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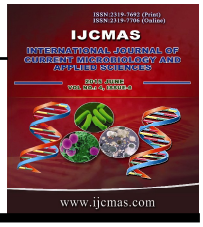

Original Research Article

Influence of Pre-Emergence Herbicides on the Soil Microflora during the Crop growth of Blackgram, *Vigna mungo.L*

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A B S T R A C T

Herbicides are targeted to control weeds in the fields and have direct / indirect consequences on the soil microflora. Both adverse and beneficial effects of herbicides on soil microflora were studied and proved in different ways. Keeping in view, an attempt was made to study the effect of new herbicide molecules like Pendimethalin, Oxyflourfen, Pursuit and Pertialachlor on rhizosphere soil microflora of Blackgram field at Agricultural Research Station, Amaravathi. A gradual raise was observed in the population of microbial groups viz., total Bacteria, total Fungi, total Actinomycetes and total Rhizobia with the application of herbicides in the rhizosphere soil of Blackgram. Among all herbicides, Oxyflourfen showed the highest populations in all the groups of microflora over control. This increase in microbial populations by herbicides may be due to the direct action of herbicide molecule as the substrate for microbial growth or due to indirect effect of enhanced release of root exudates in the rhizosphere soil. All herbicides showed an increase in nodule number of which Oxyflourfen was the highest with an increase by 17% over control. The yield of crop was significantly increased due to application of herbicides and recorded and increase in seed and haulm yield of 14.7% and 13.8% with Oxyflourfen followed by Pertialachlor with 12.5% and 12.2% increase over control.

K e y w o r d s

Pre-emergence herbicide, Soil microflora, Nodulation, Blackgram

Introduction

Herbicides are applied to control weeds in the crop field have direct (or) indirect consequences on non-targeted organisms including soil microflora. Most of the research reports indicate that herbicides do affect microorganisms, but the effect is herbicide dependent, dose dependent, soil dependent and responsive to cultural practices adopted during crop cultivation. After application of herbicides, microorganisms are able to degrade and utilize them as energy source for their metabolic activities and also for physiological processes. While processing these activities there may be a chance of change in soil physicochemical

characteristics. Diversified effect of both toxic and as well as beneficial effect of herbicides on soil microorganisms & soil characteristics were studied in different ways in the recent past. Scientific information says that there is no universal pattern of herbicidal effect on soil microorganisms (Radivojevic *et al.,* 2004; Milanova *et al.,* 2005). In addition to that recently many multinational companies have released new herbicide molecules which are again open huge scope for studying the influence of these molecules on soil microorganisms and soil characteristics. So keeping in view, an attempt was made to study the effect of selected new herbicide molecules on soil microflora and as well as soil characteristics. In the present study we have selected a short duration crop like Blackgram, *Vigna mungo*.L in the post rainy season where herbicides application is mandatory to control weed incident and reduce the loss of soil moisture and nutrients for getting good yields.

Materials and Methods

A field experiment was carried out with Blackgram, *Vigna mungo*. L crop during post rainy season at Agricultural Research Station, Amaravathi, Guntur Dt, Andhra Pradesh. The experiment was laid out in Randomized block Design (RBD) with five treatments and four replications. Blackgram crop was sown with the variety of LBG 752 which is a tolerant genotype for Yellow Mosaic Virus (YMV). We have selected four herbicide molecules for pre-emergence applications viz. Pendimethalin, Oxyflourfen, Pursuit, and Pertialachlor. All the herbicide treatments were fixed with doses as recommended for field crops (Table 1).

Pre-emergence application of herbicides was given at seven days before sowing of the crop. Microbial inoculants of Rhizobium and Phosphorus solubilizing bacteria (PSB) were applied as seed treatment and soil application respectively for Blackgram crop at the time of sowing. Soil samples were collected with a depth of 0-20 cm at 0, 8 and 24 days after emergence (DAE) and processed for air dry and passed through 2mm sieve for analyzing chemical properties. Soil Organic Carbon was estimated by Walkely and Black (1934) method, available Nitrogen by Subbaiah and Asija (1956) method and available Phosphorus by Olsen's (1954) method. Fresh soil samples were passed through 4.0 mm sieve and subjected for microbial estimations. Soil microbial populations were estimated by using serial dilution and plating technique. At grain maturity stage crop was harvested and oven dried at 70^{o}C for 5 days and separated grain and haulm.

