[12] of desired element must be used; otherwise, the injector setting needed is displayed [13]. If the user entered [14] an injector setting equal to calculated injector setting, the irrigation water would contain the desired ppm of element [15]. An injector setting less than the calculated setting may be entered and the irrigation water would contain greater than desired elemental concentration [16]. The user is then given the option to dilute the fertilizer in a mixing tank [17] prior to injection, thus resulting in the desired concentration of element in irrigation water [18]. An injector setting larger than the calculated setting may be entered and the irrigation water would contain a smaller than desired elemental concentration [19]. The desired elemental concentration in irrigation water may then be obtained by using fertilizer with a larger percentage [20] of element desired. The user may elect to repeat the program to select different inputs or end the program.

Option A of the second program is used when blended dry fertilizers are dissolved then injected into irrigation water. Option A begins with an introduction [1] that explains the purpose of the program and what the user can obtain by using the program (Fig. 2). The grade or analysis of the fertilizer is entered [2] and the user is asked to input the element [3] for which calculations are based. The ppm of desired element in irrigation water is entered [4] along with the naturally occurring concentration of the desired element [5] in irrigation water. If the naturally occurring concentration equals or exceeds the desired concentration, the fertilizer would not be needed [6]. Once the dilution ratio of injector [7] and total volume of solution [8] in mixing tank (fertilizer and water) are entered, the amount of fertilizer [9] to be added to the mixing tank and dissolved to the specified volume is displayed along with the concentration of N, P and/or K [10] in irrigation water when using the specified dilution ratio.

A caution statement is displayed to warn the user [11] that the amount of fertilizer that will dissolve depends upon concentration of natural salts in irrigation water. Therefore, an equivalent amount of fertilizer to dissolve in 1 gal, as a check; is displayed along with instructions for fertilizers that do not dissolve. The user may elect to repeat option A using different inputs, go to option B, or end the program.

Option B is used when dissolving individual fertilizer compounds to supply specific nutrients for injection into irrigation water. Option B begins with an introduction [12] that explains the purpose of the program and what the user can obtain by using the program (Fig. 2).

The user is asked to select from a list of fertilizer compounds [13] the compound [14] that will be dissolved and injected into irrigation water. If the fertilizer compound contains more than one plant required element (i.e. ammonium sulfate) the user can choose the element [15] for which calculations are based. The percent of element in fertilizer compound [16] is displayed and may be changed if the fertilizer used contains a different percentage. The ppm of desired element in irrigation water is entered along with the naturally occurring concentration of desired element [17] in irrigation water. If the naturally occurring concentration equals or exceeds the desired, the fertilizer would not be needed [18]. Once the dilution ratio of injector and total volume [19] of mixing tank (fertilizer and water) are entered, the amount of fertilizer compound [20] to be added to the mixing tank and dissolved to the specified volume is displayed along with the concentration of element desired in irrigation water [21]. If the amount of fertilizer to be dissolved exceeds maximum solubility, a message is displayed indicating the amount of fertilizer needed will not dissolve [22] in the volume specified. If the amount of fertilizer to be dissolved does not exceed maximum solubility, a caution statement is displayed to warn the user that the amount of fertilizer that will dissolve depends upon concentration of natural salts in irrigation water [23]. Therefore, an equivalent amount of fertilizer to dissolve in 1 gal, as a check, is displayed along with instructions for fertilizer compounds that do not dissolve. The user may elect to repeat option B using different inputs, go to option A or, end program.

Conclusion

These programs are designed to assist ornamental plant growers with fertilizer dilution calculations. The programs enable growers to perform computations rapidly with minimal errors, thus facilitating timely and correct fertility management decisions. Display screens of elemental concentrations injected contain pertinent inputs and important outputs, so these displays should be printed for permanent records.

