

## Evaluation of Garbanzo Bean Herbicides

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### Introduction:

In the southern San Joaquin Valley, garbanzos are grown as a dry bean. They are typically planted in December and harvested the following mid-summer. Because they grow rather slowly the first two months, they offer poor competition with weeds. Therefore, growers must use preplant and/or preemergence herbicides to protect the stand. Although growers in California have a fairly large arsenal of herbicide tools at their disposal, most of the products used lose their efficacy in mid-spring, just as the plant canopy begins to develop and close-in. Weeds like nightshade, prickly lettuce, and annual sowthistle then become major problems. Nightshade, in particular, can produce dark purplish berries that stain the mature beans, reducing quality. Additionally, some of the more important herbicides used (namely oxyfluorfen and metribuzin) can cause crop injury and delayed growth after emergence when conditions are cold and wet.

To battle these and other weed escapes, growers have to rely on costly hand weeding to achieve clean fields, sometimes adding an additional \$150/acre or more to production costs. A Study was conducted in 2004/05 to determine the effectiveness of preemergence herbicides on weed efficacy, crop response, and yield.

### Method:

A field trial was conducted at the West Side Research & Extension Center in Five Points, CA. The soil is a Panoche clay loam. The herbicides evaluated were oxyfluorfen (Goal), Pendimethalin (Prowl), metribuzin (Sencor), dimethenamid (Outlook), Metolachlor (Dual Magnum), flumioxazin (Chateau), imazamox (Raptor), and sulfentrazone (Aim). Thirty-inch beds were listed, fertilized, and shaped in November 2004. A single variety (HB-14) was used for the study. The treatments were arranged in a randomized complete block design with four replications each. Plots were four beds-wide and 40' long. The trial was planted on December 14, 2004 and harvested on July 20, 2005. The trial area was watered with furrow irrigation.

Herbicide treatments were applied preplant incorporated (PPI) or post-plant, preemergence (PRE). All treatments were applied using a ground sprayer that delivered the spray broadcast in a spray volume of 20 gpa. When mature, the beans were undercut and allowed to dry in windrows for about two weeks, then harvested. Sub-samples were taken to determine bean size and the number seeds/oz (can count) was determined. Data were analyzed using ANOVA and significant means were determined using LSD at a level of  $p=0.05$ .

Prowl EC and Prowl H<sub>2</sub>O were applied before planting as standard treatments to the soil and incorporated with a power bed mulcher. Garbanzos were then planted and the other herbicide treatments were applied and the field was irrigated the next day. An untreated and hand weeded treatment was included in the study. The field was cultivated and weeds were hoed from the hand weeded treatment on March 2, 2005.

The center 35' of each plot was pitch forked into a mechanical thrasher and beans were weighed. Bean yield was expressed in lbs of clean beans/acre, bean size, and can count (number seeds/oz). All data was analyzed using ANOVA and significant means were determined using the LSD at a significant level of  $p=0.05$ .

**Results:**

When compared to the untreated or hand weeded plots, garbanzo stand was not reduced where Chateau was used at 0.094 lb ai/acre, but was reduced by 20% at 0.188 lb ai/acre (table 1). However, even some of the standard treatments (Sencor and Goal 2X) showed a similar reduction in stand as the high rate of Chateau. Initial winter weed control was excellent in all treatments, except where Prowl was applied alone. Prowl is typically weak on weeds in the mustard family (including shepherd's-purse and London rocket). Later evaluations (tables 2 and 3) showed that Chateau provided excellent control of prickly lettuce in addition to the winter annuals, but was not different from the standard Prowl/Goal combination. Raptor provided poor control of prickly lettuce and Aim was weak on all weeds present in the field.

Table 1. Garbanzo and weed stand per 10' of row on 2/4/05

Treatment	Timing	Lb ai/A	Garbanzos	Shepherd's -purse	London rocket	Volunteer cereals
1. Prowl 3.3E	PPI	1.2	38.8	2.0	0.8	0.0
2. Prowl H <sub>2</sub> O	PPI	1.2	38.3	2.0	1.5	0.0
3. Sencor DF	PRE	0.25	35.0	0.0	0.0	0.0
4. Goal 2XL	PRE	0.25	33.8	0.0	0.0	0.0
5. GoalTender 4F	PRE	0.25	36.0	0.0	0.0	0.0
6. Prowl H <sub>2</sub> O	PRE	1.0	35.8	0.0	0.0	0.0
GoalTender 4F	PRE	0.25				
7. Outlook	PRE	0.75	33.0	0.0	0.0	0.0
8. Dual Magnum	PRE	1.6	36.0	0.0	0.0	0.0
9. Chateau 50DF	PRE	0.094	38.0	0.0	0.0	0.0
10. Chateau 50DF	PRE	0.188	31.8	0.0	0.0	0.0
11. Raptor	PRE	0.047	37.8	0.0	0.0	0.0
12. Aim EC	PRE	0.25	40.3	0.0	0.0	3.8
13 Dual Magnum	PRE	1.6	40.5	0.0	0.0	0.0
Aim EC	PRE	0.25				
14 Handweeded	3/2/05	---	44.8	29.3	13.8	3.8
15 Untreated	---	---	43.0	29.8	15.8	3.5
Statistical notation @ $p=0.05$		CV: LSD:	13.11% 7.4	19.41% 1.2	31.38% 1.0	57.88% 0.6

