Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(5): 2696-2698
Received: 22-07-2017
Accepted: 23-08-2017

M Silambarasan
Assistant Professor,
Department of Agronomy,
The Indian Agriculture College,
Radhapuram, Tamil Nadu, India

NK Sathyamoorthy
Assistant Professor,
Department of Agronomy,
AC & RI, Madurai, Tamil Nadu,
India

M Dhananivetha
Assistant Professor,
Department of Agronomy,
The Indian Agriculture College,
Radhapuram, Tamil Nadu, India

K Sangli Vikram Kumar
Assistant Professor
(Animal Husbandry),
The Indian Agriculture College,
Radhapuram, Tamil Nadu, India

V Kathiravan
Assistant Professor
(Agricultural Economics),
The Indian Agriculture College,
Radhapuram, Tamil Nadu, India

Correspondence
M Silambarasan
Assistant Professor,
Department of Agronomy,
The Indian Agriculture College,
Radhapuram, Tamil Nadu, India

Effect of drip herbigation on native microbial population in maize

M Silambarasan, NK Sathyamoorthy, M Dhananivetha, K Sangli Vikram Kumar and V Kathiravan

Abstract
Herbigation is an application of herbicide through irrigation water can be effectively done through drip irrigation. Drip irrigation (DI) is advanced method of precise application of water most efficiently at the required rate at right time, at the active root zone of the crop. Field trial was conducted during *Rabi* (Jan - May) season to evaluate the effect of native microbial population under irrigated condition in maize. Application of herbicide through drip and conventional spraying were studied for pre emergence application of single Pre emergence herbigation of atrazine (100% recommended dose), Pre emergence herbigation of atrazine (150% recommended dose), Pre emergence herbigation of pendimethalin (100% recommended dose), Pre emergence herbigation of pendimethalin (150% recommended dose), Pre emergence herbigation of pendimethalin (100% recommended dose) + Blackgram, Pre emergence herbigation of pendimethalin (150% recommended dose) + Blackgram, Pre emergence application of atrazine (100% recommended dose), Pre emergence application of pendimethalin (100% recommended dose), Hand weeding twice (15 and 30 DAS) and compared with Weedy Check. Herbicide application done at second irrigation (3 DAS). No significant difference was observed between herbigation and conventional spraying method on native microbial population at before herbicide application. The plots after herbicide application bacterial population was found to be higher under hand weeding twice and weedy check treatments. All the herbicide applied treatments results lower microbial population at 5 DAS. Initial set back in microbial population was recorded over a period of 30 DAS. Most of the studies has been carried out in some other crops but no studies has been done so far in maize in India. So this study forms a baseline in carrying out herbigation in maize.

Keywords: Maize, Herbigation, soil microbes

Introduction
Herbigation is an application of herbicide through irrigation water can be effectively done through drip irrigation. Drip irrigation (DI) is advanced method of precise application of water most efficiently at the required rate at right time, at the active root zone of the crop. DI system offers many advantages compared to other irrigation systems as it is the way for applying fertilizer and herbicide through the irrigation water to soil surface. It is highly suitable to the crops like maize. Weeds cause enormous damage to the maize crop. Weed infestation with crop plants causes considerable reduction in yield (50 to 60%). Critical period of crop weed competition is 3 to 6 weeks after sowing. Farmers usually use soil applied pre emergence herbicide for weed control in corn field. Atrazine and pendemethalin (pre emergence herbicide) are the mostly used pre emergency herbicides. Normal method of application through knapsack sprayer take considerable time and expensive. Heavy wind at the time of spraying and improper application causes more herbicide loss, environmental pollution and drifting injury to the nearby fields especially on sensitive crops. In the present study, we have evaluated an alternative system of herbicide application for control of pre emergence weeds in maize field without cause any effect on soil microbes.

Materials and Method
The experimental site is situated at 9°54' N latitude and 78°54' 'E' longitude with an altitude of 147 m above mean sea level. The field trial was conducted on a well-drained sandy clay loam under irrigated condition at Department of Farm management, Agricultural College and Research Institute, Madurai in 2016 during *Rabi* (Jan-May) season. After field preparation to a fine tilth, raised beds of the size 60 cm × 30 cm were formed leaving 30 cm on all around the bed. In each bed, leaving 30 cm from the edge of bed, two sowing line were marked at 90 cm apart. In each raised bed one lateral line were fitted with turbo key drippers to deliver 8 lph.

