

had superior taste and retained a fresh appearance. At 2,000 ppm, AVG increased the amount of marketable 'T-19' berries treated twice with ethephon by about 72% and of 'T-19' berries treated with daminozide plus ethephon by about 62%. Also, the amount of marketable 'Tifblue' treated only with 2000 ppm AVG was about 55% greater than that of 'Tifblue' treated only with daminozide plus ethephon. This marked effect of AVG in increasing storage life of berries is probably due to its potential in retarding ethylene-induced senescence. This hypothesis, however, needs to be tested experimentally.

The present study showed that both AVG treatments (1,000 and 2,000 ppm), immediately after harvest, with or without preharvest sprays of daminozide and/or ethephon effectively retarded senescence and deterioration of blueberries during storage at 3°C. A direct effect of AVG on increasing longevity was demonstrated and is of practical significance. This is the first time that longevity of rabbiteye blueberries has been appreciably increased by chemical treatments. Of the compounds tested, AVG, a suppressant of ethylene, was the most effective inhibitor of senescence of rabbiteye blueberries. It maintained firmness and increased the longevity of 'T-19' and 'Tifblue'. The effect of AVG in lengthening the storage life of rabbiteye blueberries was marked. However, it should be recognized that AVG and daminozide have not been released by the EPA for blueberry use. At present the best way to prolong the storage life of blueberries is to keep them at 3°C and 95+ % relative humidity. Any other treatment should be considered as a supplement to good temperature and humidity maintenance.

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## FIELD EVALUATION OF HEXAZINONE (VELPAR<sup>®</sup>) HERBICIDE IN PECANS<sup>1</sup>

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**Abstract.** Postemergence and preemergence weed control effectiveness from hexazinone (Velpar<sup>®</sup>) was evaluated in an 11-year-old pecan [*Carya illinoensis* (Wang.) K. Koch] orchard. Weed control was rated 4, 12, and 20 weeks after an early April application of 0, 0.9, 1.8, and 3.6 lb. ai/acre of hexazinone in 1977. In 1978 rates were changed to 0, 0.45, 0.9, and 1.8 lb. ai/acre. Two applications, once on April 6, the

other on July 13, of 0, 0.45, 0.9, and 1.8 lb. ai/acre hexazinone were evaluated 4, 12, 17, and 21 weeks after the initial April treatment in 1979. All treatments included the surfactant WK<sup>®</sup> at .125% (v/v).

Hexazinone generally provided excellent postemergence weed control at 0.9 and 1.8 lb. ai/acre. Preemergence weed control was excellent at least 21 weeks after treatment with dual applications of 1.8 lb. ai/acre. Treatments did not significantly influence trunk diameter increase from September 1977 to January 1980.

Postemergence or contact herbicides generally result in non-selective but short term weed control. Preemergence or residual herbicides can control selective weeds for several months. The general weed control method for mature pecans in north Florida is to treat with 2 tank mix applications of postemergence and preemergence herbicides, once in early spring and again in mid-summer. Additional treatments with glyphosate (Roundup<sup>®</sup>) are applied as needed,

<sup>1</sup>Florida Agricultural Experiment Station Journal Series No. 2533. Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product and does not imply its approval to the exclusion of other products that may also be accepted.

normally in late spring and again in late summer or early fall.

Hexazinone (Velpar<sup>®</sup>)<sup>2</sup>, a 90% wettable powder, has been shown to give relatively broad-spectrum long-term weed control (4). This herbicide has been used on non-cropland area (3), alfalfa (1), pasture (10), pine plantations or seedbeds (2, 5, 9) and sugarcane (6, 8). Hexazinone has been found to be fairly safe to the environment with a short soil half-life. No residual buildup after repeated applications has been attributed to microbial degradation (6, 7).

In this experiment hexazinone was field tested on mature pecans for 3 years to determine postemergent and pre-emergent herbicidal effectiveness. Tree tolerance was determined by visible phytotoxicity.

### Materials and Methods

An 11-year-old pecan orchard in Monticello, Florida was used in a randomized block design of 4 treatments with 3 replications, 4 trees per replication. The orchard was planted to alternate rows of 'Desirable' and 'Elliott' cultivars on a 50' x 50' spacing. Soil was a Faceville sandy loam with 1-2% organic matter and pH 5.9.