Table 2. Weed control on 2/28/05

Treatment	Timing	Lb ai/A	Shepherd's -purse	London rocket	Prickly lettuce	Volunteer cereals
1. Prowl 3.3E	PPI	1.2	9.2	9.3	0.0	10.0
2. Prowl H <sub>2</sub> O	PPI	1.2	8.8	8.7	0.0	10.0
3. Sencor DF	PRE	0.25	9.5	9.8	0.0	0.0
4. Goal 2XL	PRE	0.25	10.0	10.0	10.0	8.4
5. GoalTender 4F	PRE	0.25	10.0	10.0	10.0	8.4
6. Prowl H <sub>2</sub> O	PRE	1.0	9.9	10.0	10.0	10.0
GoalTender 4F	PRE	0.25				
7. Outlook	PRE	0.75	8.6	9.6	9.9	10.0
8. Dual Magnum	PRE	1.6	8.9	8.9	0.0	0.0
9. Chateau 50DF	PRE	0.094	9.9	10.0	10.0	9.7
10. Chateau 50DF	PRE	0.188	10.0	10.0	10.0	10.0
11. Raptor	PRE	0.047	9.4	9.8	0.0	9.2
12. Aim EC	PRE	0.25	9.6	9.3	9.8	0.0
13 Dual Magnum	PRE	1.6	9.8	9.4	9.5	0.0
Aim EC	PRE	0.25				
14 Handweeded	3/2/05	---	0.0	0.0	0.0	0.0
15 Untreated	---	---	0.0	0.0	0.0	0.0
Statistical notation @ p=0.05		CV: LSD:	4.56% 0.57	3.44% 0.4	1.45% 0.1	3.64% 0.3

Table 3. Weed control on 5/17/05

Treatment	Timing	Lb ai/A	Shepherd's -purse	London rocket	Prickly lettuce	Volunteer cereals
1. Prowl 3.3E	PPI	1.2	9.0	9.0	0.0	9.9
2. Prowl H <sub>2</sub> O	PPI	1.2	9.0	9.0	0.0	9.8
3. Sencor DF	PRE	0.25	10.0	9.9	0.0	0.0
4. Goal 2XL	PRE	0.25	9.5	10.0	10.0	7.5
5. GoalTender 4F	PRE	0.25	10.0	10.0	10.0	7.5
6. Prowl H <sub>2</sub> O	PRE	1.0	10.0	10.0	10.0	10.0
GoalTender 4F	PRE	0.25				
7. Outlook	PRE	0.75	8.5	9.5	9.5	10.0
8. Dual Magnum	PRE	1.6	9.6	9.0	0.0	0.0
9. Chateau 50DF	PRE	0.094	9.9	10.0	10.0	9.5
10. Chateau 50DF	PRE	0.188	10.0	10.0	10.0	10.0
11. Raptor	PRE	0.047	9.5	9.5	0.0	9.0
12. Aim EC	PRE	0.25	9.5	9.5	9.6	0.0
13 Dual Magnum	PRE	1.6	9.8	9.5	9.5	0.0
Aim EC	PRE	0.25				
14 Handweeded	3/2/05	---	9.9	10.0	9.9	9.9
15 Untreated	---	---	0.0	0.0	0.0	0.0
Statistical notation @ p=0.05		CV: LSD:	3.51% 0.6	1.73% 0.2	3.50% 0.4	1.28% 0.2

There was no visible crop injury in any of the plots treated with Chateau, Raptor, or Aim (table 4). There was some injury (necrosis of stem and leaves) associated with the standard Goal treatments 60 days after treatment, but no injury was observed in those plots 30 days later. Although garbanzo plants were reduced in growth in the Chateau plots by as much as 8%, 90 days after treatment, standard treatments of Goal and Dual Magnum, and Outlook (not registered) showed a similar response. Similar reductions in plant growth were seen with these treatments in a trial conducted in 2003/04. Raptor did not result in reduced plant growth.

