Effect of Pre-emergence Herbicides on Microbial Biomass and Biochemical Processes in a Typic Fluvaquent Soil Amended with Farm Yard Manure

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Abstract—*Application of thiobencarb, pendimethalin and pretilachlor at rates of 7.5, 10.0 and 2.5 kg a.i. ha-1, respectively, under laboratory conditions, significantly increased microbial biomass C, N and P, resulting in greater availability of C, N and P in soil amended with farm yard manure. Application of thiobencarb highly induced microbial biomass C (46.3 %) and N (40.6 %), while pretilachlor and thiobencarb augmented microbial biomass P to the extent of 14.9 % and 14.1 %, respectively. Application of pendimethalin retained the highest amount of total N (19.9 %), soluble NO_3^- (56 %) and available P (69.5 %) in soil. A similar trend was recorded with thiobencarb for oxidizable organic C (18.1 %) and with pretilachlor for exchangeable NH_4^+ (65.8 %). At the end of the experiment, the highest stimulation of bacteria was recorded with thiobencarb (29.6 %), while pretilachlor harboured the maximum number of actinomycetes (37.2 %) and fungi (40 %) in soil compared to the untreated control. The use of herbicides for combating unwanted weeds in crops is now a common practice in agriculture. During herbicide application, a portion of these chemicals accumulates in the top soil layer (0–15 cm), where most microbiological activities occur (Alexander 1978). Microorganisms are scavengers in soil and possess physiological variability, degrading a variety of chemical substances, including many herbicides, to derive energy, C and other nutrients for their metabolism (Das and Debnath 2006). As a result, microbial biomass increases (Perucci and Scarponi 1994; Das et al. 2012), which in turn, favourably influences the transformation of nutrients in soil (Das et al. 2003). Some herbicides are not utilized by soil microorganisms and are degraded through co-metabolism (Kearney et al. 1967; Alexander 1978). Reports are also available (El-Ghamry et al. 2001) on the toxic effect of herbicides on growth and activities of microorganisms in soil. Therefore, no definite conclusion can be made on the effect of herbicides on the growth and activities of microorganisms in soil, since different groups of herbicides exhibit manifold variations in toxicity (Alexander 1978). Moreover, comparative residual effects of widely used thiocarbamate, dinitroaniline and chloroacetamide herbicides on microbial activities under a particular set of soil conditions have rarely been studied. Therefore, to determine the nutrient availability for better crop growth, it becomes imperative to study the effect of these herbicides on the activities of microorganisms in relation to the availability of plant nutrient elements in soil. Objectives of the present study were to investigate the effect of three pre-emergence herbicides viz., thiobencarb [(S-(4-chlorophenyl) methyl) N,N-diethylcarbamothioate], pendimethalin [N-(1-ethylpropyl)-2,6-dinitro-3,4-dimethylaniline] and pretilachlor [2-chloro-N-20,60-diethyl-N-(2-propoxyethyl) acetanilide], representing thiocarbamate, dinitroaniline and chloroacetamide herbicides respectively, at rates of 7.5, 10.0 and 2.5 kg active ingredient (a.i.) ha-1 respectively (fivefold of field application rates), on the changes of microbial biomass carbon (C), nitrogen (N), and phosphorus (P) as well as mineralization and availability of C, N and P in a fluvaquent soil amended with farm yard manure (FYM).The high concentration of herbicide was taken due to frequent and indiscriminate use of herbicide by the farmers in some localities to combat weeds in the crop fields according to their own choice and to mitigate the toxic effect of the herbicide (if any) on the microbial activities, the soil was amended with organic substances (FYM) easily available to the Indian farmers.*