Treatments included an untreated check (treatment A) and 3 rates of hexazinone (treatments B, C, and D). B received 0.9, 0.45, and 0.45 + 0.45 lb. ai/acre in 1977, 1978, and 1979, respectively. Treatment C was treated with 1.8, 0.9 and 0.9 + 0.9 lb. ai/acre in the three successive years. Treatment D was 3.6 (1977), 1.8 (1978), and 1.8 + 1.8 lb. ai/acre (1979). A surfactant<sup>3</sup> was included in all hexazinone treatments at 0.125% (v/v).

Application dates were April 6, 1977, April 5, 1978, and April 6 and July 13, 1979. Existing weed cover was mowed to a height of 6 inches two days prior to the 1977 application. Vegetation had grown 6 inches high by the April 1978 application; therefore, it was not mowed. The grower disked the entire orchard 3 weeks before the April 1979 treatment. The orchard was 95% bare of ground cover. Prior to the July 13th 1979 application the 0.45 and 0.9 lb. ai/acre plots were mowed to insure good spray coverage. All plots were harrowed once in the fall each year.

Treatments were applied using a tractor-mounted sideboom. Three 8004 tips delivered 50 GPA at a pressure of 30 psi to a 7 foot swath on each side of the tree row.

Adequate moisture was received to move hexazinone into the weed root zone. Accumulative rainfall (in inches) for the experimental period was:

	1977	1978	1979
Up to week 4	2.4	3.9	3.8
Up to week 12	6.7	8.2	9.6
Up to week 16	—	—	19.6
Up to week 20	17.6	17.9	22.2

Each predominant weed specie (see Table 1) was visually rated for percent control (absence or injury of above ground plant tissue) 4, 12, and 20 weeks after application in 1977 and 1978. In 1979, weed control and percent bare ground were recorded 4, 12, 17, and 21 weeks following the initial treatment.

Phytotoxicity was monitored visually on each rating date.

Separate analyses of variance (ANOVA) were performed for each type of weed, by year to detect significant differences among the levels of application and days after treatment

Table 1. Major weed species rated for control by hexazinone.

Bermudagrass	<i>Cynodon dactylon</i> (L.) Pers.
Carolina fakedandelion	<i>Pyrrhopappus carolinianus</i> (Walt) DC.
Cutleaf eveningprimrose	<i>Oenothera laciniata</i> Hill
Purple nutsedge	<i>Cyperus rotundus</i> L.
Southern crabgrass	<i>Digitaria ciliaris</i> (Retz.) Koel.
Southern sandbur	<i>Cenchrus echinatus</i> L.
Spiny amaranth	<i>Amaranthus spinosus</i> L.
Virginia pepperweed	<i>Lepidium virginicum</i> L.
Wild blackberry	<i>Rubus cuneifolius</i> Pursh.
Wild radish	<i>Raphanus raphanistrum</i> L.

interaction. The variable percentage of bare ground was transformed before analysis using an arc sin transformation to stabilize the variance. In the few instances where the ANOVA did not provide sufficient information to determine the significance of differences among the levels, individual t-tests were performed.

### Results and Discussion

**1977 ratings.** A single application of 0.9 lb. ai/acre of hexazinone resulted in good control of annuals and fair control of perennials by the 4th week (Table 2). Rates of 1.8 and 3.6 lb. ai/acre gave 50-100% control of all rated weeds with no significant difference between the two rates 4 weeks after treatment.

The 12th and 20th week ratings show hexazinone at 1.8 and 3.6 lb. ai/acre can control annual and perennial grasses as well as blackberry vines with no advantage from the 3.6 lb. ai/acre rate.

Phytotoxic symptoms were limited to one tree out of 12 in the 3.6 lb. ai/acre rate plots. This tree was partially defoliated the 12th week but had refoliated by week 20. This illustrated the injury was only temporary.

**1978 ratings.** Due to the phytotoxic effects in 1977, the rates were dropped to 0.45, 0.9, and 1.8 lb. ai/acre. The 0.45 lb. ai/acre rate exhibited fair to good postemergence control of the predominant weeds (Table 3). The 0.9 and 1.8 lb. ai/acre rates statistically differed only in the control of wild blackberry; otherwise, both resulted in 100% control at 4 weeks.

The 0.45 lb. ai/acre rate lost all weed control by the 12th week. At week 12, the 0.9 lb. ai/acre rate was statistically no different than the 1.8 lb. ai/acre rate, both having good to excellent control of all major weeds. However, on week 20, 0.9 lb. ai/acre no longer controlled any rated weed better than 30%. On the other hand, the 1.8 lb. ai/acre rate maintained good weed control of the major weeds (60-90%).

