weight of marketable roots were recorded. Root weight averaged at least 25 per cent less for the middle application date. Crop tolerance appeared slightly, but not significantly, superior for chloroxuron plus S209 or S509 and for linuron plus S210 or S510 than for their combinations with the other surfactants tested.

Discussion and Summary

General weed control provided by linuron and chloroxuron, without surfactant, was excellent, except for late-season sowthistle and dogfennel in chloroxuron-treated plots. Weed control declined slightly for advancing weed seedling sizes. Conversely, carrot tolerance increased with advancing plant age. All herbicide and herbicide-surfactant combinations suppressed carrot growth but early growth inhibition did not imply detrimental yield response. Conversely, lack of visible growth effects did not preclude yield reduction for specific combinations.

The marked enhancement of crop and weed phytotoxicity for S-WK combinations suggests further testing to determine if lower herbicide dosage rates plus S-WK could provide acceptable levels of weed control and crop performance. The data demonstrate the importance of crop and weed seedling growth at time of treatment and of prior experience with specific combinations.

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EVALUATION OF HERBICIDES FOR WATERMELON IN FLORIDA

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Abstract. **During 1972-1974, several preemergence herbicides and herbicide combinations were evaluated for phytotoxicity and weed control in direct-seeded watermelon, Citrullus lanatus (Thunb.) Matsum. & Nakai, at Gainesville and Leesburg, Florida. Currently labelled herbicides, including naptalam [*N*-1-naphthylphthalamic acid], bensulide [*O,O*-diisopropyl phosphorodithioate *S*-ester with *N*-(2-mercaptoethyl)benzenesulfonamide], nitralin [4-(methylsulfonyl)-2,6-dinitro-*N,N*-dipropylaniline], and trifluralin [*a,a,a*-trifluoro-2,6-dinitro-*N,N*-dipropyl-*p*-toluidine] were unsatisfactory due to crop phytotoxicity, erratic weed control, or the presence of tolerant weed species. Alachlor [2-chloro-2′,6′-diethyl-*N*-(methoxymethyl)acetanilide], butralin [4-(1,1-dimethylethyl)-*N*-(1-methylpropyl)-2,6-dinitrobenzenamine], and napropamide [2-(*a*-naphthoxy)-*N,N*-diethylpropionamide] were the most promising herbicides for weed control in watermelon. Diphenamid [*N,N*-dimethyl-2,2-diphenylacetamide] was satisfactory on the heavier soil type at Gainesville. In initial tests, bensulide and naptalam in combination with napropamide, butralin, and alachlor also provided satisfactory weed control.**

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The commercial production of watermelons in Florida covers a more extensive geographical area and a greater number of acres than any other vegetable crop grown in the state. Although acreage in Florida has declined from a high of 95,000 acres in 1958 to 48,700 acres in 1973, production has remained fairly steady due to a 60 per cent increase in yield per acre since 1958 (8). The value of the marketed crop has exceeded $16 million in 8 of the last 10 seasons.

Weeds are a serious problem in watermelon because of the initial slow plant growth and low plant population. Cultivation is difficult once the vines begin to run. With the reduced availability of virgin land, the seriousness of the weed problem will increase.

Erratic weed control or crop injury limit the acceptance and use of herbicides currently labelled for watermelon. Although wide crop tolerance exists for naptalam (Alanap), and bensulide (Prefar), erratic weed control limits the use of the former and weed tolerance is too great for the latter (1, 3, 4, 5, 6). Nitralin (Planavin) and DCPA, dimethyl tetrachloroterephthalate (Dacthal), do not satisfactorily control weeds at recommended rates and are somewhat phytotoxic to watermelon (1, 2, 3, 5, 6, 7). Crop tolerance to trifluralin (Treflan) is not adequate on sandy soils (1, 2, 6).

The purpose of these experiments was to evaluate certain herbicides and herbicide combinations for their effectiveness in controlling weeds and their toxicity to watermelon.

