

of contribution from the nursery trees themselves and mineralization of soil organic matter. A soil test for organic matter content prior to planting a new grove could give an indication as to the potential contribution of N from this source.

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MULTIPLE APPLICATIONS OF PREEMERGENCE HERBICIDE TANK MIXTURES IN YOUNG CITRUS GROVES

MEGH SINGH, D.P.H. TUCKER AND S. H. FUTCH
*University of Florida, IFAS
Citrus Research and Education Center
700 Experiment Station Road
Lake Alfred, FL 33850*

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Abstract. Young citrus grove sites were selected in Polk, Indian River, and Collier counties to evaluate preemergence herbicides for weed control and tree phytotoxicity. The studies were carried out for 2 yr starting in the spring of 1988. Herbicides evaluated included bromacil (Hyvar), diuron (Direx and Karmex), metolachlor (Dual), napropamide (Devrinol), norflurazon (Solicam), oryzalin (Surflan), oxadiazon (Ronstar), oxyfluorfen (Goal), pendimethalin (Prowl) and simazine (Princep). All herbicide treatments reduced weed populations compared with untreated controls and there were significant differences among weed control treatments. Better weed control was observed at 60 days after treatment (DAT) than at 120 DAT. Bromacil + diuron and all combinations with norflurazon provided the best weed control at all 3 locations. Variation in weed control was observed with frequency and time of herbicide application. None of the herbicides consistently produced any phytotoxicity symptoms on trees. Occasional mild symptoms of bromacil appeared on foliage in weaker soil areas only at the Indian River County location.

Prevention of weed infestation is the best strategy to minimize losses due to weeds, but is not practical in commercial citrus production. Some acceptable level of control is the goal of growers who utilize several weed control methods in an integrated control program.

Weed control accounts for 20-25% of the production budget and losses from weeds can be substantial in young groves as they compete for nutrients and moisture and contribute to other undesirable effects (1, 2). Chemical control or suppression is the most common method of weed control utilized on over 90% of Florida citrus acreage. Preemergence herbicides are used alone or in combination with postemergence herbicides for the control of established weed cover. Preemergence herbicides currently registered for citrus include bromacil, diuron, EPTC, metolachlor, napropamide, norflurazon, oryzalin, oxyfluorfen, pendimethalin, simazine and trifluralin. These herbicides vary in efficacy, chemical properties, safety, and cost. Herbicide should be considered by growers based on weed species and density, variety and age of trees, soil type, and local environmental conditions. Mixtures of 2 or more herbicides at reduced rates may be used to maximize efficacy and minimize environmental impact.

Singh and Tucker (6) reported that frequent applications of low rates of preemergence herbicides will improve weed control consistency without any phytotoxicity to young trees in containers and in the field. Singh and Achhiredy (5) also demonstrated the safe use of preemergence herbicides on young citrus rootstock plants. Bromacil and diuron have been found to be effective against a wide range of grass and broadleaf weed species and generally safe for use around citrus trees (8, 9). Norflurazon is an effective herbicide for use in water rings (7), for application through irrigation systems, and for general weed control in groves. Simazine is effective against germinating annual grasses, broadleaf weeds, and vines (3, 4).

Objectives of these experiments were to examine the effectiveness of various preemergence herbicides against commonly found weed species under central Florida ridge, east coast, and southwest flatwoods growing conditions and to record phytotoxic effects if any.

Materials and Methods

Three young groves planted in 1987 located in Lake Alfred (Polk County), Vero Beach (Indian River County)

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Table 1. Herbicide used in the study.

Common name	Trade name(s)	Formulation	Manufacturer
Bromacil	Hyvar	3.2 L, 80 WP	E. I. duPont Company
Bromacil + Diuron (1:1)	Krovar I	80 DF	E. I. duPont Company
Diuron	Karmex	80 DF	E. I. duPont Company
Diuron	Direx	4 F	Griffin Corporation
Glyphosate	Roundup	4 L	Monsanto Company
Metolachlor	Dual	8 EC	Ciba-Geigy Corporation
Napropamide	Devrinol	50 WP	I C I Americas, Inc.
Norflurazon	Solicam	80 DF	Sandoz Crop Protection, Inc.
Oryzalin	Surflan	4 F	Dow-Elanco Company
Oxadiazon	Ronstar	2 EC	Rhone-Poulenc Company
Oxyfluorfen	Goal	1.6 EC	Rohm and Haas Company
Pendimethalin	Prowl	4 F	American Cyanamid Company
Simazine	Princep	90 WDG	Ciba-Geigy Corporation
Simazine	Simazine	90 DF	Terra International, Inc.
Simazine	Simazine	4 L	Drexel Chemical Company

