

The Effect of Irrigation Practices on the Performance of Lettuce Herbicides

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The herbicides used in lettuce have changed little in more than 30 years. Poast was registered for grass control in the 1980's although preemergent applications of Kerb, Balan and Prefar have been the principal herbicides used in lettuce production since the mid 1960's. Balan was changed from a 1.5 lb./gal. Emulsifiable concentrate to a 60% dry flowable formulation in the mid 80's, Kerb has always been a 50% wettable powder and Prefar is still a 4 lb./gal. emulsifiable concentrate.

Growers are constantly changing cultural practices to improve production or to become more efficient. The change in one cultural practice can, and often does, effect other cultural practices. The use of sprinklers to establish lettuce has become increasingly widespread in the Yuma area over the past 20 years. Kerb and Prefar can be mechanically incorporated into shaped beds although both are commonly incorporated with irrigation water. The change in irrigation practices during stand establishment from furrow irrigation to sprinklers has effected the performance of both Kerb and Prefar. Balan is normally disced into the soil prior to bed formation and is not as effected by irrigation practices during stand establishment.

Four tests are presented in this paper that help explain the effect of irrigation practices on the performance of Kerb and Prefar.

Kerb

Kerb (pronamide) inhibits the growth of developing weed seedlings by disrupting mitosis or cell division. The growth of roots and shoots of small seedlings is stopped. Kerb differs from Prefar and Balan by how it moves both in the soil and the plant. Kerb is readily absorbed into roots and translocated upward. It has postemergence activity on very small weeds. Kerb also will move in the soil when large amounts of water are applied. Prefar and Balan move little in either the soil or plant. Both are strongly adsorbed to the soil where they remain throughout the growing season. Both also are not translocated up into the plant but have a localized effect on those roots or shoots that are contacted.

Kerb is normally applied after planting to dry soil and incorporated with sprinkler irrigation. When sprinklers are not used, shallow preplant mechanical incorporation is recommended although Kerb works well when incorporated with furrow irrigation. Prior to the widespread use of sprinklers, Kerb was incorporated with furrow irrigation and worked well. As sprinkler use for stand establishment increased, complaints of poor weed control increased. This lead some users to suspect that the herbicide had somehow changed. A change in the manufacturing process from using xylene to water occurred in the mid 1980's although our tests conducted in 1996-97 indicated that there was no significant difference in weed control produced by the old and new Kerb. Those same tests indicated that there was a significant difference

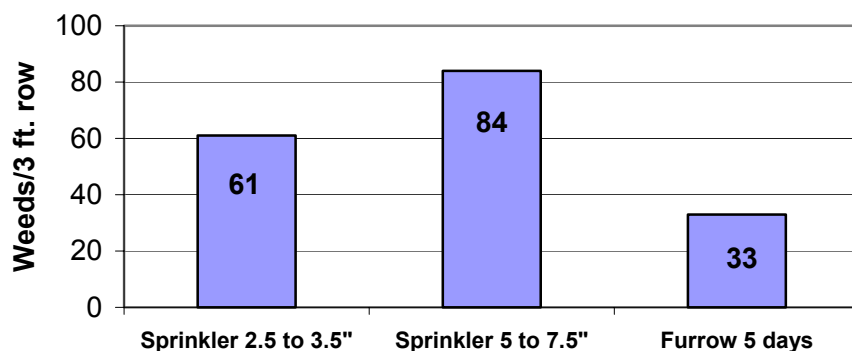
between the weed control produced when Kerb was incorporated with furrow irrigation compared to Kerb incorporated with sprinklers. The Kerb was twice as effective when incorporated with furrow irrigation. (Table 1, Graph 1).

Table 1. Comparison of sprinkler and furrow incorporated Kerb

	Irrigation Type	Irrigation Amount	Weed Control (Seedlings/3 ft.)	
			Grass	Mustard
Kerb –3 lb./a	Sprinkler	2.5 to 3.5	0	61
Kerb - 3 lb./a	Sprinkler	5 to 7.5	0.7	83
Kerb – 3 lb./a	Furrow	5 days	0	33

Notes: Plot size = 15 ft. X 2 beds, 4 replications; Spray volume = 20 gpa
Weeds = Shepardspurse, Annual ryegrass; Weed counts made 26 days after application.

Graph 1. Comparison of sprinkler and furrow incorporated Kerb



This test indicated that a possible cause of the increased failures with Kerb was that the herbicide was being leached below the germinating weed seeds when it was applied prior to the application of large amounts of sprinkler water. It is common to apply between 2 and 5 inches or more of water in 4 to 7 days with sprinklers to establish lettuce in the low desert.