Table 4. Garbanzo growth and injury

Treatment	Timing	Lb ai/A	2/28/05		3/17/05	
			Growth	Injury	Growth	Injury
1. Prowl 3.3E	PPI	1.2	9.7	0.0	9.8	0.0
2. Prowl H <sub>2</sub> O	PPI	1.2	9.7	0.0	9.9	0.0
3. Sencor DF	PRE	0.25	9.5	0.0	9.7	0.0
4. Goal 2XL	PRE	0.25	6.9	2.3	9.1	0.0
5. GoalTender 4F	PRE	0.25	7.5	1.8	9.6	0.0
6. Prowl H <sub>2</sub> O	PRE	1.0	8.0	1.5	9.8	0.0
GoalTender 4F	PRE	0.25				
7. Outlook	PRE	0.75	8.4	0.0	8.8	0.0
8. Dual Magnum	PRE	1.6	9.2	0.0	9.1	0.0
9. Chateau 50DF	PRE	0.094	8.5	0.0	9.4	0.0
10. Chateau 50DF	PRE	0.188	7.0	0.0	9.2	0.0
11. Raptor	PRE	0.047	9.9	0.0	10.0	0.0
12. Aim EC	PRE	0.25	9.9	0.0	10.0	0.0
13 Dual Magnum	PRE	1.6	9.9	0.0	10.0	0.0
Aim EC	PRE	0.25				
14 Handweeded	3/2/05	---	9.0	0.0	10.0	0.0
15 Untreated	---	---	9.0	0.0	8.5	0.0
Statistical notation @ p=0.05		CV: LSD:	4.03% 0.5	59.02% 0.3	2.72% 0.4	n.s.
Growth based on a visual scale of 0-10; 0 = no growth and 10 = vigorous Injury based on a visual scale of 0-10; 0 = no injury and 10 = all plants killed						

Yield was reduced with both rates of Chateau and Raptor treatments (20%, 25%, and 16%, respectively) when compared to the hand weeded control, which yielded 3100 lbs/acre (table 5). The Goal 2XL and Goal/Prowl combination also showed similar reductions in yield. There were no differences seen in bean size classes and can counts with any of the treatments.

Table 5. Garbanzo yield on 7/20/05

Treatment	Timing	Lb ai/A	Yield	% Beans by size			Can Count
			Lbs/Acre	<20	20-24	>24	Beans/oz
1. Prowl 3.3E	PPI	1.2	2638.5	3.0	51.3	45.7	56.8
2. Prowl H <sub>2</sub> O	PPI	1.2	2661.0	4.4	55.1	40.6	57.8
3. Sencor DF	PRE	0.25	3058.8	3.8	54.4	41.8	58.5
4. Goal 2XL	PRE	0.25	2417.5	4.2	48.0	47.6	56.5
5. GoalTender 4F	PRE	0.25	2731.8	3.6	49.8	46.6	57.8
6. Prowl H <sub>2</sub> O	PRE	1.0	2610.5	4.0	50.1	45.9	56.5
GoalTender 4F	PRE	0.25					
7. Outlook	PRE	0.75	2675.8	4.1	58.1	37.8	57.3
8. Dual Magnum	PRE	1.6	2902.8	3.7	52.8	43.5	56.3
9. Chateau 50DF	PRE	0.094	2504.5	3.7	44.5	51.8	56.8
10. Chateau 50DF	PRE	0.188	2327.5	3.4	47.6	49.0	57.0
11. Raptor	PRE	0.047	2592.0	4.6	48.9	46.6	57.5
12. Aim EC	PRE	0.25	2705.0	4.9	48.5	46.7	56.5
13 Dual Magnum	PRE	1.6	2722.5	4.5	49.4	46.1	57.5
Aim EC	PRE	0.25					
14 Handweeded	3/2/05	---	3100.4	5.3	46.8	47.9	55.8
15 Untreated	---	---	1976.0	4.8	47.4	47.9	57.3
Statistical notation @ p=0.05		CV: LSD:	11.46% 446.4	26.71% n.s.	15.71% n.s.	18.55% n.s.	4.02% n.s.

Yield is based on harvesting the center 35' of 2 rows of each plot and running plants through a mechanical thrasher. Samples were cleaned and weighed and a sub-sample (cut sample 4X) was used for bean size and can counts.

Discussion:

There was a reduction in both the growth and yield of HB-14 where Chateau and Raptor were used. The excessively cold and wet season in 2004/05 may have contributed to this reduction in growth and yield. Similar treatments tested in 2003/04 did not show a reduction in growth or yield under milder conditions. Similarly, we did not see a reduction in yield where Raptor was used in previous studies, as we did in the 2004/05 trial. The medium soil type of the trial site is not likely to have contributed to this response. However, similar reductions in yield have shown up occasionally in other replicated trials in the state. In order to take advantage of the positive attributes these herbicides can offer garbanzo weed control, it will be necessary to further evaluate the response of HB-14 and other garbanzo varieties to different rates of Chateau and Raptor.