藥作誌(Korean J. Medicinal Crop Sci.) 3(2) : 146－150

高麗人蔘에 대한 除草劑 Fluazifob-butyl의 安全性

曺在星*, 元俊淵*

Safety of the Herbicide Fluazifop-butyl application on the Korean Ginseng(*Panax ginseng* C.A. Meyer)

Jae-seong Jo*, Jun-yeon Won**

ABSTRACT : Weed control in the Korean ginseng(*Panax ginseng* C.A. Meyer) garden is more difficult than in other crops because the ginseng is a perennial crop and has to be cultivated under the artificial shading. As hand weeding is the only practical means to control weed after crop establishment, a selective herbicide would greatly simplify the control of weed in ginseng garden. In an exploratory experiment, the hervicide Fluazifop-butyl was found to be selectively safe for the Korean ginseng plants.

Various rates of Fluazifop-butyl were sprayed on 2-, 3-, and 4-years old ginseng plants as a foliar spray to detect crop injury and to difine their critical concentration. No apparent injury to the ginseng plant was noticable even the doubled application rate of Fluazifop-butyl the based on recommended dosage. Neither abnormal foliar change nor any inhibition in leaf and stem growth was resulted for 2-, 3-, and 4-years old ginseng plants treated with Fluazifop-butyl tripled the recommended usage. The foliar treatments of Fluazifop-butyl did not influence the photosynthesis ability but inhibited the respiration of the ginseng leaf.

Introduction

Because the ginseng is a perennial crop and has to be cultivated under the aritificial shading, weed control in ginseng planting is more difficult than in other crops. Ginseng plants have been known to be affected rather easily by the chemical herbicides and any selective herbicide for the ginseng plant has not been found up to now except 2,4-D[3,4]. As hand weeding is the only practical means of eliminating weed after crop establishment, a selective herbidide would greatly simplify the control of weeds in ginseng plantings and reduce labor costs.

Fluazifop-butyl is commonly used to control grasses in soybean, cotton, carrot, and garlic field[1,7]. This herbicide was occasionally used by the Korean ginseng growers to control weeds in path of ginseng plantings. In 1991, the author had found that the Fluazifop-butyl was selectively safe for the Korean ginseng plant and might safely be

* 忠北大學校 農科大學(Chungnam National University, Taejon, 305－764)
** 中部大學校(Joong-bu University, Chungnam, 312－940)

used for control of weeds in ginseng plantings. This study was conduced to investigate the effects of foliar application of the herbicide Fluazifop-butyl on plant growth, photosynthesis ability and respiration of the Korean ginseng plant for determining non-toxicity of the herbicide.

Materials and Methods

The experiments were carried out at a farmer's ginseng field in Keumsan, Chungnam Province and at the experiment field of the Agricultural college, Chungnam National University for 2 years since 1992.

To determine the effects of Fluazifop-butyl on the photosynthesis and respiration of the ginseng, the herbicide was treated to 4 years old ginseng plants as a foliar spray at the rates of 0, 75, 150, 225 and 300mℓ/100ℓ of water at the 40 days after plant emergence. The amounts of photosynthesis were measured 10 times in each day from 8 to 17 o'clock by 1 hour interval and respiration amounts were measured 10 times from 20 to 5 o' clock by 1 hour interval. To determine the effects of Fluazifop-butyl treatment on the plant growth of the ginseng, 6 concentrations(0, 37.5, 75, 112.5, 150 and 225mℓ/100ℓ of water) of the herbicide were treated to each 2-, 3-, and 4-years-old ginseng plants as foliar spray at the 40 days after plant emergence and the plant growth was observed at the 20 days after the herbicide treatment.

Results and Discussion

The Fluazifop-butyl is a phenoxy compound and commonly used in soybean, sugarbeet, coffee and cotton plantings as a post emergence herbicide to control grasses. The compound is absorbed in plants through the roots and shoots and inhibits acetyl-CoA carboxylase, the enzyme catalyzing the first commintted step in fatty acid synthesis[2,3,7].

Table 1. Changes in the photosynthesis amounts of the Korean ginseng plant by Fluazifop-butyl foliar application

Concentration applicated (mℓ/100ℓ)	Photosynthesis amount(mg/CO_2/hr) after the days of application					
	1	3	5	7	10	15
0	1.63a	1.67a	2.36a	1.59b	2.33a	1.69bc
75	1.71a	1.79a	2.17a	2.28a	2.20a	2.43a
150	1.59a	1.72a	2.19a	2.26a	2.05ab	1.94b
225	1.16b	1.34b	1.82b	2.05a	1.81b	1.63c
300	0.70c	0.79c	1.23c	1.42b	1.37c	1.20d

1. The amounts of photosynthesis were measured 10 times from 8 AM to 5 PM by 1 hour interval.
2. Mean separation within the treatments by DMR at 5% significant level.