The turbo key drippers were fitted at 30 cm apart so as to share one dripper for one crop hills/plant. The treatments were arranged in randomised block design with three replications. Pre emergence herbigation of atrazine (100% recommended dose), Pre emergence herbigation of atrazine (150% recommended dose), Pre emergence herbigation of pendimethalin (100% recommended dose), Pre emergence herbigation of pendimethalin (150% recommended dose), Pre emergence herbigation of pendimethalin (100% recommended dose) + Blackgram, Pre emergence herbigation of pendimethalin (150% recommended dose) + Blackgram, Pre emergence application of atrazine (100% recommended dose), Pre emergence application of pendimethalin (100% recommended dose), Hand weeding twice (15 and 30 DAS) and compared with Weedy Check. For the herbigation treatments, the herbicide were applied through drip laterals and enhance the spreading of herbicide in soil surface. Herbicide application done at second irrigation (3 DAS). The soil of the experimental fields was low in nitrogen (244.4 kg ha^{-1}), medium in phosphorus (21.88 kg ha^{-1}) and potassium (272.50 kg ha^{-1}). Maize hybrid Co MH – 6 was used in this experiment. The maize sowing was done at Jan, 22nd of 2016.
The irrigation was scheduled once in three days based on the daily pan evaporation. The irrigation was given at 100% PE and the quantity of water was calculated as follows

Volume (lit ha^{-1}) = PE × Area (m^2)

$$\text{Time of application} = \frac{\text{Volume of water required (lit)}}{\text{Emitter discharge (lit hr}^{-1}\text{) x No. of emitters plot}^{-1}.}$$

The weed control efficiency (WCE) has been worked out using the following formula.
Dry matter of weeds in control plot

$$\text{WCE} = \frac{\text{Dry matter of weeds in treated plot}}{\text{Dry matter of weed in control plot}} \times 100$$

The recommended fertilizer dose of 250: 75: 75 kg of N, P_2O_5, and K_2O ha^{-1} was applied to maize crop as NK is was scheduled once in seven days starting from 7 to 42 DAS and the entire P as basal. The nutrients have supplied based on the crop growth demand. The harvest was completed in the first week of May. The data collected were statistically analysed and the pooled mean is presented and discussed.

Soil microbiological analyses
Rhizosphere soil samples (0-30 cm soil depth) collected from different treatment plots were serially diluted in 90 ml ringers solution up to 10^{-4} dilution and 1 ml of aliquot was pour plated in selective media, viz. Nutrient Agar for bacteria (Allen 1959) [2], Martin Rose Bengal Agar for fungi (Martin 1950) [8], Kin Knights and Munaiers Agar (Allen 1959) [1] for actinomycetes. The plates were incubated at optimum temperature (28±1 for bacteria; 30±1 for fungi and actinomycetes) in triplicates. The microbial colonies appearing after the stipulated time period of incubation (3days for bacteria; 5 days for fungi and 7 days for actinomycetes) were counted and expressed as total culturable colony forming units (Cfus)/g of the sample.