Materials and Methods

The trials were conducted in 1973 and 1974 on Astatula fine sand at the Agricultural Research Center, Leesburg and in 1972-1974 on Kanapaha and Leon fine sands at the University of Florida Horticultural Unit, Gainesville. The herbicides evaluated were: naptalam, bensulide, nitralin, trifluralin, napropamide (Devrinol), butralin (Amex-820), alachlor (Lasso), and diphenamid (Dymid). Other herbicides were tested but did not show promise due to lack of weed control or severe phytotoxicity. These materials included terbacil, 3-*tert*-butyl-5-chloro-6-methyluracil (Sinbar); perfluidone, 1,1,1-trifluoro-*N*-[2-methyl-4-(phenylsulfonyl) phenyl] methanesulfonamide (Destun);

Table 1. Crop vigor, weed control, and total marketable yield following soil treatment with various herbicides at Leesburg, 1973.

Treatment[z]	Crop vigor: Rating[yx]	Crop vigor: Weight[w] (g/plant)	Weed control[xv]: B	Weed control[xv]: G	Yield[x] (cwt/acre)
Hoed check	10.0 a	10.6	9.5 a	10.0 a	388 a
Butralin, ppi, 1.5	8.5 abc	6.7	6.2 bcd	7.8 b	322 ab
Butralin, ppi, 3.0	8.5 abc	5.9	8.0 abc	7.5 b	342 ab
Napropamide, ppi, 5	8.5 abc	5.6	8.5 ab	9.5 a	334 ab
Naptalam, sur, 3	8.0 abc	4.7	5.2 cd	6.8 b	318 ab
Napropamide, ppi, 5 + Naptalam, sur, 3	6.5 c	2.0	6.0 bcd	7.2 b	238 bcd
Bensulide, ppi, 5	9.2 ab	7.9	4.2 d	7.8 b	270 abc
Trifluralin, ppi, 1.5	7.5 bc	5.9	5.8 bcd	6.8 b	304 ab
Nitralin, sur, 1	10.0 a	8.5	6.2 bcd	3.8 d	266 abc
Alachlor, sur, 2	8.8 abc	6.7	7.0 abcd	4.5 cd	292 abc
Diphenamid, sur, 6	4.2 d	0.9	6.5 bcd	6.0 bc	110 d
Unhoed check	10.0 a	10.2	4.5 d	4.2 d	362 ab

z Chemicals preplant incorporated (ppi) or applied preemergence (sur) in lb a.i./acre.
y Rated from 1, low vigor, to 10, excellent plant growth on April 2.
x Mean separation in columns by Duncan's multiple range test, 5% level.
w Fresh weight of plants removed at thinning.
v Control of broadleaves (B) and grasses (G) rated from 1, no control, to 10, complete control, on May 18.

Table 2. Crop vigor, weed control, and total marketable yield following soil treatment with various herbicides at Leesburg, 1974.

Treatment[z]	Crop vigor rating[y]	Weed control[xv]	Yield (cwt/acre)
Hoed check	7.8	10.0 a	492
Butralin, ppi, 1.5	9.0	8.8 ab	381
Butralin, ppi, 3.0	7.5	9.4 ab	366
Napropamide, ppi, 4	7.2	8.9 ab	452
Naptalam, sur, 3	8.2	3.5 c	358
Napropamide, ppi, 4 + Naptalam, sur, 3	9.2	8.0 ab	332
Bensulide, ppi, 5	7.8	3.9 c	318
Naptalam, sur, 3 + Bensulide, ppi, 5	8.2	6.8 b	322
Alachlor, sur, 2	8.5	6.6 b	444
Unhoed check	9.2	3.5 c	363

[z] Chemicals preplant incorporated (ppi) or applied preemergence (sur) in lb a.i./acre.
[y] Rated from 1, low vigor, to 10, excellent plant growth on April 12.
[x] Control of broadleaf weeds rated from 1, no control, to 10, complete control on May 21.
[v] Mean separation in columns by Duncan's multiple range test, 5% level.

profluralin, *N*-(cyclopropylmethyl)-*a,a,a*-trifluoro-2,6-dinitro-*N*-propyl-*p*-toluidine (Tolban); isopropalin, 2,6-dinitro-*N-N*-dipropylcumidine (Parrlan); and dinitramine, *N*[4],*N*[4]-diethyl-*a,a,a*-trifluoro-3,5-dinitrotoluene-2,4-diamine (Cobex).