Some growers have recognized the problem of leaching Kerb when incorporated with large volumes of water with sprinklers. One potential solution has been to apply Kerb by air after the sprinklers have been running. This avoids putting large volume of water over the Kerb. The correct time of application has been unclear however. Optimally it has been thought that the correct time would be before the weeds and lettuce had germinated but after all but 0.5 to 1.0 inch of sprinkler water had been applied. Too early and the herbicide will be leached; too late and you risk crop injury and poor weed control. A test was conducted this year and evaluated various times of applications. Treatments included Kerb applied before the sprinklers were started, 1 day after, 2, 3, 4, 5 and 6 days after. (Table 2, Graph 2).

Table 2. Weed control and crop injury from Kerb applied at various times.

Time Applied	Weed Control (%)*	Injury (%)*
Before sprinklers started	9	0
1 day after sprinklers started	40	0
2 day after sprinklers started	50	0
3 day after sprinklers started	69	0
4 day after sprinklers started	75	2.5
5 day after sprinklers started	88	7.5
6 day after sprinklers started	93	14
Untreated	0	0

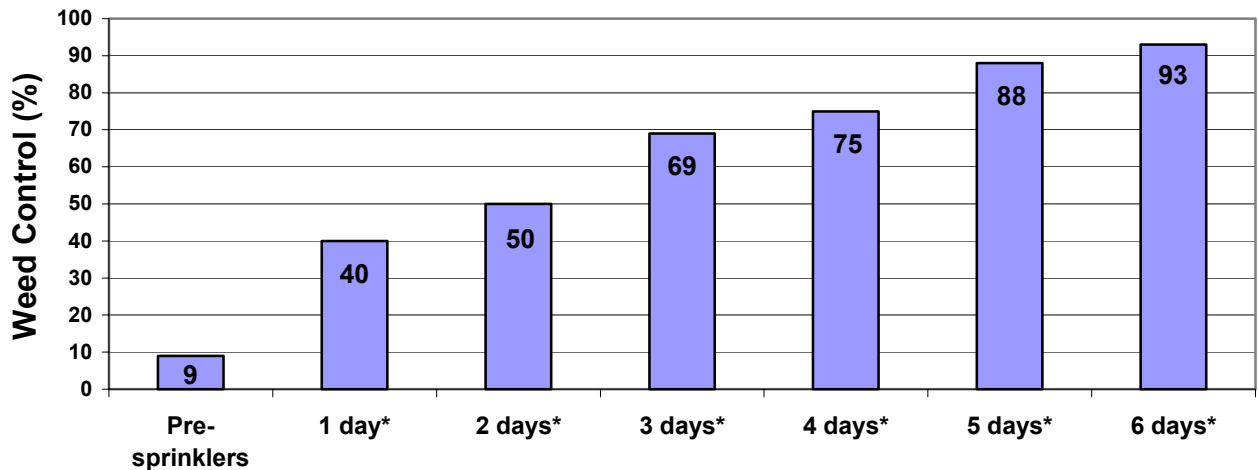
Notes: Plot size = 6 beds x 50'; Kerb - 2 lbs./a

1st treatment applied on 10/27/98; Last treatment applied on 11/3/98

Spray volume = 20 gpa; Lettuce and wild mustard emerged on 10/30/98

* Average of 4 replications.

Graph 2. Weed control from Kerb applied at various times



- Note: Number of days after sprinklers started.

Weed control in this test ranged from less than 10 percent when applied before the sprinklers were started to almost 95 percent when applied after the sprinklers had run for 6 days and continued to run for only 5 more hours after application. The same rate of Kerb, 2 lbs./a of product on a broadcast basis, was applied to all plots. The best control was achieved after both the lettuce and wild mustard had germinated and begun to emerge. This occurred after 3 days of sprinkler irrigation. Crop injury ranged from 2.5% stunting when Kerb was applied after 3 days of running the sprinklers to a high of 14 percent when Kerb was applied after 6 days of sprinklers and one day before they were shut off. This test clearly demonstrated that Kerb works best when the sprinkler are run for only 1 or 2 days after application even when the weeds had begun to

emerge but were still very small. Crop injury was increased but still tolerable. It should be emphasized that results might vary with different environmental conditions and different weed species.

Prefar

Prefar (bensulide), like Kerb, inhibits root growth of developing weed seedlings. It does not disrupt but inhibits mitosis or cell division before it is started. Root growth is stopped without clubbing or other malformation. Prefar differs from Kerb in how it moves in the plant and the soil. Prefar is absorbed only by the roots of plants and does not move upward. Roots that do not contact the herbicide grow normally. If Prefar is not uniformly distributed and incorporated, erratic weed control will result. Prefar also does not move in the soil. It is strongly adsorbed by most soils and will not move downward with irrigation water.

