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A study of the fate of herbicide Imazosulfuron in soil environment

Kazuki MIKATA

Agricultural Research Laboratories, Agro Company, Takeda Chemical Industries, Ltd.
Tsukuba, 300-4247, Japan

Imazosulfuron, 1-(2-chloroimidazo[1,2-α]pyridin-3-ylsulfonyl)-3-(4,6-dimethoxy-pyrimidin-2-yl)urea, developed by Takeda Chemical Industries, Ltd., is a sulfonylurea herbicide with imidazo[1,2-α]pyridine moiety. It exhibits potent herbicidal activities against most relevant weeds such as *Cyperus difformis, Lindernia procumbens, and Scirpus juncoides* in rice paddy fields, and *Capsella bursa pastoris* and *Matricaria* varieties in wheat and barley field at low application rate of 9-25 g a.i./ha. It has been reported that the mode of action of imazosulfuron is an inhibition of acetolactate synthase, a key enzyme in the biosynthetic pathways of branched-chain amino acids such as isoleucine and valine, and the crop selectivity is considered to reside in rapid metabolic inactivation by the tolerant plant.

In practical field use of pesticide the most amount of pesticide applied is translocated into soils. Therefore predicting the behavior of pesticide in soils is significant to avoid the contamination of environment. In the present study, the degradation, adsorption-desorption and mobility of imazosulfuron in soils were investigated to estimate the fate of imazosulfuron in soil environment.

Degradation of imazosulfuron in flooded and upland soils were investigated under laboratory conditions using two kinds of ^{14}C labeled imazosulfuron. A significant difference in the degradation of imazosulfuron was observed between aerobic and anaerobic conditions. The half-lives of imazosulfuron were determined 40 and 3 days under aerobic and anaerobic flooded conditions, respectively. Under aerobic upland condition, the half-life was determined 60 days. Imazosulfuron under aerobic flooded and upland condition was degraded by hydrolysis of the sulfonylurea bond to give 4,6-dimethoxy-2-pyrimidinamine (ADPM) and 2-chloroimidazo[1,2-α]pyridine-3-sulfonamide (IPSN) as the primary degradation products. On the other hand, imazosulfuron under anaerobic flooded condition was degraded by soil microorganisms to give1-(2-chloroimidazo[1,2-α]pyridin-3-ylsulfonyl)-3-(4-hydroxy-6-methoxypyrimidin-2-yl)urea (HMS).

In soil adsorption-desorption study under laboratory conditions, Freundlich K values of 0.96 to 5.27 were obtained by the batch adsorption technique. The soil desorption constants of imazosulfuron in upland soils increased with time by a factor of 2.4 to 36.4 during 60 days of aging. These findings suggested that imazosulfuron would rapidly dissipate in paddy field maintained to be anaerobic flooded condition. On the other hand, imazosulfuron could be considered to indicate significant movement in upland soils judging from small Freundlich K values and a long half-life of 60 days. However, it was assumed that imazosulfuron would become more strongly retained in upland soils by the increase of soil desorption constant, and the mobility of imazosulfuron would decrease with time.

In lysimeter study under field condition, three lysimeters with 1 m^2 surface and 110 cm depth were treated with two kinds of ^{14}C labeled imazosulfuron at the rate of 50 g a.i./ha. The yearly

mean concentrations of imazosulfuron and degradation products in the leachate water from lysimeters did never exceed 0.10 μg/L during the 3-years monitoring period even after the applications of 50 g/ha in two subsequent years. At the termination of monitoring period of three years the main portion of ^{14}C recovered was found in the upper 30 cm soil layer in each lysimeter, and no ^{14}C was detected below 50 cm of depth.

Although imazosulfuron could be considered to have significant mobility in upland soils based on the results of laboratory degradation and adsorption studies, the concentrations of imazosulfuron in the leachate water from lysimeters were less than 0.10 μg/L during monitoring period. On the basis of these results, it was assumed that soil desorption is important factor determining the mobility of imazosulfuron, and the increase of soil desorption constants contributed to the low mobility of imazosulfuron in soils under field condition. From these findings, it was reasonably concluded that imazosulfuron and degradation products will not reach environmentally significant concentrations in soils and groundwater in practical field use.

Key words: Imazosulfuron; soil; degradation; adsorption; desorption: mobility; lysimeter