At Leesburg, seeds were planted ('Allsweet', March 9, 1973; 'Smokylee', March 7, 1974) in hills spaced at 5 ft in rows 10 ft apart. A broadcast application of 1200 lb/acre of a 6-4.4-5.0 (N-P-K) fertilizer was made over the 40-inch bed area prior to bedding. Supplemental fertilizer was applied at emergence (100 lb/acre, 15-0-11.6) and at layby (350 lb/acre, 15-0-11.6). Dates of application for preplant incorporated and preemergence herbicides were March 8-9, 1973 and March 4, 1974. Plots were 10x25 ft and were arranged in a randomized complete block design replicated 4 times. Fruit were harvested during June. The most commonly occurring broadleaf weed species in both years were Florida pusley (*Richardia scabra* L.), hairy indigo (*Indigofera hirsuta* L.), carpetweed (*Mollugo verticillata* L.), pigweed (*Amaranthus* sp.), and nightshade (*Solanum* sp.). Annual grasses were not a problem but bahiagrass (*Paspalum notatum* Flugge) was prevalent each year. Crop vigor and weed control were estimated by visual ratings. In 1973 watermelon seedlings removed at thinning were weighed as a second means of assaying vigor.

At Gainesville, 'Charleston Gray' seeds were planted in hills spaced at 5 ft in rows 9 ft apart. Prior to planting 1000 lb/acre of a 6-3.5-6.6 fer-

Table 3. Crop vigor, weed control, and total marketable yield following soil treatment with various herbicides at Gainesville, 1972.

Treatment[z]	Crop vigor[yx]	Weed control[xw] April 17 B	April 17 G	June 14 B	June 14 G	Yield[x] (cwt/acre)
Hoed check	9.8 a	10.0 a	10.0 a	10.0 a	9.5 a	216 a
Butralin, ppi, 2	9.5 ab	9.5 a	9.3 a	6.5 bc	3.3 b	48 b
Butralin, ppi, 4	7.8 ab	10.0 a	10.0 a	8.8 ab	8.5 a	94 b
Napropamide, ppi, 4	9.3 ab	10.0 a	10.0 a	9.3 a	9.3 a	288 a
Napropamide, ppi, 8	4.5 c	10.0 a	10.0 a	9.0 a	9.3 a	150 b
Bensulide, ppi, 6	8.8 ab	7.3 b	9.0 a	6.5 c	1.8 bc	78 b
Naptalam, ppi, 2 + Bensulide, ppi, 4	9.8 a	5.5 c	5.3 b	7.8 abc	2.0 bc	36 b
Butralin, ppi, 2 + Bensulide, ppi, 4	9.0 ab	6.8 bc	8.3 a	9.0 a	8.5 a	124 b
Unhoed check	7.0 b	0.0 d	0.0 c	0.0 d	0.0 c	48 b

[z] Chemicals preplant incorporated (ppi) or applied preemergence (sur) in lb a.i./acre.
[y] Rated from 0, plant dead, to 10, excellent plant growth on April 17.
[x] Mean separation by Duncan's multiple range test, 5% level.
[w] Control of broadleaves (B) and grasses (G) rated from 0, no weed control, to 10, 100 per cent weed control.

tilizer was broadcast over a 5 ft swath prior to bedding. A side-dress application of 1000 lb/acre of a 6-3.5-6.6 fertilizer was applied at layby. Seeds were planted March 7 and 9, 1972; April 19, 1973; and March 11, 1974. Dates of herbicide application were March 9, 1972; April 18-19, 1973; and March 11, 1974. Fruit were harvested in late June in 1972 and 1974. Due to the late planting date, excessive rains, and severe weed infestation, there was no harvest in 1973. The most prevalent broadleaf weeds were pigweed (*Amaranthus* sp.), black nightshade (*Solanum nigrum* L.), common purslane (*Portulaca oleracea* L.), and showy crotalaria (*Crotalaria spectabilis* Roth.). Grasses were predominantly goose grass (*Eleusine indica* (L.) Gaertn.) and crabgrass (*Digitaria* sp.).

