Benzobicyclon activity on common Louisiana rice weeds

BM McKnight[A], EP Webster[A], GM Telo[A], EA Bergeron[A], and SY Rustom[A]
[A] Louisiana State University Agricultural Center, Baton Rouge, Louisiana, USA

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Introduction

Benzobicyclon is an HPPD inhibiting herbicide that is currently marketed for use in Japan rice production systems and is available in several different forms and pre-packaged mixture combinations (Komatsubara et al. 2009). Typical symptoms on susceptible weed species include bleached plant tissue followed by necrosis and eventual plant death (Sekino et al. 2008). Currently in the US, no herbicides with an HPPD inhibiting mode of action are labeled for use in rice.

Weed resistance was first documented in Arkansas rice fields beginning in the early 1990s and has become an increasing problem in recent years (Baltazar and Smith 1994). Rotating herbicide mode of action and the adoption of new modes of action that currently are not labeled for use in a particular crop can enhance resistance management (Norsworthy et al. 2012). The scope of this research was to evaluate the activity of benzobicyclon on weed species that are a common in Louisiana rice cropping systems.

Materials and Methods

Field studies were conducted in the 2015 and 2016 growing season at the LSU Agricultural Center H. Rouse Caffey Rice Research Station (RRS) near Crowley, Louisiana and in 2015 at the LSU Agricultural Center Northeast Research Station (NERS) near St. Joseph, Louisiana. The study was conducted on two different sites at the RRS on different soils, a Crowley silt loam (fine montmorillonitic, thermic Typic Albaqualf) with 1.4% organic matter and pH 5.5, and a Midland silty clay loam (fine, smectitic, thermic Chromic Vertic Epiaqualf) with 1.2 % organic matter and pH 5.2. Soil at the NERS is a Sharkey clay (very-fine, smectitic, thermic Chromic Epiaquert) with a pH 6.1 and 2.1% organic matter.

Following soil preparation at each location, galvanized metal rings, 91-cm in diameter, were randomly installed near the center of 1.5 by 5.2 m^2 plots for benzobicyclon treatment containment. No rice was planted in the study area in an effort to maximize growth of the naturally occurring weed population, and water management in the research area mimicked a water-seeded production system commonly used in Louisiana. After weed emergence and when ducksalad [*Heteranthera limosa* (Sw.) Willd.] reached the first elongated leaf growth stage herbicide treatments were applied. Benzobicyclon treatments consisted of nine different rates: 31, 62, 123, 185, 246, 492, 738, 984, and 1230 g ai/ha. The experimental design was a randomized complete block design with four replications. Herbicide applications were made using a CO_2-pressurized backpack sprayer calibrated to deliver 140 L/ha. At the conclusion of the trial, 56 days after treatment, all weeds were hand-harvested from the galvanized ring and separated by species for fresh-weight determination. Data from each location and year was subjected to ANOVA and means were separated using Fischer's protected LSD at the $P< 0.05$ probability level.

Results and Discussion

In 2015, at the RRS on the Crowley silt loam (RRS-C) and the Midland silty clay loam (RRS-M), benzobicyclon reduced ducksalad fresh weight to 11 and 0% of the nontreated with rates of 246 and 185 g/ha, respectively (Table 1). At the NERS, rates of 986 g/ha reduced ducksalad biomass to 14% of the check. No difference in fresh weight biomass was observed in purple ammannia (*Ammannia coccinea* Rottb.), Indian toothcup [*Rotala ramosior* (L.) Koehne], and false pimpernel [*Lindernia dubia* (L.) Pennel] at the NERS. Benzobicyclon rates of 739 g/ha and higher reduced yellow nutsedge (*Cyperus esculentus* L.) biomass to 13% of the check or less at the RRS-C. No difference was observed for barnyardgrass biomass (data not shown).