and Immokalee (Collier County) were selected in the spring of 1988 for these herbicide studies. Scion/rootstock combinations were 'Valencia' orange [*Citrus sinensis* (L.) Osb.] budded on Swingle citrumelo [*Poncirus trifoliata* (L.) Raf. x *C. paradisi* Macf.] in Lake Alfred, 'Flame' grapefruit (*C. paradisi* Macf.) budded on Cleopatra mandarin (*C. reticulata* Blanco) in Vero Beach and 'Valencia' orange budded on Carrizo citrange [*C. sinensis* (L.) Osb. x *P. trifoliata* (L.) Raf.] in Immokalee. All groves had low volume under-tree microsprinkler irrigation systems. Herbicide treatments evaluated in these experiments are shown in Table 1. All are currently registered for use in citrus except oxadiazon. Oxyfluorfen and pendimethalin are currently registered only for non-bearing groves. Treatments were

first applied on April 27 at Lake Alfred, March 15 at Vero Beach and on April 21, 1988 at Immokalee and were repeated at 4-month intervals at all 3 locations for a total of 6 applications. First applications were made to essentially bare ground and subsequent applications were applied with 1.0 lb/acre glyphosate (1.0 q/acre Roundup) to control existing vegetation. Some treatments did not require glyphosate to control existing vegetation at subsequent applications, but for consistency glyphosate was applied to all treatments. Major weed species present at the experimental sites were recorded and listed for all 3 locations (Table 2).

Treatments were applied with a tractor mounted boom-sprayer equipped with 5 stainless steel air-tight tanks

Table 2. Major weeds present at experimental sites.

Common Name	Scientific Name	Lake Alfred	Vero Beach	Immokalee
Alexandergrass	<i>Brachiaria plantaginea</i>	Y	N	N
Alligatorweed	<i>Alternanthera philoxeroides</i>	N	Y	Y
Bahiagrass	<i>Paspalum notatum</i>	N	Y	Y
Balsam Apple	<i>Momordica charantia</i>	Y	N	N
Bermudagrass	<i>Cynodon dactylon</i>	Y	Y	N
Citron Melon	<i>Citrullus vulgaris</i>	Y	N	N
Crabgrass	<i>Digitaria adscendens</i>	Y	Y	Y
Crowfootgrass	<i>Dactyloctenium aegyptium</i>	Y	Y	N
Dayflower	<i>Commelina benghalensis</i>	Y	Y	Y
Dogfnnel	<i>Eupatorium capilifolium</i>	Y	N	Y
Florida Pusley	<i>Richardia scabra</i>	Y	Y	Y
Goatweed	<i>Scoparia dulcis</i>	N	Y	Y
Goosegrass	<i>Eleusine indica</i>	Y	Y	Y
Guineagrass, B.L.	<i>Panicum maximum</i>	Y	Y	N
Guineagrass, N.L.	<i>Panicum maximum</i>	Y	Y	Y
Lambsquarter	<i>Chenopodium album</i>	Y	Y	Y
Maypop	<i>Passiflora incarnate</i>	Y	N	N
Nutsedge	<i>Cyperus rotundus</i>	Y	Y	Y
Paragrass	<i>Brachiaria mutica</i>	Y	Y	Y
Pepperweed	<i>Lepidium virginicum</i>	Y	N	N
Pigweed	<i>Amaranthus viridis</i>	N	Y	Y
Primrose	<i>Oenothera biennis</i>	Y	Y	Y
Ragweed	<i>Ambrosia artemisiifolia</i>	Y	Y	N
Sandspur	<i>Cenchrus echinatus</i>	Y	N	Y
Sicklepod	<i>Casia obtusifolia</i>	N	Y	N
Signalgrass	<i>Brachiaria piligera</i>	Y	Y	N
Spanish Needles	<i>Bidens pilosa</i>	Y	Y	Y
Spurge	<i>Chamaesyce hyssopifolia</i>	Y	N	Y
Teaweed	<i>Sida acuta</i>	Y	Y	Y
Torpedograss	<i>Panicum repens</i>	N	Y	Y
Wandering Jew	<i>Tradescantia albiflora</i>	N	Y	Y

Y = Present; N = Absent

and a compressor with air tank. Application volume was 30 gal/acre applied at 30 psi using 8002 Teejet nozzle tips and an offset OC-04 at the end of the boom. Tractor speed was 2.78 mph. A swath width of 10 ft in the tree row was maintained in each plot and the plot length varied with location from 14 to 20 trees.