Results and Discussion

Watermelon shows no phytotoxicity to bensulide at applications up to 12 lb a.i./acre (1), but the predominant weeds at Leesburg and Gainesville were not controlled with the recommended 4 to 6 lb/acre rate (Tables 1 to 5). Naptalam was somewhat phytotoxic as reflected in the crop vigor at Leesburg in 1973 (reduction in seedling weight) and Gainesville in 1974 (Tables 1 and 5). Weed control with naptalam was poor in 1973 and 1974 (Table 2) at Leesburg although at Gainesville in 1974 control of broadleaf weeds was good. At Leesburg, the affect on vigor and poor weed control resulted in yields that were generally lower than those of the hoed check. Treatment with naptalam at Gainesville resulted in yield that was somewhat higher than that of the hoed check. In an attempt to improve weed control with recommended materials naptalam and bensulide were applied together. There was some increase in weed control at Leesburg in 1974 with this combination (Table 2), but in Leesburg in 1972 (1) and in Gainesville (Tables 3 and 4) weed control with naptalam plus bensulide was no better than with either material applied alone. In 1971 at Gainesville, pre-plant incorporation of 2 and 3 lb of naptalam with 3 or 4 lb of bensulide increased toxicity to the crop compared with pre-plant incorporated bensulide and preemergence (surface) applied naptalam.

Trifluralin caused severe injury to watermelon at rates as low as 1.5 lb, but weed control was not satisfactory at that or lesser rates (Tables 1, 4, and 5). Nitralin was relatively safe but was in-

Table 4. Crop vigor and weed control following soil treatment with various herbicides at Gainesville, 1973.

		Weed control[xw]				
		May 17			June 12	
Treatment[z]	Crop vigor[yx]	C	P	G	B	G
Hoed check	10.0 a	10.0 a	10.0 a	10.0 a	10.0 a	9.5 a
Butralin, ppi, 2	9.5 ab	4.2 bcd	9.5 a	8.5 abc	4.5 b	6.5 ab
Butralin, ppi, 4	9.5 ab	6.5 abc	10.0 a	10.0 a	7.5 ab	6.5 ab
Napropamide, ppi, 4	9.0 ab	3.8 bcd	9.0 a	7.8 abc	4.8 b	3.8 bc
Napropamide, ppi, 8	8.8 ab	8.0 ab	9.8 a	8.8 abc	8.0 ab	6.0 b
Bensulide, ppi, 6	9.2 ab	6.2 abc	8.5 a	4.5 d	6.5 ab	4.0 bc
Naptalam, ppi, 3 + Bensulide, ppi, 4	8.0 b	4.8 bc	9.5 a	6.0 cd	7.0 ab	2.0 cd
Trifluralin, ppi, 0.75	8.8 ab	5.8 abc	8.2 a	7.2 abcd	6.2 ab	4.5 bc
Alachlor, sur, 2	8.0 b	4.5 bc	10.0 a	9.2 ab	4.5 b	5.0 bc
Alachlor, sur, 4	8.0 b	2.0 cd	9.8 a	9.2 ab	5.0 b	5.0 bc
Diphenamid, sur, 4	8.5 b	8.0 ab	9.2 a	6.8 bcd	6.8 ab	3.8 bc
Diphenamid, sur, 6	9.5 ab	8.2 ab	9.2 a	9.5 a	5.2 b	8.5 ab
Unhoed check	10.0 a	0.0 d	0.0 b	0.0 e	0.0 c	0.0 d

[z] Chemicals preplant incorporated (ppi) or applied preemergence (sur) in lb a.i./acre.
[y] Rated from 0, plant dead, to 10, excellent plant growth, on May 17.
[x] Mean separation by Duncan's multiple range test, 5% level.
[w] Control of crotalaria (C), purslane (P), broadleaves (B), and grasses (G) rated from 0, no weed control, to 10, 100 per cent weed control.

effective against predominant weeds (1, 7) (Tables 1 and 5).