Results and Discussion

Soil chemical properties

The soils of Agricultural Research Station, Amaravathi are vertisols and normally have a pH rage of 8.0 to 8.2. The plots received the Oxyflourfen raised the soil pH by 8th day of crop emergence to the maximum extent (8.9) and has come down to initial stage by 24th day after crop emergence. Over–all there is no significant influence of herbicide molecules on the soil pH (Fig. 1). The reduction in soil pH after 8 days of crop emergence is may be due to more activity of acid producing microbes in the soil. Later on the released root exudates of host plant might have contributed to the improvement in rhizosphere soil organic carbon and stabilized the changes in soil pH. The present result is in accordance with that of the results reported by Brown (1990) where soil is saline to alkaline there is no significant influence of herbicide molecules

in altering the soil pH. Similar way we observed no significant variation of soil pH and it was stabilized after three weeks of herbicide application.

All the herbicides molecules increased the soil organic carbon except the herbicide molecule Persuit. Among all, Oxyflourfen has showed high organic carbon content i.e. T3 treatment followed by Pretialachlor (Fig. 2). The increase in per cent organic carbon may be due to break down or degradation of herbicide molecules and more of microbial biomass proliferation by using oxyflourfen as a carbon source for their nourishment. The quantum of breakdown will depend on the synthetic nature of herbicide molecules and it will vary from one to another. Similar way, Srirama Raju and Rangaswamy (1971) reported that soil bacteria and fungi utilize several herbicides when applied at higher concentrations as a carbon source by degrading those complex molecules. The presence of herbicides in the rhizosphere soil of Blackgram might have influenced on the physiological activities of host plant root system and this might have lead to release more quantum of exudates and indirectly contributed to record higher levels of soil Organic Carbon.

Where as in the case of herbicide molecule persuit the behavior is different and it might be persisting more days than other molecules because of low preference by soil microorganisms which were further confirmed by in-vitro studies. Ultimately the herbicide application might have temporarily increased the soil organic carbon in the vertisol fields as shown in the fig 2.

The maximum available Nitrogen was recorded with the pre-emergence herbicide application of Oxyflourfen i.e. 388 kg N/ha (Fig. 3) followed by pendimethalin and pursuit at 8 days after emergence of the crop. In the present study, all the herbicide molecules significantly increased the soil's available Nitrogen over the control. The increase of N may be associated with effective weed control by pre-emergence herbicides and it has indirectly supported the availability of more moisture which might have added nutrients to the soil (Bhutani *et al.*, 1994) and also might have stimulated the growth and activities of aerobic N_2 fixing bacteria and other soil microorganisms and accumulated higher amount of available nitrogen in the soil (Nongthombam *et al.*, 2008).

The herbicide molecule, Oxyflourfen increased the available Phosphorus to the maximum of 31.0 kg P_2O_5/ha (Fig. 4). Oxyflourfen significantly increased the soil available P_2O_5 over the control followed by pretialachlor and pendimethalin. The results indicate that the release of phosphorus in the soil may be slow where the treatment received the pursuit as we recorded in case of soil organic carbon.

Oxyflourfen may highly augmented the proliferation and activities of heterotrophic group of bacteria which has utilized as carbon source and accumulated higher amount of available nutrients and also might have produced organic acids which are major contributors to release mineral phosphates from unavailable reserves in the soil and increased the soil available phosphorus in the early days of crop (Whitelaw, 2000).

Microbial communities

Herbicides degrade in soil through a combination of bridge hydrolysis and microbial degradation. Hydrolysis is significantly faster under acidic (pH 5) than alkaline (pH 8) conditions, allowing the use

of soil pH as a predictor of soil residual activity. Chemical and microbial processes combine to give typical field dissipation half-lives of 1–6 weeks, depending on the soil type, location and compound (Brown, 1990).

Regardless of the herbicide applied the active component mediating the biodegradation and conversion process during crop growth is resident microbial community. After 8th day of crop emergence, there is a rapid increase in the total bacterial population with all treatments (Fig. 5). Oxyflourfen has showed highest bacterial count among others.

The rate of increase of bacterial population is much slow with the treatment of Pursuit and pedimethalin. This is generally depends up on the bacterial community structure present in the particular soil type as well as their preference to utilize either as carbon source or nitrogen source as reported by Tebbe and Reber (1988).

