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新除草劑 Azimsulfuron의 除草活性과 土壤中 行動

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Herbicidal Property and Soil Behavior of a New Herbicide, Azimsulfuron

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Abstract

Azimsulfuron [1H-pyrazole-5-sulfonamide,N-(((4,6-dimethoxy-pyridine-2-yl-aminocarbonyl-4-(2-methyl-2H-tetrazole-5-yl)] is a new sulfonamide herbicide that selectively controls a wide range of weeds in lowland rice (*Oryza sativa*). It effectively controlled *Cyperus serotinus, Eleocharis kuroguwai, Sagittaria pygmaea, S. trifolia, and Scirpus juncoides* at 7.5 - 30 g ai/ha. In the tolerance test on grasses carried out in a nutrient solution containing 0.3 - 30 ppm of azimsulfuron, greater inhibition occurred in roots of both rice and barnyardgrass (*Echinochloa crus-galli*) than in shoots. However, rice root was approximately 5-fold more tolerant than that of barnyardgrass. The downward movements as determined by 50% growth inhibition of *S. juncoides* were 4-cm in clay loam and 6.5-cm in sandy loam soil with 3-cm/day leaching for 3 days. When incubated at 20 and 30℃, the residual effect in clay loam soil lasted for 30 and 21 days, respectively. In a soil column applied at 15 g ai/ha of azimsulfuron followed by 3-cm/day leaching for 3 days, dry weights of *S. trifolia* emerging at 5, 10, and 15-cm depth were reduced to 87, 85, and 79% of the corresponding untreated control, respectively. Susceptibility of *S. trifolia* to azimsulfuron did not greatly vary with the emergence depth.

Key words : Azimsulfuron, Herbicidal property, Soil behavior

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INTRODUCTION

Azimsulfuron is a new pre-emergence sulfonamide herbicide being developed by E. I. DuPont de Nemours Company for control of a wide range of broadleaves and sedges.[1]. In Korea change in dominant weed population from annual to perennial weeds has occurred due to very extensive use of herbicides effective to annual weeds[2]. This has required an introduction of herbicides which are effective to perennial weeds. In spite of wide use of the present sulfonylurea herbicides, however, such perennial weeds as *E. kuroguwai* and *S. trifolia* are difficult to satisfactorily control.

Our preliminary field trials with azimsulfuron have shown good activity against the major troublesome weed species. The herbicide can be applied at rates of 7.5 to 30 g ai/ha within 10 to 15 days after the rice is transplanted. Based on the results obtained, azimsulfuron is considered to be a new promising herbicide which can effectively control the perennial weeds that are tolerant to the present sulfonylurea herbicides. To obtain more informations on azimsulfuron to develop a new rice herbicide, we determined differential responses of rice and various weed species to azimsulfuron and some soil behaviors.

MATERIALS AND METHODS

Growth response

Granular formulated azimsulfuron (0.05%) was applied at rates of 7.5 to 30 g ai/ha into the 3-cm standing water of plastic pots containing 2 leaf stage of rice and dormancy-broken weed seeds and tubers. The pots were placed in a greenhouse maintained with at a 30℃ day/23℃ night temperature regime and 14-h photoperiod. Water was not added to the pots for 2 days after azimsulfuron application, after which flood level was maintained at 3-cm water depth. Rice injury and herbicidal activity were determined 30 days after application by recording shoot dry weight reduction of the treated plants compared with untreated control plants.

To compare differential susceptibility of rice and barnyardgrass to azimsulfuron, thirty pre-germinated seeds of rice and barnyardgrass were transferred to a hydroponic nutrient solution containing azimsulfuron ranged from 0.3 to 30 ppm. They were placed in a dark chamber (25℃, 70% RH). Shoot and root lengths of the plants were measured 10 days after herbicide application.

Persistence

Azimsulfuron at the rate of 15 g ai/ha was applied to two types of soils (clay loam and sandy loam) in plastic pots maintained with 3-cm water depth. The pots were kept in growth chambers of 20 and 30℃. Seeds of *S. juncoides* were sown at the interval of 5-day and harvested 2 weeks after seeding. Growth inhibition was determined as percent of the untreated controls on the basis of shoot dry weight. Half-life was calculated on the basis of the day required to cause 50% growth inhibition of *S. juncoides*.