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CHEMICAL WEED CONTROL IN FLOWERING GLADIOLUS[1]

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Abstract. **Pre- and postemergence applications of 1.5 + 2.0 lb./acre of alachlor + CIPC, 2.0 lb./acre of napropamide, 2.0 lb./acre of oryzalin, 2.0 lb./acre of pronamide and 4.0 lb./acre of thiobencarb were evaluated for control of crabgrass** (Digitaria ciliaris **(Retz.) Koel.) and pigweed** (Amaranthus hybridus **L.) in flowering 'Manatee White' gladiolus** (Gladiolus x hortulanus **L.). Napropamide and thiobencarb reduced vigor of gladiolus plants. Crabgrass and pigweed control was excellent with each herbicide treatment after 2 and 4 applications, with the exception of thiobencarb and pronamide, which provided poor control of pigweed. Four applications of napropamide and thiobencarb reduced the number and weight of flower spikes cut, while yields with alachlor + CIPC, oryzalin and pronamide were comparable to the hoed check.**

Weed control in gladiolus has been researched and documented (1-9); however, several new herbicides are now available which show varying degrees of promise for use in flowering gladiolus. Pronamide and oryzalin provide ex-

[1]Florida Agricultural Experiment Stations Journal Series No. 5910.
[2]The author wishes to extend his sincere appreciation to Manatee Fruit Company for growing the crop in all of the preliminary screening experiments, and for providing the corms for the final study reported herein.

Table 1. Effect of multiple applications of various herbicides on vigor of 'Manatee White' gladiolus in preliminary herbicide screening experiments. Bradenton, FL. 1981-83.

Treatment	Rate (lb. a.i./acre)	Method of initial application[y]	Vigor rating[z] Fall 1981 (2 applications)	Spring 1982 (3 applications)	Fall 1982 (2 applications)	Spring 1983 (4 applications)
Cultivated check	—	—	7.1 c[x]	8.5 abc	7.6 c	9.9 a
Acifluorfen	0.5	post	4.5 d	4.5 i	9.8 a	—
Alachlor + CIPC[w]	1.5 + 2.0	pre	10.0 a	9.2 ab	—	9.9 a
Bensulide	3.5	pre	7.1 c	—	—	—
Bentazon	1.0	post	—	3.8 i	—	—
Bifenox	2.0	post	7.6 bc	7.1 ef	—	—
Chloramben	4.0	pre	7.3 c	—	—	—
Dinoseb	7.5	pre	6.5 c	—	—	—
Diuron	1.0	pre	6.0 cd	6.0 gh	—	—
Ethofumesate	1.5	pre	9.1 ab	9.1 ab	9.0 b	—
Fluazifop-butyl	0.5	post	10.0 a	9.2 ab	9.9 a	9.8 a
Metolachlor	2.0	ppi	7.5 bc	—	—	—
Metribuzin	0.25	ppi	5.0 d	—	—	—
Napropamide	2.0	pre	8.1 b	9.2 ab	9.2 b	9.6 a
Oryzalin	2.0	pre	9.9 a	8.5 abc	9.5 ab	10.0 a
Oxyfluorfen	0.5	pre	—	5.5 h	—	—
Pebulate	4.0	ppi	1.0 e	—	—	—
Pendimethalin	1.0	pre	7.0 c	—	—	—
Pronamide	2.0	pre	—	8.0 cde	9.0 b	9.6 a
Sethoxydim	0.5	post	10.0 a	—	10.0 a	10.0 a
Simazine	1.0	pre	8.0 b	—	—	—
Thiobencarb	4.0	pre	9.5 a	8.8 bc	9.0 b	9.4 a
MK 616	2.0	pre	7.0 c	6.6 fg	—	—

[z]Vigor was evaluated on a 0 to 10 scale where 0 indicates all plants are dead and 10 represents no injury, optimum growth.
[y]Initial applications were made as indicated (pre = preemergence, ppi = preplant incorporated and post = postemergence) with additional applications made postemergence over the top.
[x]Mean separation within columns by Duncan's new multiple range test, 5% level.
[w]Additional applications consisted of alachlor only.

cellent control of cypressvine morningglory (unpublished data), but many other weeds occur in field grown gladiolus. Among some of the more economically important weeds are crabgrass and pigweed. Standard cropping practices in Florida are to apply herbicide an average of 4 times during the season. This consists of 1 preemergence application after planting the corms, and 3 additional applications over the top of the gladiolus plants at each sidedressing of fertilizer. Each sidedressing is mechanically incorporated which disturbs the soil and necessitates additional herbicide applications. Thus, any herbicide used must be nonphytotoxic to gladiolus in various stages of growth and at accumulated rates.