There were no phytotoxic symptoms expressed by any tree.

**1979 ratings.** In 1978 there was no phytotoxicity but the weed control was not completely satisfactory. Therefore, hexazinone treatments of 0.45, 0.9, and 1.8 lb. ai/acre were applied once in April and again in July (week 0 and 13, respectively).

There was no statistical difference among any of the three rates—0.45, 0.9, and 1.8 lb. ai/acre—on control of any individual weed specie 4 weeks after application (Table 4). However, the 0.45 lb. ai/acre rate was lower in overall weed control compared to 0.9 and 1.8 lb. ai/acre as determined by percent bare ground.

By the 12th week as in 1978, weed control in the 0.45 lb. ai/acre rate was almost none (12% bare ground) with an exception or two, such as southern crabgrass 57%, and spiny amaranth 97%. The weed control by 0.9 lb. ai/acre of the major weeds was only slightly less than the control by 1.8 lb. ai/acre. There was a significant difference between these

<sup>2</sup>Formerly tested as DPX 3674, E. I. duPont de Nemours and Co., Inc., Wilmington, Delaware. Not currently approved by EPA for use in pecans.

<sup>3</sup>WKR, E. I. duPont de Nemours and Co., Inc.

Table 2. Weed control from 3 rates of hexazinone in an 11-yr-old pecan orchard 4, 12, and 20 weeks after application in 1977.<sup>2</sup>

Treatment	Rate	% Weed Control							
		Bermudagrass	Carolina falsedandelion	Cutleaf eveningprimrose	Purple nutsedge	Southern crabgrass	Southern sandbur	Virginia pepperweed	Wild blackberry
(lb. ai/acre)									
4 week rating									
Untreated check	—	0cy	0c	0b	0b	—	—	0b	0c
Hexazinone	0.9	60b	83b	97a	23b	—	—	100a	37b
Hexazinone	1.8	97a	100a	100a	57a	—	—	100a	50ab
Hexazinone	3.6	93a	97a	100a	63a	—	—	100a	63a
12 week rating									
Untreated check	—	0c	—	—	0c	—	0b	—	0c
Hexazinone	0.9	63b	—	—	80b	—	83a	—	75b
Hexazinone	1.8	100a	—	—	100a	—	100a	—	93ab
Hexazinone	3.6	100a	—	—	100a	—	100a	—	100a
20 week rating									
Untreated check	—	0c	—	—	0c	0b	0b	—	0b
Hexazinone	0.9	45b	—	—	63b	90a	77a	—	23b
Hexazinone	1.8	100a	—	—	100a	100a	100a	—	93a
Hexazinone	3.6	100a	—	—	100a	100a	100a	—	100a

<sup>2</sup>Mean separation in columns per rating by analysis of variance, 5% level. Means are of 3 replications/treatment.<sup>3</sup>Skips in data indicate that weed specie population was insufficient to rate.

two rates on percent bare ground with 53% for the 0.9 lb. ai/acre rate and 93% with 1.8 lb. ai/acre.

Four weeks after the second application, on week 17, good to excellent control of all weeds was recorded for 0.9 and 1.8 lb. ai/acre. The 0.45 lb. ai/acre rate had good to excellent control of annual grasses, a broadleaf, and purple nutsedge, but was not effective against bermudagrass or wild blackberry.

The last rating at week 21 showed the 1.8 lb. ai/acre resulted in 95% bare ground. The good to excellent control of the predominant weeds and good overall weed control (70% bare ground) resulted from 0.9 lb. ai/acre. The lowest rate, 0.45 lb. ai/acre dropped to poor control at 27% bare ground.

The same tree that was partially defoliated in a 3.6 lb. ai/acre plot in 1977 showed signs of necrosis, epinasty, and

Table 3. Weed control from 3 rates of hexazinone in a 12-yr-old pecan orchard 4, 12, and 20 weeks after application in 1978.<sup>2</sup>