Vigor ratings at both Leesburg and Gainesville indicated that butralin had a limited range of selectivity for weed control in watermelon (Tables 1 to 5). In some tests weed control at the 1.5 and 2 lb rates was weak. Increasing the rate to 3 and 4 lbs resulted in seedling injury at Leesburg in 1974 and at Gainesville in 1972 and 1974. The higher rate of butralin generally provided improved control of both broadleaf weeds and grasses. The reduction in crop vigor with butralin was not necessarily reflected in the total marketable yield. Butralin applied in combination with bensulide provided longer weed control than either material applied alone and resulted in a larger yield (Table 3).

Napropamide treatment resulted in some crop injury, especially at the 8 lb rate in 1972 and 1974 at Gainesville. The 4 and 5 lb rates of napropamide provided good weed control at Leesburg in both 1973 and 1974 and at Gainesville in 1972. Combining napropamide with naptalam to improve weed control has been successful (1) although the combination was somewhat phytotoxic to watermelons in 1973 at Leesburg.

There was very little reduction in crop vigor following a preplant incorporated treatment with alachlor (Tables 1, 2, and 4). This treatment was weak on crotalaria at Gainesville in 1973 but controlled the predominant weeds at Leesburg. Yield was good at Leesburg following treatment with alachlor.

Severe seedling injury occurred at Leesburg following treatment with diphenamid at 6 lb/acre (Table 1). Severe injury did not occur at Gainesville (Tables 4 and 5). Weed control was poor at Leesburg but was excellent at Gainesville in 1974. These differences were probably due to differences in soil type and soil moisture at the 2 locations.

In summary, bensulide did not provide control of predominant weeds and was promising only when applied in combination with butralin. The range of selectivity of naptalam is rather narrow and weed control at selective rates was not adequate. Further evaluation of naptalam in combinations with napropamide, butralin, and alachlor should be made. Butralin, napropamide, and

Table 5. Crop vigor, weed control, and total marketable yield following soil treatment with various herbicides at Gainesville, 1974.

Treatment[z]	Crop vigor[yxw] April 12	Crop vigor[yxw] May 24	Weed control[xv] B	Weed control[xv] G	Yield[x] (cwt/acre)
Hoed check	10.0 a	10.0 a	10.0 a	10.0 a	115 ab
Butralin, ppi, 2	7.0 bc	8.0 abc	6.0 cd	6.5 bc	142 a
Butralin, ppi, 4	5.0 cde	7.3 bc	7.5 bc	8.0 ab	123 ab
Napropamide, ppi, 4	5.2 cde	8.0 abc	6.2 cd	6.7 b	66 ab
Napropamide, ppi, 8	2.7 e	6.5 bc	6.0 cd	7.2 b	87 ab
Bensulide, ppi, 4	7.8 abc	7.5 bc	3.5 d	4.5 d	99 ab
Bensulide, ppi, 6	8.2 ab	8.0 abc	3.2 de	3.7 d	144 a
Naptalam, sur, 4	6.2 bcd	8.5 ab	8.2 abc	6.2 bc	165 a
Trifluralin, ppi, 1.5	4.2 de	8.0 bc	7.0 bc	6.5 bc	86 ab
Nitralin, ppi, 4.0	5.7 bcd	6.8 bc	7.7 bc	8.5 ab	99 ab
Diphenamid, sur, 4	6.8 bcd	7.8 bc	9.7 ab	10.0 a	155 a
Unhoed check	10.0 a	6.0 c	0.0 e	0.0 e	0 b