The purpose of this experiment was to evaluate 5 herbicides, previously selected from preliminary screening experiments, for efficacy of control of crabgrass and pigweed and phytotoxicity to gladiolus.

Materials and Methods

Twenty-two herbicides were evaluated for efficacy and phytotoxicity to gladiolus over 4 cropping seasons in preliminary screening work (Table 1). Five were selected from these for more extensive evaluation in the fall of 1983. The experimental area was rototilled, bedded, and fumigated with a mixture of 67% methyl bromide and 33% chloropicrin on August 4, 1983. Beds were immediately covered with black polyethylene film which was removed 2 weeks later. A 6-6-6 fertilizer with micronutrients was applied broadcast at a rate of 800 lb./acre and incorporated on August 25. Treatments were assigned to 4.5 x 15-ft plots arranged in a randomized complete block design with each treatment replicated 4 times. Number 2 size corms (1.25-1.5 inches diameter) of 'Manatee White' gladiolus were planted upright in a single row at a rate of 3.5 corms/ft on August 25 and were covered to a depth of 5-6 inches with Myakka fine sand. Immediately after planting the corms, 0.28 oz each of crabgrass and pigweed seed were evenly distributed over each plot and incorporated with a rake to a depth of 1-1.5 inches. Additional fertilizer was supplied by 3 sidedressings during the season to provide a total of 168, 73, and 140 lb./acre of N, P and K, respectively.

Treatments were weedy check; hoed check; 1.5 lb./acre alachlor + 2.0 lb./acre CIPC (CIPC was included only for the first application, and additional applications to this experimental unit consisted of 1.5 lb./acre alachlor alone); 2.0 lb./acre of napropamide, oryzalin and pronamide; and 4.0 lb./acre of thiobencarb. Treatments were applied 4 times during the season. Initial applications were preemergence surface applied on August 25 after planting. Subsequent applications were made over the top of the gladiolus after each sidedressing of fertilizer on September 14, October 4, and October 26, 1983. All herbicides were applied with a CO_2 back pack sprayer operated at 3 mph and 22 psi pres-

Table 2. Influence of 1 preemergence and 1 over-the-top application of selected herbicide treatments on early season weed control and plant vigor of 'Manatee White' glodiolus. Bradenton, FL. September 23, 1983.

Treatment	Rate (lb. a.i./acre)	Vigor[z]	Weed control[y] Crabgrass	Pigweed
Weedy check	—	8.2 b[x]	0.0 b	0.0 d
Hoed check	—	10.0 a	10.0 a	9.9 a
Alachlor + CIPC[w]	1.5 + 2.0	9.6 a	10.0 a	9.8 a
Napropamide	2.0	8.5 b	10.0 a	8.8 a
Oryzalin	2.0	9.6 a	10.0 a	10.0 a
Thiobencarb	4.0	8.5 b	9.5 a	4.5 c
Pronamide	2.0	9.8 a	9.8 a	6.8 b

[z]Vigor was evaluated on 0 to 10 scale, where 0 indicates all plants were dead and 10 indicates no phytotoxicity.
[y]Weed control was evaluated on a 0 to 10 scale, where 0 indicates no control and 10 indicates 100% control.
[x]Mean separation within columns by Duncan's new multiple range test, 5% level.
[w]Postemergence applications consisted of alachlor alone.

Table 3. Influence of 1 preemergence and 3 postemergence applications of various herbicide treatments on late season weed control and yield of marketable flower spikes of 'Manatee White' gladiolus. Bradenton, FL. 1983.

Treatment	Rate (lb. a.i./acre)	Weed control[z]		Yield of spikes	
		Crabgrass	Pigweed	Number	Weight (lb.)
Weedy check	—	0.0 b[y]	0.0 c	1 b[y]	0.2 c
Hoed check	—	10.0 a	10.0 a	59 a	12.8 a
Alachlor + CIPC[x]	1.5 + 2.0	10.0 a	9.1 a	53 a	12.3 a
Napropamide	2.0	10.0 a	9.4 a	6 b	1.1 c
Oryzalin	2.0	9.3 a	10.0 a	57 a	13.0 a
Thiobencarb	4.0	9.2 a	5.5 b	3 b	0.4 c
Pronamide	2.0	9.0 a	3.2 b	55 a	11.0 b

[z]Weed control was evaluated on a 0 to 10 scale, where 0 indicates no control and 10 indicates 100% control.
[y]Mean separation within columns by Duncan's multiple range test, 5% level.
[x]Postemergence applications consisted of alachlor alone.

sure with two 11004 unijet nozzles delivering 26.6 gal/acre. Hoed checks were hoed and hand weeded twice weekly for the season.