Prefar is normally applied preemergence after planting and incorporated with sprinkler or furrow irrigation. It can also be applied by chemigation through sprinkler systems. Shallow preplant mechanical incorporation is also on the label. Prefar was registered in 1965, the same year as Balan and four years earlier than Kerb. Prior to the widespread use of sprinklers during stand establishment, Prefar developed a reputation of producing erratic and narrow spectrum weed control. More effective and consistent weed control has been achieved in recent years with the use of sprinklers for incorporation. Tests have been conducted over the past few years to evaluate sprinkler and furrow irrigation incorporation with variable volumes of water. Two of these tests are summarized here.

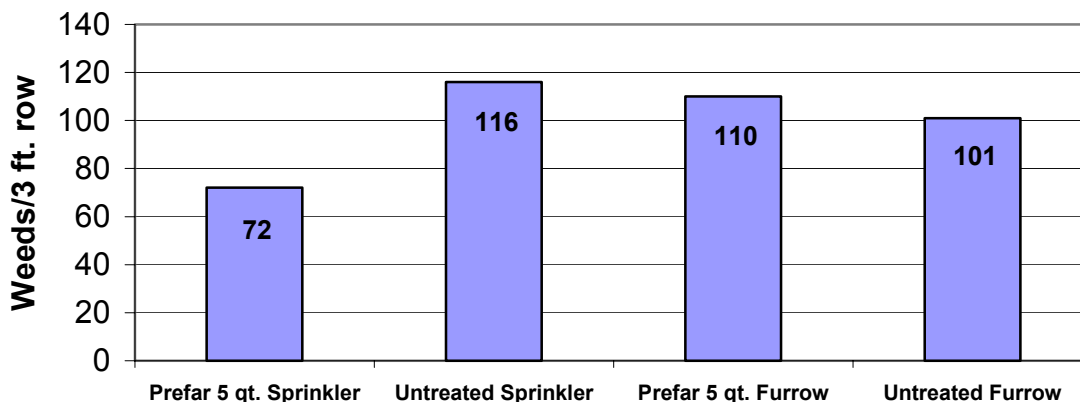
A test was conducted to compare a moderate rate (5 qts./a) of Prefar incorporated with sprinkler and furrow irrigation. (Table 3, Graph 3)

Table 3. Weed control from Prefar incorporated with sprinkler and furrow

Herbicide	Rate	Irrigation type	Irrigation amount	Weeds/3 ft. Row
Prefar	5 qts.	Sprinkler	2.5 to 3.5"	72
Untreated	-	Sprinkler	2.5 to 3.5"	116
Prefar	5 qts.	Furrow	5 days	110
Untreated	-	Furrow	5 days	101

Notes: Plot size = 15 ft. X 2 beds, 4 replications; Spray volume = 20 gpa
Weeds = Shepardspurse, Annual Ryegrass; Weed counts made 26 days after application

Graph 3. Weed control from Prefar incorporated with sprinkler and furrow irrigation



Weed control was significantly better when Prefar was incorporated with sprinklers compared to furrow irrigation. It is unclear why this occurs although it is consistent with grower experience. Grower experience has also demonstrated that Prefar works well when applied through the sprinkler system and has not worked well when mechanically incorporated. Chemigation can be uneven, however, and result in poor weed control or crop injury.

A test was conducted to evaluate the effect of irrigation amount and herbicide rate on the weed control achieved with Prefar incorporated by sprinkler irrigation. Prefar rates of 1 to 6 quarts were incorporated with an overhead sprinkler modified to apply 0.25, 0.325, 0.5, 0.67 and 0.75 inches of water. The one qt. rate was too low to produce weed control although at all rates above 2 qts./a the weed control was improved with increasing amounts of water. (Table 4)

Table 4. Barnyardgrass seedlings counted per 3 feet of row 7 days after Bensulide treatment

Bensulide 4E Rate (lbs. ai/a)	Seedlings/3 ft.				
	Inches Water				
	0.25	0.325	0.5	0.67	0.75
Untreated	18.0	22.3	22.6	27.0	22.0

1.0	29.0	26.0	26.0	28.6	21.5
2.0	16.0	9.6	6.3	2.6	2.5
3.0	2.0	1.0	1.6	0.6	0.3
4.0	3.5	0.6	0.3	0	0
6.0	0	0	0.3	0	0

Note: Plot size = 3 x 25 ft. - 4 replications
Spray volume = 20 gpa