The increase in microflora of soil may be due to increase in organic matter content. Therefore, a shift in microflora population significantly influences the maintenance of soil fertility and productivity owing to the faster rate of decomposition and mineralization of organic materials. Zhao and Li (2008) reported that herbicides in addition also act as microfloral substrate and enhance the growth and multiplication of soil organisms.

Table.1 Treatment details applied in the present study

Treatment	Herbicide	Dosage
T_1	Control	-
T_2	Pendimethalin	1 lit/acre
T_3	Oxyflourfen	400ml/acre
T_4	Pursuit	400ml/acre
T_5	Pertialachlor	800ml/acre

Table.2 Effect of pre-emergence herbicides in vertisol soils on Black gram crop yields

Treatment	Grain yield (Kg/ha)	Haulm yield (Kg/ha)
Control	535	565
Pendimethalin	620	638
Oxyflourfen	768	785
Pursuit	565	608
Pretialachlor	673	690
CD at 5% level	17.743	29.382

Fig.1 Change of soil pH as influenced by application of pre-emergence herbicides

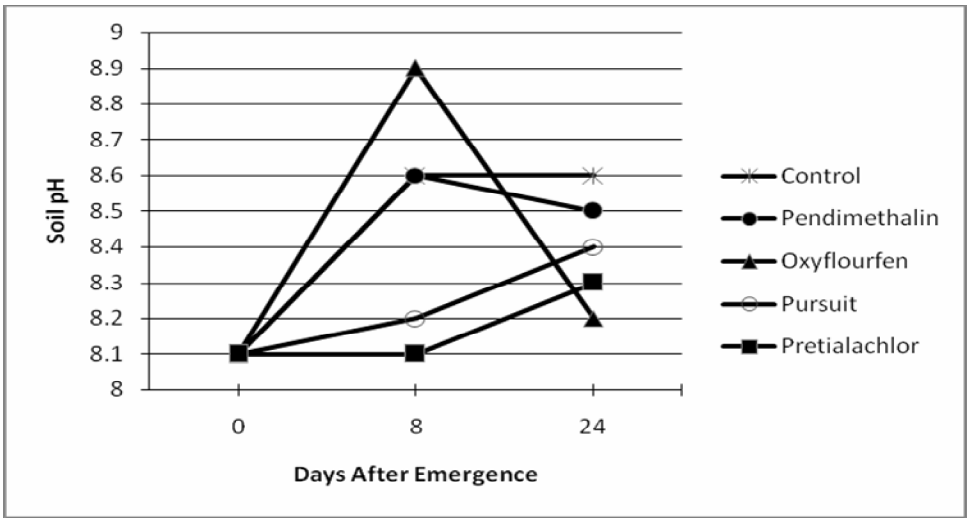


Fig.2 Soil Organic Carbon as influenced by application of pre-emergence herbicides in vertisols

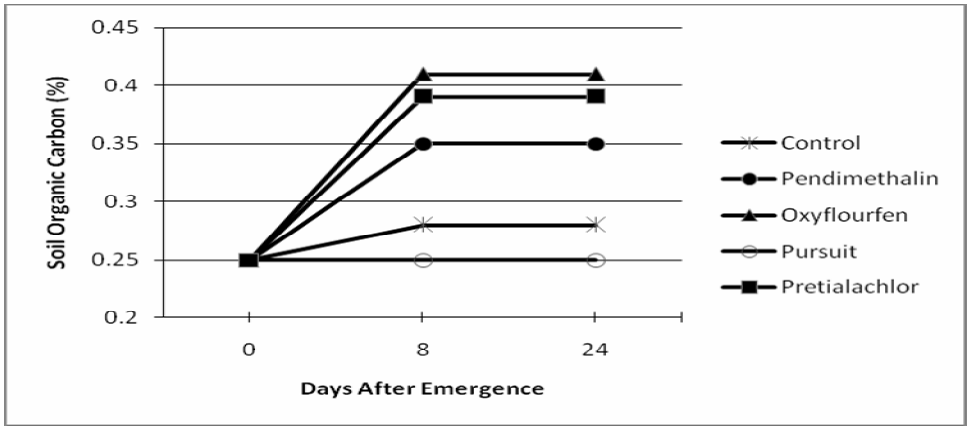


Fig.3 Soil available nitrogen as influenced by application of pre-emergence herbicides in vertisols