In 2016, ducksalad fresh weight was reduced 21 and 12% of the nontreated at the RRS-C and RRS-M with 185 and 62 g/ha benzobicyclon, respectively. Among all benzobicyclon rates applied at the RRS-C location, no differences in fresh weight biomass were observed for barnyardgrass (data not shown), false pimpernel, and Indian toothcup. Complete control of Indian tootchup and purple ammannia inside containment rings was observed at the RRS-M with benzobicyclon rates of 492 g/ha and higher. At rates of 492 g/ha and higher, yellow nutsedge fresh weight biomass was reduced to 9% or less of the check at the RRS-C.

Table 1. Fresh weight biomass of different weed species treated with benzobicyclon.[A]

Rate	——— HETLI ———			— AMMCO —		—— LIDDU ——		—— ROTRA ——		CYPES
g/ha	RS-C[B]	NES	RS-M	NES	RS-M	NES	RS-M	NES	RS-M	RS-C
0	100 a	100 a	100 a	100 a	100bc	100 a	100 b	100 a	100 a	100 ab
31	95 a	77 ab	75 b	98 a	326 a	133 a	250 b	689 a	29 bc	79 abc
62	66 b	85 ab	31 c	107 a	166 b	71 a	250 b	367 a	86 ab	124 a
123	58 b	97 a	18 cd	79 a	51 cd	70 a	708 a	361 a	21 bc	76 abc
185	43 c	74 ab	0 d	66 a	20 d	26 a	167 b	133 a	3 c	100 ab
246	11 d	82 ab	0 d	94 a	38 cd	111 a	150 b	572 a	0 c	18 bc
492	5 d	69 ab	0 d	97 a	15 d	67 a	67 b	344 a	1 c	34 bc
739	1 d	51 bc	0 d	99 a	2 d	21 a	0 b	105 a	0 c	13 c
986	0 d	14 d	0 d	43 a	8 d	18 a	17 b	94 a	0 c	13 c
1232	0 d	21 cd	0 d	39 a	1 d	4 a	0 b	22 a	0 c	0 c

[A] Weed species are listed as Bayer codes; HETLI, ducksalad; AMMCO, purple ammannia; LIDDU, false pimpernel; ROTRA, Indian toothcup; CYPES, yellow nutsedge.
[B] Location codes; RS-C, Rice Research Station Crowley silt loam; RS-M, Rice Research Station Midland silty clay loam; NES, Northeast Research Station Sharkey clay.

Conclusion

These field trials indicate that benzobicyclon has activity on common weed species that occur in Louisiana rice cropping systems. Benzobicyclon activity has been observed on rice flatsedge (*Cyperus iria* L.), Amazon sprangletop [*Leptochloa panicoides* (J. Presl) Hitchc.] and grassy arrowhead (*Sagittaria graminea* Michx. Var. graminea) in other field trials conducted in Louisiana. Little to no activity has been observed when benzobicyclon was applied to alligatorweed [*Alternanthera philoxeroides* (Mart.) Grisb.], hemp sesbania [*Sesbania herbacea* (Mill.) McVaugh] and Indian jointvetch (*Aeschynomene indica* L.). Often, these species can become particularly troublesome early in the growing season in a water-seeded production system, which accounts for approximately 35% of Louisiana rice acreage. Because benzobicyclon must be applied in flood water to be actively absorbed into susceptible plants, this product has a fit in Louisiana rice production and provides a unique control spectrum for a water-seeded production systems.

References

Baltazar AM, Smith RJ (1994) Propanil-resistant barnyardgrass (*Echinochloa crus-galli*) control in rice. Weed Technology **8**, 576-58.

Komatsubara K, Sekino K, Yamada Y, Koyanagi H, Nakahara S (2009) Discovery and development of a new herbicide, benzobicyclon. Journal of Pesticide Science **34**, 113-114.

Norsworthy JK, Ward SM, Shaw DR, Llewellyn RS, Nichols RL, Webster TM, Bradley, KW, Frisvold G, Powles SB, Burgos NR, Witt WW, Barret M. (2012) Reducing the risk of herbicide resistance: Best management practices and recommendations. Weed Science **60**, 31-62.

Sekino K, Koyanagi H, Ikuta E, Yamada Y (2008) Herbicidal activity of a new paddy bleaching herbicide, benzobicyclon. Journal of Pesticide Science **33**, 364-370.