Downward movement

Fifteen-cm stacked-cylinder columns were prepared from 12-cm diameter plastic pipe which had been cut into 1-cm sections. The columns were packed with soils and flooded with 1-cm water depth. Azimsulfuron at the rate of 15 g ai/ha was

applied to the columns. Leaching with the rate of 1, 2, and 3-cm/day was initiated 5 hours after herbicide application. One-cm water depth in the columns was always maintained during the leaching process by watering from top of the columns. Upon completion of the leaching process, the soil column was divided into 1-cm sections and the section soil was transferred to a plastic pot. Seeds of *S. juncoides* were sown into the pot and grown in the growth chamber described above. Dry weight of the shoots was measured at 20 days after seeding. The experiment was replicated three times.

Suceptibility of *S. trifolia* and *E. kuroguwai* emerging from different soil depths to azimsulfuron was determined in relation to downward movement of azimsulfuron. Unless stated, the above experimental procedure was followed. Tubers of the two weeds were planted at 5, 10, and 15 cm depth of the clay loam soil column. After application of azimsulfuron with 15 g ai/ha, water was leached with the rate of 3-cm/day for 3 days. Growth inhibition on the basis of the dry weight was determined as percent of the corresponding untreated control at each planting depth.

RESULTS AND DISCUSSION

Susceptibility difference

There was a great difference in susceptibility to azimsulfuron between rice and broadleaves and sedges treated (Fig. 1). Rice transplanted at 2-leaf stage tolerated to azimsulfruron applied at rates of 7.5 to 30 g ai/ha. At 30 g ai/ha of azimsulfuron growth inhibition of rice reached only about 10% of the untreated control, while about 90% growth inhibition was obtained for all the weed species tested. As decreasing the application rate, however, susceptibility difference between the weed species occurred. At 7.5 and 15 g ai/ha of azimsulfuron a relative tolerance was greater in *S. pygmaea* than in *S. trifolia*. A similar effect was also found with the sedges, that is, *C. serotinus* was more tolerant than *E. kuroguwai* and *S. juncoides*.

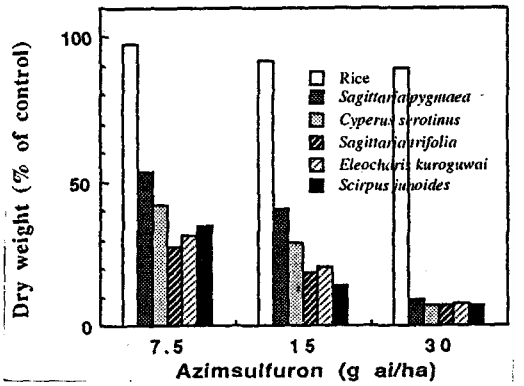

Fig. 1. Growth response of rice and perennial paddy weeds to azimsulfuron.

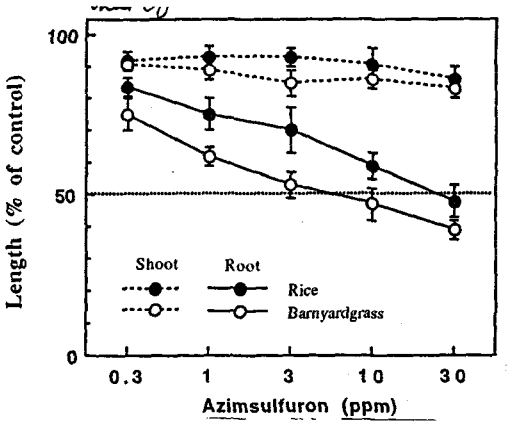

Fig. 2. Differential response of rice and barnyardgrass to azimsulfuron.

Susceptibility difference to azimsulfuron was also found between rice and barnyardgrass. In the tolerance test carried out in a nutrient solution containing 0.3 - 30 ppm of azimsulfuron, greater inhibition occurred in roots of both plants than in

shoots (Fig. 2). However, root of rice was approximately 5-fold more tolerant than that of barnyardgrass. Concentration of azimsulfuron required to cause 50% growth inhibition of root was 5.5 ppm for barnyardgrass and 28 ppm for rice.

Persistence

Persistence of azimsulfuron in soil did not vary with soil type, but was affected by temperature. There was no significant difference half-life in the soil between clay loam and sandy loam soils (Table 1). However, the half-life was longer when incubated at 20℃ than at 30℃. In both the soils, azimsulfuron persisted for 30 to 32 days at 20℃ and for 21 to 22 days at 30℃.

Table 1. Persistance of azimsulfuron in different soil types at two temperature regimes.