[z] Chemicals preplant incorporated (ppi) or applied preemergence (sur) in lb a.i./acre.
[y] Rated from 0, plant dead, to 10, excellent plant growth.
[x] Mean separation by Duncan's multiple range test, 5% level.
[w] All plots except unhoed check cultivated on April 15.
[v] Control of broadleaves (B) and grasses (G) rated from 0, no weed control, to 10, 100 percent weed control on April 12.

alachlor all show some promise for weed control in watermelon. Diphenamid might be useful on heavier soil types such as the flat-wood soils but appear to be limited on light sandy soil. Nitralin and trifluralin should not be considered for further use in watermelon on the sandy soils in Florida.

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SEVERITY OF BACTERIAL RIND NECROSIS IN WATERMELON CULTIVARS IN FLORIDA

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Abstract. Symptoms of bacterial rind necrosis (BRN) usually consist of brown, dry, and hard necrosis of the watermelon rind from which bacteria may be isolated. 'Sweet Princess' and 'Jubilee' had both the lowest incidence of BRN and the mildest symptoms of any cultivars tested. 'Klondike Blue Ribbon' and 'Klondike R7' had the highest incidence and the most severe symptoms. Systemic necrosis throughout the rind and brown or yellow spots in the flesh often occurred in these cultivars. BRN is severe enough in these 2 cultivars to prevent their production in Florida. Incidence of BRN in 'Charleston Gray' ranked near the median of cultivars tested. Round-fruited cultivars tended to have a higher incidence of BRN than long-fruited ones.

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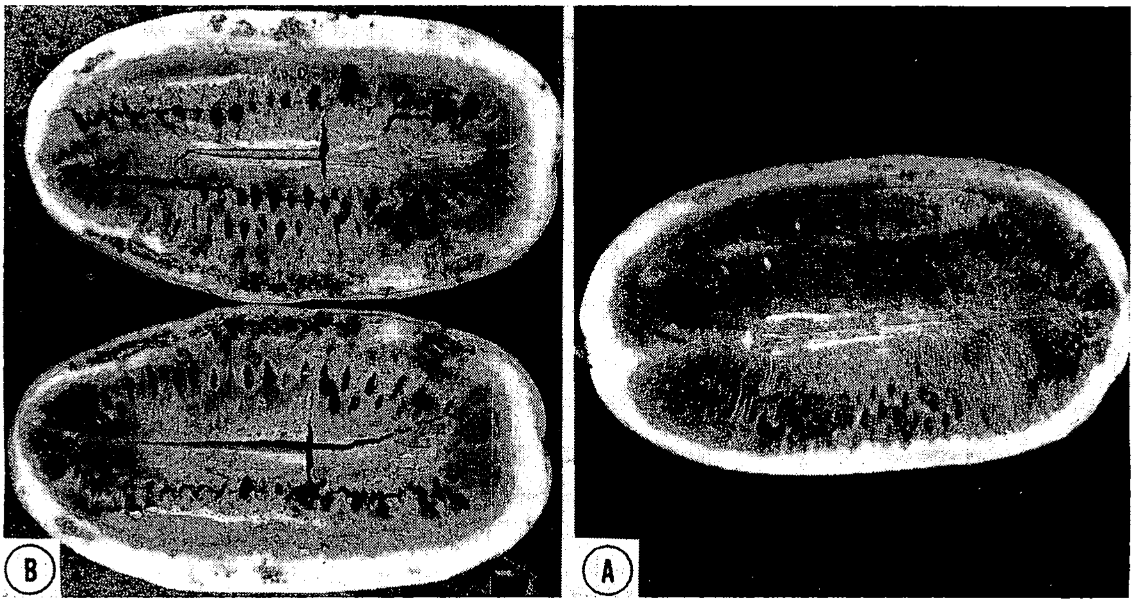

Fig. 1. Symptoms of bacterial rind necrosis of watermelon: A) few small, necrotic spots; B) severe, systemic necrosis in rind.