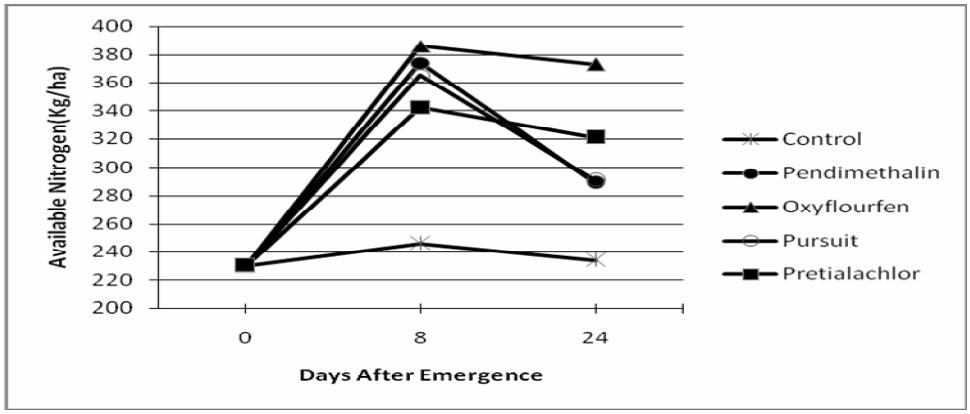


Fig.4 Influence of pre-emergence herbicides application on soil available phosphorus

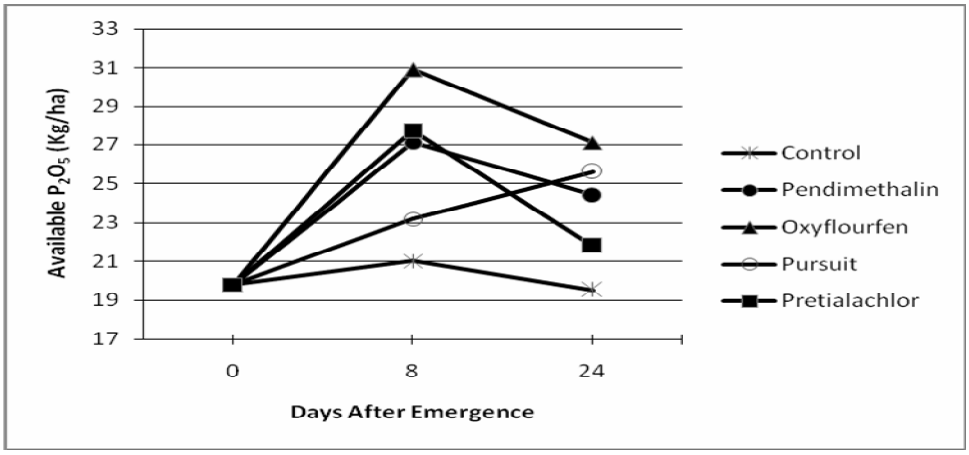


Fig.5 Total bacterial population in vertisol soil as influenced by pre-emergence herbicides

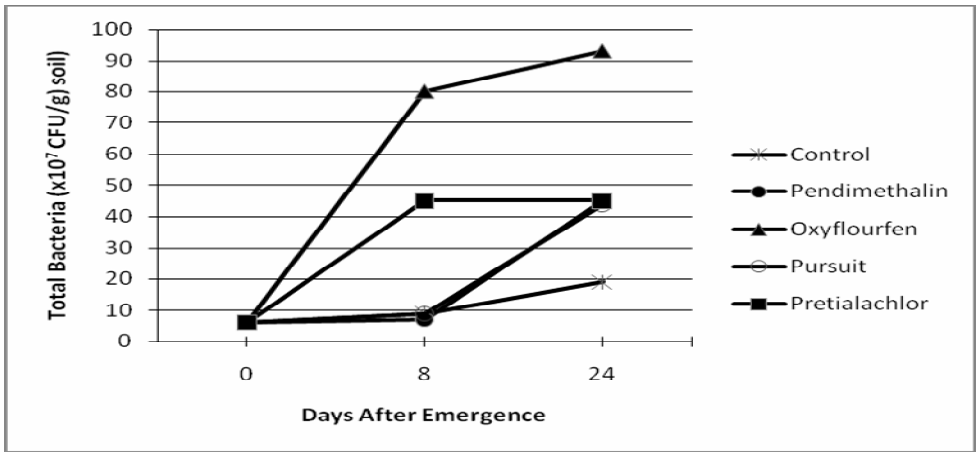


Fig.6 Changes in soil fungal population during Black gram crop growth as influenced by pre-emergence herbicides