All 3 experiments were laid out as randomized complete blocks with 3 replications. Plots were visually rated on the basis of weed cover (% control) on a scale of 0 to 100, 0 being complete ground cover as in untreated controls and 100 being complete weed control. Observations were made at 60 and 120 days after treatment applications (DAT), with subsequent treatments being made at the 120 DAT rating. Data were analyzed using proc ANOVA for each rating date and means compared using LSD at 5% level of significance.

Results and Discussion

All herbicide treatments provided significantly greater weed control than untreated controls at all 3 locations (Tables 3, 4 and 5). Weed control at 60 DAT was greater than that at 120 DAT for all treatments at all locations. Treatment rankings based on overall mean weed control showed the best treatments at all locations were combinations including norflurazon and the bromacil + diuron (1:1). Weed control ranged from 86 to 93 at Lake Alfred, 77 to 88 at Vero Beach and 76 to 89% at Immokalee (Table 6).

At Lake Alfred (Table 3), all herbicide treatments at 60 DAT following first application provided weed control ranging from 93 to 100% with no significant differences among treatments. At 120 DAT overall weed control was reduced from 97 to 89%. Reduced control was noted in

Table 3. Herbicide treatments and weed control (%) at Lake Alfred.

Number	Herbicides	Rate (lb/A)	Apr. 1988 Application 1		Aug 1988 Application 2		Dec. 1988 Application 3		Apr. 1989 Application 4		Aug. 199 Application 5		Dec. 1989 Application 6		Average
			60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT	
1	Norflurazon + Simazine	3.2+ 2.0	99	86	72	67	96	85	93	77	85	87	95	90	86
2	Norflurazon + Diuron	3.2+ 2.0	99	95	77	75	95	83	91	87	95	90	98	96	90
3	Norflurazon + Oxyfluorfen	3.2+ 0.8	100	96	87	88	96	87	93	86	95	93	95	94	93
4	Norflurazon + Oxadiazon	3.2+ 4.0	100	93	88	88	92	93	90	92	93	75	88	85	90
5	Oryzalin + Simazine	2.0 + 2.0	98	82	60	48	83	32	62	47	78	67	75	70	67
6	Oryzalin + Diuron	2.0+ 2.0	98	88	75	72	94	82	83	43	82	63	80	72	78
7	Oryzalin + Oxyfluorfen	2.0+ 0.8	99	93	82	77	95	88	82	75	88	86	90	85	87
8	Oryzalin + Oxadiazon	2.0+ 4.0	98	88	78	72	96	90	57	57	92	72	80	75	80
9	Pendimethalin + Simazine	2.0+ 2.0	93	65	53	53	88	68	42	13	52	48	55	45	56
10	Pendimethalin + Diuron	2.0+ 2.0	100	91	82	63	93	90	67	40	75	48	78	55	74
11	Pendimethalin + Oxyfluorfen	2.0+ 0.8	99	83	67	60	97	85	90	40	85	80	89	82	79
12	Pendimethalin + Oxadiazon	2.0+ 4.0	99	88	63	57	93	82	63	62	83	33	78	42	70
13	Napropamide + Simazine	2.5+ 2.0	99	83	27	28	77	10	52	7	22	12	32	29	40
14	Napropamide + Diuron	2.5+ 2.0	100	94	78	73	88	87	52	5	35	23	38	32	59
15	Napropamide + Oxyfluorfen	2.5+ 0.8	99	90	72	68	78	75	38	30	53	43	65	58	64
16	Napropamide + Oxadiazon	2.5+ 4.0	98	78	47	40	80	70	22	13	65	30	67	53	55
17	Metolachlor + Simazine	4.0+ 2.0	100	89	58	53	87	82	37	2	13	5	45	37	51
18	Metolachlor + Diuron	4.0+ 0.8	100	99	93	95	95	95	80	32	67	60	70	58	79
19	Metolachlor + Oxyfluorfen	4.0+ 0.8	99	94	88	78	98	90	87	62	80	67	82	78	84
20	Metolachlor + Oxadiazon	4.0+ 4.0	98	92	87	77	96	92	87	40	75	53	78	63	78
21	Bromacil + Diuron	1.6+ 1.6	98	97	85	75	95	97	93	50	93	78	92	90	87
22	Control	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average			99	89	72	67	91	79	69	46	72	58	75	66	74
L.S.D. (0.05)			NS	7	9	8	7	11	10	12	11	13	10	11	

*DAT = Days After Treatment Application

Table 4. Herbicide treatments and weed control (%) at Vero Beach.