Result and Discussion
Effect of delivery methods on soil microbial population:
Herbicide degradation in soil may be photochemical, chemical or microbial in nature. Microorganisms are efficient decomposers of aliphatic and hydroxyl compounds, but they decompose aromatic substances at a slower rate. The compounds that contain oxygen, sulfur or nitrogen in the ring are slowest to decompose (Janjia *et al*., 1996) [6]. The herbicide application methods did not influence the microbial population. The different method of weed control has exerted variation on the population of bacteria, fungi and actinomycetes numerically. Numerically lesser microbial population was recorded under all the herbicide applied plots during initial stage. Similar report registered by Ananeva *et al*. (1986) [4]. 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) [14] reported that herbicides in addition also act as microfloral substrate and enhance the growth and multiplication of soil organisms.
The effect of drip herbigation on microbial population is shown in table 1. The soil samples taken from the plots after herbicide application bacterial population was found to be higher under hand weeding twice (T_9) of 14.36 × 10^7 cfu g^{-1} of dry soil and weedy check (T_{10}) of 13.81 × 10^7 cfu g^{-1} of dry soil. The treatment pre emergence application of pendimethalin at 100 per cent recommended dose (T_8) performed better next to above said treatments in recording bacterial population. Among the treatments, pre emergence herbigation of atrazine at 150 per cent recommended dose recorded lower bacterial population (9.65 x 10^7 cfu g^{-1} of dry soil). Unintended consequence of herbicides applications may be the reduction of sensitive populations and/or stimulation of certain microbial groups with or without detriment to co-existing microbial populations that may compete for available resources. The fate of the herbicide residues in soil is a matter of great concern since they would persist on top soil (Ayansina *et al*., 2003) [5], accumulate to toxic level and become harmful to microorganisms (Amakiri, 1982) [3], and changes in nutrient levels (Wang *et al*., 2008) [13]. The similar findings are reported by Stanley *et al*., 2013 [12] when herbicide are applied, the chemical exist certain effects non-target microorganisms including soil microorganisms especially immediately after application. Similar trend was also observed in recording fungi and actinomycetes. Ramesh and Nadanassababady (2005) [10] reported that shortly after application of herbicides (5 DAS) significant difference in microbial population.
The soil samples collected from the treated plots after 15 DAS, the bacterial population was found to be higher under hand weeding twice (T_9) of 16.51 × 10^7 cfu g^{-1} of dry soil and weedy check (T_{10}) of 17.96 × 10^7 g^{-1} cfu g^{-1} of dry soil. The treatment pre emergence spray of pendimethalin at 100 per cent recommended dose (T_8) performed better next to above said treatments. Pre emergence herbigation of atrazine at 150 per cent recommended dose recorded lower bacterial population (13.95 10^7 cfu g^{-1} of dry soil). Similar trend was also observed in fungi and actinomycetes. All herbicide applied treatments recorded lower microbial population compared to hand weeding and weedy check (Alaguselvi, 2014) [1].
Initial set back in microbial population was recorded over a period of 30 DAS. The plots which treated with weedy check (T_{10}), hand weeding twice (T_9) recorded the microbial population of bacteria (44.55 and 44.27× 10^7 cfu g^{-1} of dry soil), fungi (48.23 and 47.61× 10^3 cfu g^{-1} of dry soil) and

actinomycetes (20.09 and 19.85× 10^4 cfu g^{-1} of dry soil) respectively. Pre emergence herbigation of pendimethalin at 150 per cent recommended dose with blackgram (T_6) recorded the microbial population of 44.18 × 10^7 cfu g^{-1} of dry soil, 48.93× 10^3 cfu g^{-1} of dry soil and 20.47× 10^4 cfu g^{-1} of dry soil bacteria, fungi and actinomycetes respectively. The microbial population build up at 30 DAS clearly suggested that all the herbicides and methods tried are safe to be used in maize crop. This is in conformity findings of Nalayini *et al*. (2013) [9]. Most studies have shown that the use of herbicides at recommended application rates does not adversely affect the microbial activity (Lupwayi *et al*. 2004, 2007) [7]. Smith (1982) reported no significant residual toxic effect to soil microbes due to application of inorganic herbicides.

Conclusion

From this study it is concluded that, the use of herbicides at recommended application rates does not adversely affect the microbial activity. Hence, the use of normal method of herbicide application and herbigation have no any significant effect on microbes. So, from economic point of view, herbication is recommended for better profitability. Further studies should be carried out in studying the herbigation movements in the soil for understanding the effective action of herbicide.

Acknowledgement

The authors would like to thank their colleagues and water shed management labours of AC&RI, Madurai for their help and support during this study.