Treatment	Rate	% Weed control							
		Bermudagrass	Cutleaf eveningprimrose	Purple nutsedge	Southern crabgrass	Southern sandbur	Virginia pepperweed	Wild blackberry	Wild radish
(lb. ai/acre)									
4 week rating									
Untreated check	—	0c <sup>y</sup>	0b	0b	—	—	0b	0c	0b
Hexazinone	0.45	43b	100a	87a	—	—	100a	40b	100a
Hexazinone	0.9	100a	100a	100a	—	—	100a	90b	100a
Hexazinone	1.8	100a	100a	100a	—	—	100a	100a	100a
12 week rating									
Untreated check	—	0b	—	0b	0b	0b	—	0b	—
Hexazinone	0.45	1b	—	0b	0b	1b	—	0b	—
Hexazinone	0.9	90a	—	100a	97a	73a	—	87a	—
Hexazinone	1.8	90a	—	100a	100a	93a	—	100a	—
20 week rating									
Untreated check	—	0c	—	0b	0b	0b	—	0b	—
Hexazinone	0.45	0c	—	0b	0b	0b	—	0b	—
Hexazinone	0.9	30b	—	10b	1b	0b	—	20b	—
Hexazinone	1.8	60a	—	87a	83a	83a	—	90a	—

<sup>2</sup>Mean separation in columns per rating by analysis of variance, 5% level. Means are of 3 replications/treatment.<sup>3</sup>Skips in data indicate that weed specie population was insufficient to rate.

Table 4. Weed control 4, 12, 17, and 21 weeks after application of 3 rates of hexazinone at week 0 and week 13 in 1979 to a 13-yr-old pecan orchard.<sup>z</sup>

Treatment	Rate	% Weed control									
		% Bare ground	Bermudagrass	Cutleaf eveningprimrose	Purple nutsedge	Southern crabgrass	Southern sandbur	Spiny amaranth	Virginia pepperweed	Wild blackberry	Wild radish
(lb. ai/acre)											
4 week rating											
Untreated check	—	0c <sup>y</sup>	0b	0b	0b	—	—	—	0b	0b	0b
Hexazinone	0.45 + 0.45	88b	87a	100a	100a	—	—	—	97a	80a	100a
Hexazinone	0.9 + 0.9	98a	100a	100a	100a	—	—	—	100a	97a	100a
Hexazinone	1.8 + 1.8	100a	100a	100a	100a	—	—	—	100a	100a	100a
12 week rating											
Untreated check	—	0c	0b	—	0b	0c	0d	0b	—	0c	—
Hexazinone	0.45 + 0.45	12c	17b	—	0b	57b	17c	97a	—	27b	—
Hexazinone	0.9 + 0.9	53b	75a	—	100a	93a	63b	100a	—	90a	—
Hexazinone	1.8 + 1.8	93a	93a	—	100a	97a	93a	100a	—	97a	—
17 week rating											
Untreated check	—	0d	0c	—	0b	0b	0c	0b	—	0c	—
Hexazinone	0.45 + 0.45	43c	20b	—	100a	100a	63b	100a	—	33b	—
Hexazinone	0.9 + 0.9	83b	90a	—	100a	100a	87a	100a	—	97a	—
Hexazinone	1.8 + 1.8	97a	100a	—	100a	100a	100a	100a	—	93a	—
21 week rating											
Untreated check	—	0d	0b	—	0c	0c	0d	0b	—	0b	—
Hexazinone	0.45 + 0.45	27c	13b	—	67b	77b	33c	100a	—	0b	—
Hexazinone	0.9 + 0.9	70b	83a	—	87ab	93ab	73b	97a	—	93a	—
Hexazinone	1.8 + 1.8	95a	90a	—	100a	100a	100a	100a	—	100a	—

<sup>z</sup>Mean separation in columns per rating by analysis of variance, 5% level. Means are of 3 replications/treatment.

<sup>y</sup>Skips in data indicate that weed specie population was insufficient to rate.

paler green color to the leaves in 1.8 + 1.8 lb. ai/acre in 1979. All the other trees in all remaining plots did not exhibit any visible phytotoxic symptoms.

**Trunk diameter.** Trunk diameters measured from December 1977 to January 1980 showed no significant increase from any treatment over the untreated check plots.

### Conclusions

Use of hexazinone in a mature pecan orchard could provide excellent control of most weeds as a postemergence herbicide at rates of 0.9 to 1.8 lb. ai/acre. As a preemergence herbicide, two treatments of 1.8 lb. ai/acre should give weed control up to 21 weeks.

To improve crop tolerance, hexazinone has been tank mixed at low rates with other preemergence herbicides such as diuron (Karmex<sup>®</sup>) in sugarcane (6, 8). If this were done in pecans, hexazinone might be safe on younger pecans.

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