Soil type	Temperature(℃)	Half-life(day)[1]
Clay loam	20	30 a
	30	21 b
Sandy loam	20	32 a
	30	22 b

[1]Means followed by a common letter are not significantly different at the 5% level by Duncan's Multiple Range Test.

Downward movement

The downward movement was expressed by the soil depth where 50% growth inhibition of the test plant, *S. juncoides* occurred. Mobility of azimsulfuron varied with soil type and amount of leaching (Table 2). The movement was greater in sandy loam soil than in clay loam soil and increased as increasing the leaching amount. The results indicate that azimsulfuron exhibits a relatively high mobility potential in the soils.

Table 2. Downward movement of azimsulfuron under different soil types and leaching grades

Soil texture	Mobility (cm)[1]		
	Leaching amount (cm/day)		
	1	2	3
Clay loam	2 d	2.5 d	4 bc
Sandy loam	3 cd	4.5 b	6.5 a

[1]Means followed by a common letter are not significantly different at the 5% level by Duncan's Multiple Range Test.

Effect of emergence depth on sensitivity of *Sagittaria trifolia* and *Eleocharis kuroguwai* to azimsulfuron

In a soil column applied at 15 g ai/ha of azimsulfuron followed by leaching with 3-cm/day for 3 days, dry weights of *S. trifolia* emerged at 5, 10, and 15-cm depth were reduced to 87, 85, and 79% of the corresponding untreated control, respectively (Fig. 3). The growth reduction of *E. kuroguwai* was obtained with 85, 80, and 57% at 5, 10, and 15-cm depth, respectively. For the both species, the growth inhibition decreased with increasing the emergence depth. This was due probably to decrease in concentration of azimsulfuron at deeper soil depths. As shown in the above mobility experiment, azimsulfuron leached to about 4-cm depth under the same condition given to this experimental system. On the other hand, difference in susceptibility between emergence depths was greater in *E. kuroguwai* than in *S. trifolia*. The fact that there is no great difference in susceptibility of *S. trifolia* between the emergence depths indicates that azimsulfuron can control

satisfactorily *S. trifolia* emerging at various soil depths.

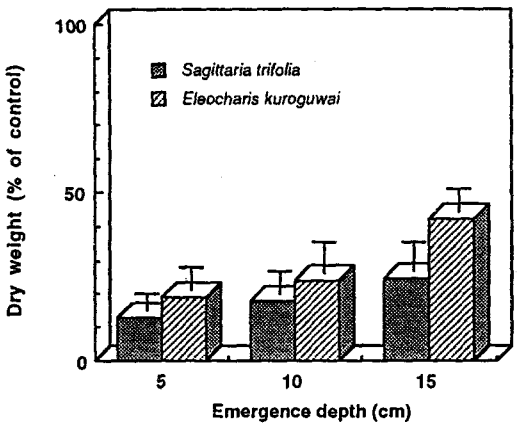

Fig. 3. Growth response of *Sagittaria trifolia* and *Eleocharis kuroguwai* emerging at different soil depths to azimsulfuron.

要 約

새로운 sulfonamide型 除草劑 asimsulfuron은 논에서 發生하는 多年生 雜草인 너도방동사니, 올방개, 올미, 벗풀 및 올챙고랭이에 대하여 7.5 - 30 g ai/ha 處理 水準에서 選擇的인 防除 效果를 나타낸다. Azimsulfuron 0.3 - 30 ppm 水準을 包含한 養液栽培에서 禾本科에 대한 耐性 檢定 結果, 벼 및 피의 地上部 莖葉에 대한 沮害보다는 뿌리에 대하여 더 큰 沮害를 나타내었다. 그러나 벼의 뿌리는 피에 대하여서 azimsulfuron에 대하여 약 5倍 以上의 耐性을 보였다. 올챙고랭이 生育 50% 沮害에 必要한 濃度를 基準으로 測定한 土壤 中 下方 移動은 3日間 3 cm/日의 溶脫 條件下에서 埴壤土에서 4 cm, 砂壤土에서 6.5 cm이었다. 埴壤土 條件下 20℃ 및 30℃에서 培養된 azimsulfuron의 殘效性은 각각 30日 및 21日 持續되었다. Azimsulfuron 15 g ai/ha 處理後 3日 동안 3 cm/日 溶脫시킨 土壤컬럼에서 表層下 5, 10 및 15 cm에 移植된 벗풀의 乾物重은 각 層位에서 出芽된 無處理 對比 87%, 85% 및 79%로써 azimsulfuron에 대한 벗풀의 感受性은 移植 深度에 따라 크게 변하지 않았다.

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