VAM fungi.

12.2 Materials and Methods

The field experiment was conducted on permanent herbicide trial in maize-chickpea cropping system during *kharif* season of 2011–2012 in split plot design replicated three times. This investigation was an attempt to check the effect of different pre and postemergence herbicide on soil physicochemical and biological properties in relation to chickpea rhizosphere (Table 12.1).

12.3 Method for Microbial Count

The soil samples were collected up to 15 cm depth and processed for microbial analysis following the dilution plate technique. The population of bacteria and fungi were determined by the standard pour plate technique using soil extract agar media for bacteria and Rose Bengal Agar media for fungi. Triplicate plates for each sample

Table 12.1 Treatments details

Treatments in 1st crop (maize)	Treatments in 2nd crop (chickpea)
T_1 = weedy check	T_1 = weedy check
T_2 = mechanical weeding	T_2 = mechanical weeding
T_3 = atrazine at 0.75 ha^{-1}	T_3 = pendimethalin at 1.0 kg ha^{-1} PE
T_4 = atrazine at 1.50 kg ha^{-1}	T_4 = pendimethalin at 0.75 kg ha^{-1} PE fb-mechanical weeding
T_5 = atrazine at 0.75 kg ha^{-1} fb-2,4-D at 0.5 kg ha^{-1}	

and microbial group were used for microbial population before sowing and after harvest.

12.4 Results and Discussion

12.4.1 Effect of Weed Control Treatments in Chickpea (*Rabi* Season)

12.4.1.1 Microbial Biomass Carbon and Basal Soil Respiration

The basal soil respiration was not influenced due to weed control treatment. Significantly higher basal soil respiration were observed in T_2 (mechanical weeding) followed by T_1, i.e., (weedy check), whereas significantly lowest biochemical activities were observed in treatment C4, i.e., pendimethalin at 0.75 kg ha^{-1} fb 2,4-D at 0.5 kg ha^{-1} followed by treatment C3 pendimethalin at 1.5 kg ha^{-1} (Table 12.2).

12.5 Total "N" Fixers and "P" Solubilizers

In chickpea a total number of "N" fixer were observed more than total number of "P" solubilizer. Both the beneficial microorganisms were increased in their numbers from initial to harvest. At initial days, beneficial microflora were significantly lowest in treatment C_4 - pendimethalin 0.75 kg ha^{-1} fb mechanical weeding and C_3 - pendimethalin 1.00 kg/ha, whereas highest count was observed in T_2 mechanical weeding, but at the time of harvest, the number of beneficial microflora was increased, and differences were nonsignificant (Table 12.3). Similar results were also reported by Bhutada et al. (2014), Singh et al. (2013), Yadav et al. (1983), Narendra Kumar et al. (2014), and Sunil Kumar et al. (2010).

12.6 Nodule Number and Nodule Dry Matter

Effect of different herbicide on nodule number and nodule dry matter is shown above. Nodule number and nodule dry matter were not influenced by different herbicide in chickpea. Numerically highest nodule numbers were observed in T_2

Table 12.2 Effect of different doses of herbicide on soil microbial biomass and basal soil respiration in maize-chickpea cropping system

Treatments	Microbial biomass carbon (ug/g soil)[a]			Basal soil respiration: (ug Co_2/100 g of soil/h)[a]		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
Main treatments – 1st crop (maize)						
M_1 weedy check	349.2	343.7	357.7	403.25	403.34	391.3
M_2 mechanical weeding (2)	346.5	359.8	352.4	398.33	410.0	393.0
M_3 atrazine at 0.75 kg ha^{-1} PE	342.6	371.6	358.3	400.17	405.0	397.6
M_4 atrazine at 1.0–1.50 kg ha^{-1} PE	349.0	353.8	369.5	397.67	406.9	394.7
M_5 atrazine at 0.75 kg/ha fb 2,4-D at 0.5 kg ha^{-1}	349.7	371.5	354.0	394.50	401.1	395.4
SE+	2.71	2.23	1.23	3.51	1.24	0.83
CD at 5%	7.84	6.44	3.55	11.01	3.58	2.41
Sub-treatments – 2nd crop (chickpea)						
C_1 weedy check	345.8	359.2	351.2	404.27	405.0	395.0
C_2 mechanical weeding (2)	341.4	351.0	347.2	405.33	416.1	401.8
C_3 pendimethalin at 1.0 kg ha^{-1} PE	351.3	365.3	354.9	393.20	401.8	390.8
C_4 pendimethalin at 0.75 kg ha^{-1} fb mechanical weeding	351.2	365.9	370.2	392.33	398.2	390.1
SE+	1.79	1.87	1.23	3.63	1.44	0.90
CD at 5%	5.16	5.39	3.55	11.04	4.17	2.59
Interaction						
SE+	4.00	4.18	4.01	8.11	3.23	2.01
CD at 5%	11.5	12.0	11.1	22.3	9.33	5.80

[a]Mean of three replications

mechanical weeding, whereas there were no significant differences in nodule numbers and nodule dry matter in herbicide treatment. Lowest nodule number and nodule dry matter were recorded in C_4 - pendimethalin 0.75 kg ha^{-1} fb mechanical weeding (Table 12.4).