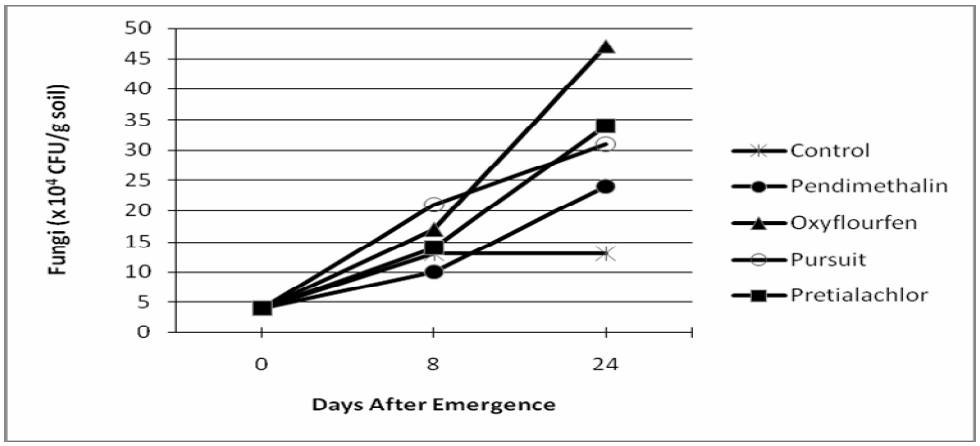
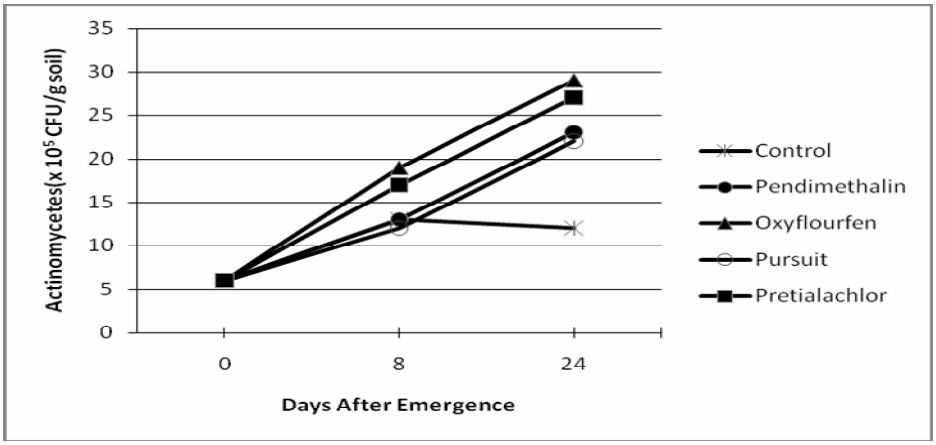


Fig.7 Effect of pre-emergence herbicides on soil actinomycetes population during crop growth



In the soil after Alpha and Beta proteobacteria actinomycetes are the maojor group of microbial communities and resposible active degradation of several organic molecules. Our study aimed the analyzing the potential influence of applied pre-emergence herbicides on the chages of actinomycetes in the soil. Except control treatment all the herbicide molecules enhanced the soil actimycetes population in logertheamic fashion (Fig 7). Oxyflourfen supported to increase maximum extent of actinomycetes population followed by Pretialachlor.

Application of herbicides stimulated the beneficial population and their activities in the soil. These induced activities indirectly influenced mineralization of total nitrogen and availability of inorganic nitrogen in the rhizosphere soil resulting in enhanced yield of the crop. The yield of the crop was significantly increased due to application of Oxyflourfen followed by Pertialachlor. Highest yield (768 kg/ha) was recorded with Oxyflourfen (T3) application as it was reported by Debnath *et al.* (2002) (Table 2).

The yield increase by application of Oxyflourfen is not only because of its chemical nature of suppressing weeds but also its synergistic influence of enhancing soil microbial populations and their activities which are the major contributing factors for obtaining significantly higher yields over control.

In conclusion, we have obtained the evidence that pre-emergence herbicide molecules applied during the crop season in vertisols with recommended dosages does not alter the soil microbial communities tested in the study. The evidence is consistent with the hypothesis that release of nutrients of carbon and nitrogen from applied herbicides depends on the microbial populations in microenvironments may be a community level control on microbial mediated process. In fact the applied herbicide molecules had a synergistic effect on soil microlora and also lead to stimulate the growth of microbial communities in vertisols.

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