Number	Herbicides	Rate (lb/A)	Apr. 1988 Application 1		Aug 1988 Application 2		Dec. 1988 Application 3		Apr. 1989 Application 4		Aug. 199 Application 5		Dec. 1989 Application 6		Average
			60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT	
1	Norflurazon + Simazine	3.2+ 2	91	76	68	66	87	63	98	89	94	93	97	93	85
2	Norflurazon + Diuron	3.2+ 2	91	87	86	80	93	53	99	96	93	88	97	92	88
3	Norflurazon + Oxyfluorfen	3.2+ 0.8	93	58	50	51	82	62	99	84	85	87	97	92	77
4	Norflurazon + Oxadiazon	3.2+ 4	81	76	68	73	88	40	98	97	92	93	98	92	83
5	Oryzalin + Simazine	2.0+ 2	92	61	56	53	73	35	94	88	76	48	82	52	68
6	Oryzalin + Diuron	2.0+ 2	91	80	80	70	80	43	88	85	83	63	82	55	75
7	Oryzalin + Oxyfluorfen	2.0+ 0.8	40	18	15	5	45	15	58	60	38	32	70	33	36
8	Oryzalin + Oxadiazon	2.0+ 4	44	14	9	0	27	20	60	53	35	25	80	32	33
9	Pendimethalin + Simazine	2.0+ 2	66	53	30	33	48	33	79	61	53	35	80	38	51
10	Pendimethalin + Diuron	2.0+ 2	68	63	46	30	68	22	75	75	55	33	72	20	52
11	Pendimethalin + Oxyfluorfen	2.0+ 0.8	82	36	18	10	55	20	67	61	65	38	82	37	48
12	Pendimethalin + Oxadiazon	2.0+ 4	56	25	23	3	50	18	67	63	46	23	45	27	37
13	Napropamide + Simazine	2.5+ 2	80	36	26	8	15	15	45	27	25	32	42	12	30
14	Napropamide + Diuron	2.5+ 2	92	61	50	43	55	33	65	60	52	43	63	22	53
15	Napropamide + Oxyfluorfen	2.5+ 0.8	68	26	13	5	27	13	37	38	31	20	50	15	29
16	Napropamide + Oxadiazon	2.5+ 4	78	38	26	16	22	20	80	68	53	30	50	22	42
17	Metolachlor + Simazine	4.0+ 2	90	71	55	43	33	27	80	60	58	28	68	23	63
18	Metolachlor + Diuron	4.0+ 2	93	72	68	60	53	38	88	72	70	45	68	23	63
19	Metolachlor + Oxyfluorfen	4.0+ 0.8	96	86	80	60	35	28	63	67	60	23	77	32	59
20	Metolachlor + Oxadiazon	4.0+ 4	95	85	86	80	58	43	94	89	88	48	70	25	72
21	Bromacil + Diuron	1.6+ 1.6	97	98	98	88	60	45	99	91	86	77	87	65	83
22	Control	0.0	0	0	0	0	0	0	0	0	0	0	0	0	00
	Average		80	58	50	42	55	31	78	71	64	48	74	43	58
	L.S.D. (0.05)		8	9	11	13	12	11	9	9	9	8	10	12	

*DAT = Days After Treatment Application

treatments norflurazon + simazine, oryzalin + simazine, oryzalin + diuron, oryzalin + oxadiazon, napropamide + oxadiazon and all combinations with pendimethalin. There was a 24% reduction in weed control between the first and second application dates. Some of the less effective treatments at 60 and 120 DAT in the second application were pendimethalin + simazine, napropamide + simazine, napropamide + oxadiazon, and metolachlor + simazine. Superior treatments providing 80% or greater control included all combinations with norflurazon, bromacil + diuron, and oryzalin with oxyfluorfen and oxadiazon. No treatments resulted in phytotoxicity symptoms on trees.