Herbicide in the present investigation had only temporary effect on soil health parameter. The herbicide used, i.e., atrazine and pendimethalin, 2,4-D in maize-chickpea cropping system, did not lower the basal soil respiration and microbial

Table 12.3 Effect of different doses of herbicide on soil total "N" fixers and total "P" solubilizers in maize-chickpea cropping system

Treatments	Total "N" fixers[a] (c.f.u. × 10^{-3})			Total "P" solubilizers[a] (c.f.u. × 10^{-3})		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
Main treatments – 1st crop (maize)						
M_1 weedy check	16.2	16.6	12.8	12.4	13.1	13.0
M_2 mechanical weeding (2)	13.2	14.6	12.1	11.4	10.7	10.7
M_3 atrazine at 0.75 kg ha^{-1} PE	15.2	15.8	12.9	12.9	12.0	12.2
M_4 atrazine at 1.0–1.50 kg ha^{-1} PE	14.6	16.1	11.4	12.5	11.5	10.7
M_5 atrazine at 0.75 kg ha^{-1} fb. 2,4-D at 0.5 ha^{-1} ha	15.1	15.7	11.7	12.5	11.0	9.7
SE+	0.63	0.45	0.22	0.188	O.16	0.25
CD at 5 %	1.83	1.32	0.66	0.54	0.47	0.74
Sub-treatments – 2nd crop (chickpea)						
C_1 weedy check	13.3	14.6	11.1	10.8	10.9	11.2
C_2 mechanical weeding (2)	18.1	18.1	14.3	15.2	14.0	12.6
C_3 pendimethalin at 1.0/1.25 kg ha^{-1} PE	15.0	15.8	11.6	12.0	11.6	11.2
C_4 pendimethalin at 0.75 kg ha^{-1} fb mechanical weeding	13.1	14.0	11.2	11.0	10.2	10.2
SE+	0.46	0.08	0.24	0.20	0.21	0.17
CD at 5%	1.34	0.88	0.74	0.58	0.61	0.50
Inter action						
SE+	1.04	0.68	0.54	0.45	0.47	0.39
CD at 5%	3.0	1.98	1.57	0.13	1.37	1.13

[a]Mean of three replications

biomass production of microbes at the harvest time of the crop. Similar results regarding beneficial microflora were found. Increasing trend in number of colonies was found from initial to harvest. Application of herbicide did not restrict the microbial growth in both the crops. There is nonsignificant effect of herbicide on number of root nodules and nodule dry matter. Total number of "N" fixers was observed more than that of "P" solubilizers.

Table 12.4 Effect of different doses of herbicide on soil total nodule No and total dry matter (mg/plant) in maize-chickpea cropping system

Treatments	Total nodules (Number/plant) 60 DAS	Total dry matter[a] (mg/plant) 60 DAS
Main treatments – 1st crop (maize)		
M_1 weedy check	20.6	0.37
M_2 mechanical weeding (2)	20.8	0.38
M_3 atrazine at 0.75 kg ha^{-1} PE	19.4	0.37
M_4 atrazine at 1.0–1.50 kg ha^{-1} PE	21.0	0.35
M_5 atrazine at 0.75 kg ha^{-1} fb. 2,4-D 0.5 ha^{-1} ha	22.7	0.42
SE+	0.20	0.004
CD at 5%	0.59	0.011
Sub-treatments – 2nd crop (chickpea)		
C_1 weedy check	20.8	0.37
C_2 mechanical weeding (2)	22.2	0.40
C_3 pendimethalin 1.0/1.25 kg ha^{-1} PE	20.8	0.37
C_4 pendimethalin 0.75 kg ha^{-1} fb mechanical weeding	19.9	0.37
SE+	0.14	0.003
CD at 5%	0.40	0.01
Interaction		
SE+	0.31	0.007
CD at 5%	NS	NS

[a]Mean of three replications

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