Crop vigor was evaluated visually September 23, 1983 using a 0 to 10 rating scale where 0 represents all plants are dead, and 10 indicates no injury, optimum growth. Weed control was evaluated September 23 and November 28, 1983, using a 0 to 10 rating scale where 0 indicates no control and 10 represents 100% control. Marketable flower spikes were harvested 9 times at 2 day intervals beginning November 17 and ending December 6, 1983. Data were recorded for number and weight of spikes at each harvest. All data were analyzed for statistical significance by analysis of variance using the general linear models procedure, and treatment means were ranked by Duncan's new multiple range test at the 5% level of significance.

Results and Discussion

Two applications of napropamide and thiobencarb reduced vigor of gladiolus plants (Table 1). Although the plants were less vigorous than those in the hoed check and in the other herbicide plots, their vigor was still commercially acceptable at the time. Early season grass control was excellent with all herbicide treatments, while control of pigweed was excellent with all treatments, except thiobencarb and pronamide (Table 2). Although pigweed control with pronamide was superior to that provided by thiobencarb, it was not commercially acceptable.

By the end of the harvest season, control of crabgrass was still excellent with all treatments, while control of pigweed was excellent with all herbicide treatments, except pronamide and thiobencarb (Table 3). Pigweed control with thiobencarb and pronamide was very poor with no difference observed between these treatments.

Napropamide and thiobencarb reduced the number of marketable flower spikes harvested over the course of the season (Table 3). No reduction in number was obtained with the other herbicide treatments. Total weight of marketable spikes was comparable to the hoed check in plots treated with alachlor (+ CIPC) and oryzalin. Although no reduction in number of spikes was obtained with pronamide, weight of spikes was reduced compared to the hoed check, alachlor, and oryzalin. This reduction may have been due to pigweed competition. Plots treated with napropamide and thiobencarb had the lowest weights which were significantly lower than that for pronamide. Since weed control was excellent throughout the season with napropamide, the yield reductions observed were believed to be due to chemical phytotoxicity rather than weed competition, which may have been the case with thiobencarb.

Based on the results of this experiment and previous screening experiments, the best herbicide treatments to use for controlling crabgrass and pigweed are preemergence application of alachlor + CIPC followed by postemergence (to the crop, preemergence to the weeds) of alachlor alone and preemergence and postemergence applications of oryzalin. Where pigweed is not a problem, pronamide may be useful, particularly where weeds not controlled by alachlor + CIPC and oryzalin are abundant.

Literature Cited

1. Bing, A. 1976. Preemergence weed control in gladiolus. Proc. N.E. Weed Sci. Soc. 30:308-312.
2. Bing, A. 1979. The effect of preemergence postplant treatments of alachlor, napropamide, oxadiazon, oxyfluorfen and prodiamine on gladiolus. Proc. N.E. Weed Sci. Soc. 33:264-269.
3. Burgis, D. S. 1959. Pre- and post-emergence herbicides for gladiolus. Proc. Fla. State Hort. Soc. 72:362-364.
4. Burgis, D. S. and W. E. Waters. 1963. Herbicides for gladiolus. Weeds 11:53-55.
5. Fetvadjieva, N. A. and M. S. Dinova. 1980. Chemical weed control in the growing of gladiolus minibulbs (cormels). Acta Horticulturae 109:333-339.
6. Stewart, P. A., R. E. Talbert and C. J. Wallinder. 1983. Yellow nutsedge control in gladiolus. HortScience 18:367-368.
7. Waters, W. E. 1965. Effects of several herbicides on gladiolus flowers and corm production. Proc. Southern Weed Sci. Soc. 18:237-245.
8. Waters, W. E. 1967. Influence of herbicides on gladiolus flower and corm production in Florida. Proc. Southern Weed Sci. Soc. 20:171-178.
9. Woltz, S. S. 1957. Chemical weed control for gladiolus. Proc. Amer. Soc. Hort. Sci. 69:549-555.