At Vero Beach (Table 4), the best treatments with overall mean control exceeding 80% were norflurazon + simazine, norflurazon + diuron, and bromacil + diuron. Some of the poorer treatments with less than 50% weed control were oryzalin + oxyfluorfen and oryzalin +

oxadiazon, pendimethalin + oxadiazon, napropamide + simazine, and napropamide + oxyfluorfen. At 60 DAT following the first application most treatments provided over 50% weed control while 120 DAT degree of weed control declined rapidly. Similar trends were observed throughout the experiment. Generally, during the summertime, weed control was poorer than in spring and winter due to the relative vigor of weed growth. There was no definite indication that continuous application of a given treatment improved weed control. Bromacil + diuron treatments produced mild phytotoxicity symptoms on 'Flame' grapefruit trees. Soil erosion was a problem at this location because of the height of beds, water ring breakdown, and absence of a well established cover crop.

At Immokalee (Table 5), the best treatments were bromacil + diuron and combinations of norflurazon with simazine, diuron and oxyfluorfen, with overall weed con-

Table 5. Herbicide treatments and weed control (%) at Immokalee.

Number	Herbicides	Rate (lb/A)	Apr. 1988 Application 1		Aug 1988 Application 2		Dec. 1988 Application 3		Apr. 1989 Application 4		Aug. 199 Application 5		Dec. 1989 Application 6		Average
			60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT	
1	Norflurazon + Simazine	3.2+ 2.0	73	73	92	80	82	80	83	83	85	83	85	83	82
2	Norflurazon + Diuron	3.2+ 2.0	53	47	93	75	82	75	81	68	85	83	88	84	76
3	Norflurazon + Oxyfluorfen	3.2+ 0.8	62	50	90	70	75	73	85	82	82	80	84	82	76
4	Norflurazon + Oxadiazon	3.2+ 4.0	67	55	77	73	78	53	82	78	86	83	90	87	76
5	Oryzalin + Simazine	2.0+ 2.0	70	58	68	57	74	58	77	55	77	75	72	69	68
6	Oryzalin + Diuron	2.0+ 2.0	60	51	93	75	82	78	73	67	75	58	74	68	71
7	Oryzalin + Oxyfluorfen	2.0+ 0.8	53	42	80	60	68	37	57	57	67	31	65	58	56
8	Oryzalin + Oxadiazon	2.0+ 4.0	60	48	85	78	77	48	78	73	77	73	74	68	70
9	Pendimethalin + Simazine	2.0+ 2.0	58	52	75	55	80	37	77	62	77	61	68	58	63
10	Pendimethalin + Diuron	2.0+ 2.0	55	52	83	71	75	45	48	38	57	33	48	42	54
11	Pendimethalin + Oxyfluorfen	2.0+ 0.8	85	72	77	68	78	58	73	55	77	66	62	57	69
12	Pendimethalin + Oxadiazon	2.0+ 4.0	67	65	80	45	72	43	67	62	78	66	65	57	64
13	Napropamide + Simazine	2.5+ 2.0	47	37	36	20	53	15	68	58	78	73	72	58	51
14	Napropamide + Diuron	2.5+ 2.0	47	43	65	50	72	17	43	28	60	40	55	42	47
15	Napropamide + Oxyfluorfen	2.5+ 0.8	45	43	21	7	43	5	47	53	73	60	55	50	42
16	Napropamide + Oxadiazon	2.5+ 4.0	48	45	28	20	37	8	47	55	65	50	58	52	43
17	Metolachlor + Simazine	4.0+ 2.0	58	55	56	45	62	40	35	30	45	25	55	42	46
18	Metolachlor + Diuron	4.0+ 2.0	58	58	77	70	78	72	47	48	67	31	62	55	60
19	Metolachlor + Oxyfluorfen	4.0+ 0.8	50	40	50	51	63	37	63	58	65	58	62	54	54
20	Metolachlor + Oxadiazon	4.0+ 4.0	58	48	68	55	68	20	58	53	77	58	65	52	57
21	Bromacil + Diuron	1.6+ 1.6	77	73	98	78	94	92	93	96	92	90	87	89	89
22	Napropamide	4.0	68	68	55	28	62	18	43	30	21	18	55	42	42
23	Control	0.0	0	0	0	0	0	0	0	0	0	0	0	0	00
	Average		60	53	70	56	71	46	65	58	71	59	68	61	62
	L.S.D. (0.05)		10	11	9	12	9	13	8	11	12	14	12	11	