Table 1: Microbial population as influenced by application methods

Treatments	Microbial population (cfu X 10^{-4} g^{-1} of dry soil)								
	Before herbigation			After herbigation			30DAS		
	Bacteria	Fungi	Actinomycetes	Bacteria	Fungi	Actinomycetes	Bacteria	Fungi	Actinomycetes
Pre emergence herbigation of atrazine (100 % recommended dose)	28.43	30.63	12.86	26.89	27.75	10.32	43.86	47.27	19.67
Pre emergence herbigation of atrazine (150 % recommended dose)	29.51	30.42	12.35	23.38	25.34	9.65	42.94	47.06	19.86
Pre emergence herbigation of pendimethalin (100 %)	29.49	31.04	12.41	27.58	30.46	11.78	43.92	48.68	20.22
Pre emergence herbigation of pendimethalin (150 % recommended dose)	29.05	30.61	12.63	24.51	28.13	10.08	43.85	48.25	19.64
Pre emergence herbigation of pendimethalin (100 % recommended dose) + Blackgram	28.21	31.76	12.37	27.23	30.58	11.51	45.63	48.40	19.18
Pre emergence herbigation of pendimethalin (150 % recommended dose) + Blackgram	28.71	31.29	12.83	24.47	29.03	9.97	44.18	48.93	20.47
Pre emergence application of atrazine (100 % recommended dose)	28.92	30.70	12.49	26.67	27.92	10.68	43.53	47.34	19.50
Pre emergence application of pendimethalin (100% recommended dose)	29.16	31.86	12.62	27.84	30.29	11.45	43.88	48.50	19.13
Hand weeding twice (15 and 30 DAS)	29.84	31.97	12.28	34.53	37.55	14.36	44.27	47.61	19.85
Weedy Check	29.75	31.59	12.14	36.07	38.56	13.81	44.55	48.23	20.09
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS – Not significant

References

1. Alaguselvi. Studies on site specific weed control with patch spray of post emergence herbicides in maize (*Zea mays L.)*. M.Sc (Ag.) Thesis, Tamil Nadu Agriculture University, Coimbatore, 2014.
2. Allen ON. Experiments in soil bacteriology. Burgess publishing, Minneapolis, MN, USA, 1959.
3. Amakiri. Response of soil microflora in herbicide residue of winter irrigated cotton. Crop Res. 1982; 45(1, 2 & 3):268-271.
4. Ananeva ND, Strekozov BP, Tyuryukanove GK. Effect of herbicides on microbial biomass in different soils. Pakistan J bio. Sci. 1986; 95:84-90.
5. Ayansina S, Ashok M, Latha, Subramanyeswara Rao A. Influence of pre-emergence herbicides on the soil microflora during the crop growth of blackgram (*Vigna mungo.* L). Int. J. Curr. Microbiol. App. Sci. 2003; 4(6):539-546.
6. Janjia, Milosevia, Mitar. Effect of herbicides on microbiological properties of soil. Int. J Scientific and Research Publications. 1996; 4(5):2250-3153.
7. Lupwayi NZ, Harker KN, Clayton GW, Turkington TK, Rice WA, Donovan OJT. Soil microbial biomass and diversity after herbicide application. Canadian journal of plant science. 2004; 84:677-85.
8. Martin JP. Use of acid, rose bengal and streptomycin in plate method for estimation of soil fungi. Soil Science. 1950; 69:215-232.
9. Nalayini, Gurhan. Herbigation in cotton (*gossypium* spp): effects on weeds control, soil microflora and succeeding greengram (*vigna radiata*). Indian J agric. Sci. 2013; 83(11):1144-8.
10. Ramesh G, Nadanassababady T. Impact of herbicides on weeds and soil ecosystem of rainfed maize (*Zea mays* L.). Indian J Agric. Res. 2005; 39(1):31-36.
11. Smith AE. Herbicides and soil environment in Canada. Canadian journal of soil science. 1982; 63(3):433-60.
12. Stanley HO, Maduike EM, Okerentugba PO. Effect of herbicide (atrazine and paraquat) application on soil bacterial population. Sky J. Soil Sci. and Environmental Management. 2013; 2(9):101-105.
13. Wang O, Olivera K, Silva, Freitas F. Effect of four herbicides on soil organic carbon, microbial biomass-c, enzyme activity and microbial populations in agricultural soil. Int. J. Res. in Environmental Sci. and Tech., 2008; 3(4):100-112.
14. Zhao, Li. Influence of pendimethalin application with different fertilizer on soil enzyme activitiesin bulandshahr soil. Int. J. Scientific and Research Publications. 2008; 8(5):225-356.