Photosynthesis ability of the ginseng leaf was not influenced by foliar application of Fluazifop-butyl at the rate of 75 and 150mℓ/100ℓ of water which doubled the concentration of the recommended dosage. The amount of photosynthesis was significantly reduced when ginseng leaf was treated with Fluazifop-butyl at the rate of 225 and 300mℓ/100ℓ of water. The ginseng leaf treated with Fluazifop-butyl at the rate of 225mℓ/100ℓ of water was photosynthesis ability in 1 week after treatment, but the leaf treated with Fluazifop-butyl at the rate of 300mℓ/100ℓ of water, was not increased until 2 weeks after treatment(Table 1).

Respiration in 4-years old ginseng plants was significantly inhibited by the foliar application of Fluazifop-butyl. The respiration amounts of the plants were significantly reduced at the concentration of 75mℓ/100ℓ of water or more of the herbicide. The higher concentration of the Fluazifop-butyl treatments resulted in the more reduced amounts of respiration. The reduced respiration

of ginseng plants at various concentrations was not recovered until 15 days after the treatment (Table 2).

Table 2. Changes in the respiration amounts of the Korean ginseng plant by Fluazifop-butyl foliar application

Concentration applicated (mℓ/100ℓ)	Photosynthesis amount(mg/CO_2/hr) after the days of application					
	1	3	5	7	10	15
0	0.51a	1.05a	0.78a	0.74a	0.33a	0.76a
75	0.35b	0.70b	0.57b	0.50b	0.23bc	0.54b
150	0.32b	0.69b	0.57b	0.52b	0.29b	0.55b
225	0.25b	0.54bc	0.49b	0.42b	0.26b	0.49bc
300	0.18c	0.38c	0.33c	0.28c	0.19c	0.36c

1. The amounts of respiration were measured 10 times from 8 AM to 5 PM by 1 hour interval.
2. Mean separation within the treatments by DMR at 5% significant level.

Decrease in respiration amounts of the ginseng plants by Fluazifop-butyl treatments was considered to be related to the inhibition effect of Fluazifop-butyl on the ATP synthesis in the plant[3].

Stem growth of 2-, 3-, and 4-years-old ginseng plants were not affected by foliar application of the Fluazifop-butyl. There were on significant differences in the diameter and length of 2-, 3-, and 4-years old ginseng plant stems between non-treated and treated with the tripled concentration of Fluazifop-butyl based on the recommended dosage(Table 3).

Foliar application of the Fluazifop-butyl did not influence the length and anble of petiole to the stem of 2-, 3-, and 4-years-old ginseng plants. There were no significant differences of the length and angle of petiole between the nontreated and the treated with Fluazifop-butyl at various concentrtions in 2-, 3-, and 4-years-old gingeng plants (Table 4).

Table 3. The length and diameter of the Korean ginseng stem at 3 weeks after Fluazifop-butyl application

Concentration applicated (mℓ/100ℓ)	Plant stem					
	2-years-old		3-years-old		4-years-old	
	Length (cm)	Diam. (mm)	Length (cm)	Diam. (mm)	Length (cm)	Diam. (mm)
0	8.1	1.9	31.7	4.3	35.8	6.4
37.5	8.3	1.9	26.8	4.1	43.5	6.3
75.0	8.0	1.8	26.8	4.9	41.4	6.8
112.5	8.7	1.7	27.5	4.1	40.0	6.5
150.0	8.1	1.7	27.5	4.1	39.4	6.3
225.0	8.5^{ns}	1.7^{ns}	27.4^{ns}	3.9^{ns}	37.7^{ns}	6.7^{ns}

Mean separation within the treatments by DMR at 5% significant level.

Table 4. The length and angle of petiole of the Korean ginseng plant at 3 weeks after Fluazifop-butyl application

Concentration applicated (mℓ/100ℓ)	Plant petiole					
	2-years-old		3-years-old		4-years-old	
	Length (cm)	Angle (°)	Length (cm)	Angle (°)	Length (cm)	Angle (°)
0	3.8	67.8	7.7	55.0	8.6	45.5
37.5	3.9	65.6	7.4	55.0	9.2	42.5
75.0	4.0	67.8	7.7	51.0	9.2	44.0
112.5	4.4	66.8	7.7	64.0	8.6	41.0
150.0	4.0	69.3	8.0	56.0	8.2	45.0
225.0	3.6^{ns}	67.3^{ns}	8.0^{ns}	57.0^{ns}	8.6^{ns}	40.8^{ns}

Mean separation within the treatments by DMR at 5% significant level.

Leaf growth of 2-, 3-, and 4-years-old ginseng plant was not influenced by foliar application of Fluazifop-butyl. There were on significant differences of the leaf length and width between 2-, 3-, and 4-years-old ginseng plants the non treated and the treated with Fluazifop-butyl at various concentrations as foliar spray(Table 5).