*DAT = Days After Treatment Application

trol ranging from 76 to 89%. Less control was evident with treatments that included napropamide + oxyfluorfen, napropamide + oxadiazon, metolachlor + simazine and napropamide + diuron, with an overall mean weed control rating of less than 50%. As before, weed control at 60 DAT was higher than at 120 DAT throughout the study, but there were no differences in weed control from one application date to another. At 60 DAT only napropamide combinations provided less than 50% control. The level of weed control dropped rapidly at 120 DAT, with only norflurazon + simazine and bromacil + diuron providing over 70% control. Generally weed control ratings at Immokalee for a given treatment increased with increasing frequency of application. Towards the end of the study period, all norflurazon combinations and bromacil +

diuron provided over 80% control at 120 DAT following the sixth application.

Around emitters some napropamide treatment combinations and bromacil + diuron broke down allowing weed emergence. None of the treatments produced phytotoxicity symptoms on trees.

Earlier studies indicated that 2 herbicide applications per year did not provide effective annual weed control (8). It appears from results presented in this study that 3 timely herbicide applications per year at lower application rates provide the basis for an effective weed control program for Florida citrus.

Many herbicide treatments start breaking down after 3 months under Florida climatic conditions, especially the southern areas. Fewer applications of higher rates of her-

Table 6. Ranking and average weed control (%) at three locations.

Number	Herbicides	Rate (lb/A)	Ranking			Average weed control (%)		
			Lake Alfred	Vero Beach	Immokalee	Lake Alfred	Vero Beach	Immokalee
1	Norflurazon + Simazine	3.2 + 2.0	6	2	2	86	85	82
2	Norflurazon + Diuron	3.2 + 2.0	2	1	4	90	88	76
3	Norflurazon + Oxyfluorfin	3.2 + 0.8	1	5	3	93	77	76
4	Norflurazon + Oxadiazon	3.2 + 4.0	3	3	5	90	83	76
5	Oryzalin + Simazine	2.0 + 2.0	15	8	9	67	68	68
6	Oryzalin + Simazine	2.0 + 2.0	12	6	6	78	75	71
7	Oryzalin + Oxyfluorfin	2.0 + 0.8	5	18	14	87	36	56
8	Oryzalin + Oxadiazon	2.0 + 0.8	8	19	7	80	33	70
9	Pendimethalin + Simazine	2.0 + 2.0	18	14	11	56	51	63
10	Pendimethalin + Diuron	2.0 + 2.0	13	13	16	74	52	54
11	Pendimethalin + Oxyfluorfin	2.0 + 0.8	9	15	8	79	48	69
12	Pendimethalin + Oxadiazon	2.0 + 4.0	14	17	10	70	37	64
13	Napropamide + Simazine	2.5 + 2.0	21	20	17	40	30	51
14	Napropamide + Diuron	2.5 + 2.0	17	11	18	59	53	47
15	Napropamide + Oxyfluorfin	2.5 + 2.0	16	21	22	64	29	42
16	Napropamide + Oxadiazon	2.5 + 4.0	19	16	20	55	42	43
17	Metolachlor + Simazine	4.0 + 2.0	20	12	19	51	53	46
18	Metolachlor + Diuron	4.0 + 2.0	10	9	12	79	63	60
19	Metolachlor + Oxyfluorfin	4.0 + 0.8	7	10	15	84	59	54
20	Metolachlor + Oxadiazon	4.0 + 4.0	11	7	13	78	72	57
21	Bromacil + Diuron	1.6 + 1.6	4	4	1	87	83	89
22	Napropamide	4.0	*	*	21	*	*	42
23	Control	0.0	22	22	23	0	0	0

Literature Cited

bicides are not environmentally sound as they are subject to rapid leaching by frequent irrigations and heavy summer rainfall. The studies further suggest that all herbicides at rates tested were safe to young orange trees on these rootstocks at all locations. At Vero Beach only the bromacil + diuron (1:1) treatment at 1.6 + 1.6 lb/A showed mild phytotoxicity symptoms on 'Flame' grapefruit on Cleopatra mandarin rootstock.

Table 6 ranks the herbicide treatment at each location with 1 representing the best weed control. Overall weed control was highest at the Lake Alfred location and lowest at Vero Beach with Immokalee showing intermediate control. These ratings reflect the density of weed cover and vigor of weed growth at the experimental sites. The bromacil + diuron and norflurazon combination treatments provided the best weed control at all locations followed by the oryzalin tank mixes and the other treatments.

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