Fluazifop-butyl inhibit acetyl-CoA carboxylase which is catalyzing fatty acid synthesis. Inhibition of fatty acid synthesis presumably blocks the production of phospholipids used in building new membranes required for cell growth. Broad leaf species are naturally resistance to Fluazifop-butyl because of an insensitive ACCase[1,2,7]. The reason why the plant growth of the ginseng was not inhibited by Fluazifop-butyl application is considered that the ginseng plant is a broad leaf species and there is little actual leaf and stem growth after leaf expansion of the ginseng in early May.

Table 5. The leaf length and width of the Korean ginseng plant at 3 weeks after Fluazifop-butyl application

Concentration applicated (mℓ/100ℓ)	Plant leaf					
	2-years-old		3-years-old		4-years-old	
	Length (cm)	Width (cm)	Length (cm)	Width (cm)	Length (cm)	Width (cm)
0	7.5	3.6	9.4	4.3	14.5	6.4
37.5	7.6	3.6	8.5	4.1	13.7	6.6
75.0	7.6	3.6	8.6	3.9	14.7	6.8
112.5	7.7	3.6	9.1	4.0	14.1	6.9
150.0	7.5	3.5	8.2	4.1	14.3	6.8
225.0	7.4^{ns}	4.0^{ns}	8.3^{ns}	4.1^{ns}	14.2^{ns}	6.6^{ns}

Mean separation within the treatments by DMR at 5% significant level.

There was no apparent plant injury to the Korean ginseng plant by foliar application of Fluazifop-butyl with tripled concentration of the recommended dosage. Neither an abnormal foliar change occurred in the ginseng plants treated with Fluazifop-butyl nor was there any visual contrast in top of the ginseng plants treated and non-treated. The application of Fluazifop-butyl was considered to be selectively safe to the ginseng plant.

摘 要

선택성 화본과 잡초의 제초제인 Fluazifop-butyl의 고려인삼에 대한 안전성을 구명하기 위하여 Fluazifop-butyl을 표준 제초약량을 위시하여 이의 3배 또는 4배 약량까지 약량별로 인삼의 경엽에 분무처리한 후 인삼 잎의 광합성량과 호흡량 및 인삼의 경엽생육을 측정하였다.

Fluazifop-butyl을 표준 제초약량 또는 2배 약량을 경엽처리할 경우에는 인삼의 광합성능력에 영향을 미치지 않았으나 3배 또는 4배 약량의 처리시에는 처리직후 광합성량의 저하를 초래하였던 바 3배약량의 처리시에는 처리후 7일에 인삼 잎의 광합성 능력이 정상으로 회복되었으나 4배 약량의 처리시에는 처리후 15일이 경과되어도 광합성 능력이 회복되지 않았다.

Fluazifop-butyl을 표준 제초약량으로 경엽처리할 경우에도 인삼잎의 호흡량은 현저한 감소를 나타내었으며 이러한 호흡량의 감소는 처리후 15일이 경과되어도 정상으로 회복되지 않았고 Fluazifop-butyl의 경엽처리에 따르는 호흡량의 감소정도는 처리약량을 증가할 수록 현저히 심해지는 경향을 나타내었다.

Fluazifop-butyl을 표준 제초약량의 3배 약량으로 경엽처리 하여도 인삼 엽병의 길이나 줄기에 대한 엽병의 각도에 전혀 영향을 미치지 않았으며 또한 인삼의 경장, 경직경, 엽장 및 엽폭의 생육에도 전혀 영향을 미치지 않았다.

Literature Review

1. Foy, Chester L. and Harold L. Witt (1992) Annual Grass Control in Alfalfa(*Medicago sativa*) with Postemergence Graminicides. Weed Technology 6 : 938−948.
2. Hendley, P., J. Dicks, T. Monaco, S. Slyfield, and J. Barrett (1985) Translocation and Metabolism of Pyridinyloxyphenoxypropionate Herbicides in Rhizomatous Quackgrass(*Agropyron repens*) Weed Science 33 : 11−24.

3. Hodogaya Chemical Co., LTD (1990) Short Review of Herbicides and PGRs pp 18－19.
4. 曺在星 (1989) 제초제 2,4-D에 대한 고려인삼의 반응. Ⅰ. 2,4-D의 농도가 인삼의 생육 및 근수량에 미치는 영향. 한국작물학회지 34(4) : 422－427.
5. Jo, Jaeseong (1990) Study on the Response of Korean Ginseng to the Herbicide 2,4-D Application. Korean J. Ginseng Sci. 14(2) : 291－296.
6. 曺在星, 元俊淵, 辛崔順 (1991) 제초제 2,4-D에 대한 고려인삼의 반응. ⅴ. 2,4-D의 경엽처리가 인삼의 광합성, 에칠렌가스 발생 및 지상부 생육에 미치는 영향. 한국작물학회지 36(2) : 107－111.
7. Weed Science Society of America (1994) Herbicide Handbook 7th Edition pp. 129－131.