**Herbicide Evaluation in Direct Seeded Bok Choi and Broccoli Raab**

Trials 2020.01

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Direct seeded bok choi and broccoli raab were treated with *S*-metolachlor (Dual Magnum) at 0.33, 0.5 and 0.65 lbs. ai/A, PRE and POST 1 week after emergence; and pyridate (Tough) was applied POST at 0.47 and 0.62 lbs. ai/A + NIS at 0.25% v/v before crop and weeds reached 3”. The standard was Dacthal PRE at 7.5 lbs. ai/A. A non-treated control was included. The trial was conducted at Salinas, CA during June to July 2020 (Table 1). Treatments were replicated 4 times and arranged in a randomized complete block design. Data collected were crop injury estimates, stand and yield, as well as weed control. Data were subjected to analysis of variance using Agricultural Research Manager and mean separation was performed using LSD’s.

**Results**

Crop Injury:

Bok choi - Dacthal, Dual Magnum PRE and Dual Magnum POST caused little or no injury to Bok choi. Pyridate caused moderate (3.5 to 5.3 ratings) injury to Bok choi, resulting in dried/yellow older leaves and stunted growth by 14DAT; from which the crop did not recover (Table 2).

Broccoli raab - Dacthal and Dual Magnum PRE caused minor to moderate (2.1 to 3.6 ratings) injury on broccoli raab, resulting in stunted growth by 14DAT. Injury from Dual Magnum at 0.65 lbs. ai/A was significantly greater than that of Dacthal and Dual Magnum at 0.33 lbs. ai/A. Dual Magnum at 1-week POST caused little or no (0 to 1.4 ratings) injury to broccoli raab. Pyridate caused moderate to severe (4.6 to 7.1 ratings) injury to broccoli raab, resulting in dried/dead older leaves and stunted growth by 14DAT; from which the crop did not recover (Table 3).

Crop Stand:

None of the treatments reduced stands of Bok choi or broccoli raab (Table 4).

Crop Yield:

Bok choi – None of the treatments reduced crop stand at time of harvest. (Tables 4, 5, 6). Neither Dacthal nor Dual Magnum PRE or POST reduced crop numbers, fresh weight or size, compared to the non-treated check. Pyridate reduced crop weight and size, compared to the non-treated check (Table 5).

Broccoli raab - None of the treatments reduced crop size at time of harvest. Neither Dacthal nor Dual magnum PRE or POST reduced crop size, compared to the non-treated check. Pyridate reduced crop numbers and weight, compared to the non-treated check (Table 6).

Weed Control:

Weeds present were shepherds-purse, common purslane, sow thistle and hairy nightshade. All rates of Dual Magnum PRE were highly effective on the weed present; whereas, none of the POST Dual Magnum treatments controlled the weeds. Pyridate + NIS was highly effective on sow thistle, but did not control shepherds-purse, common purslane or hairy nightshade. Dacthal was moderately effective on sow thistle, but did not control shepherds-purse, common purslane or hairy nightshade (Table 7).

**Table 1**. Critical trial events and dates

|  |  |
| --- | --- |
| **Critical Event** | **Date / Information** |
| Crop: | Bok Choi | Broccoli Raab |
| Cultivar: | Mei Qing Choi | Zamboni |
| Seeding Date: | 6/1/20 | 6/1/20 |
| Emergence Date: | 6/8/20 | 6/8/20 |
| Application Intervals: |
| PostPlant/Pre-Emergence (PRE): | 6/2/20 | 6/2/20 |
| 1 Week Post-Emergence (POST): | 6/15/20 | 6/15/20 |
| POST @ <3” Weeds: | 6/19/20 | 6/19/20 |
| Evaluations: |
| Weed Counts: | 6/24/20 | 6/24/20 |
| Crop Injury:PRE TreatmentsPOST Dual Magnum TreatmentsPOST Pyridate Treatments | 6/16/20 14-DAT6/30/20 28-DAT7/14/20 42-DAT6/18/20 3-DAT6/22/20 7-DAT6/29/20 14-DAT6/22/20 3-DAT6/26/20 7-DAT7/2/20 13-DAT | 6/16/20 14-DAT6/30/20 28-DAT7/14/20 42-DAT6/18/20 3-DAT6/22/20 7-DAT6/29/20 14-DAT6/22/20 3-DAT6/26/20 7-DAT7/2/20 13-DAT |
| Crop Stand:PRE TreatmentsPOST Dual Magnum TreatmentsPOST Pyridate Treatments | 6/24/20 22-DAT6/24/20 9-DAT6/24/20 5-DAT | 6/24/20 22-DAT6/24/20 9-DAT6/24/20 5-DAT |
| Yield (Fresh Weight): | 7/15/20 | 7/9-17/20  |

 DAT = Days After Treatment

**Table 2**. Bok choi crop injury estimates**¹**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Rate****(lbs. ai/A)** | **Timing** | **JUN 16****14-DAT** | **JUN 30****28-DAT** | **JUL 14****42-DAT** | **JUN 18****3-DAT** | **JUN 22****7-DAT** | **JUN 29****14DAT** | **JUN 22****3-DAT** | **JUN 26****7-DAT** | **JUL 2 13DAT** | **All Trts****14DAT** |
| **0 – 10 Scale** |
| NonTreated | 0 | --- | 0.0 | 0.0 b | 0.0 b | 0.0 | 0.0 | 0.0 | 0.0 c | 0.0 c | 0.0 c | 0.0 e |
| Dacthal | 7.5 | PRE | 0.9 | 0.0 b | 0.0 b | --- | --- | --- | --- | --- | --- | 0.9 cd |
| Dual Magnum | 0.33 | PRE | 0.3 | 0.0 b | 0.0 b | --- | --- | --- | --- | --- | --- | 0.3 de |
| Dual Magnum | 0.5 | PRE | 1.0 | 0.5 ab | 0.5 ab | --- | --- | --- | --- | --- | --- | 1.0 c |
| Dual Magnum | 0.65 | PRE | 1.1 | 0.8 a | 0.8 a | --- | --- | --- | --- | --- | --- | 1.1 c |
| Dual Magnum | 0.33 | 1-Wk POST | --- | --- | --- | 0.0 | 0.1 | 0.1 | --- | --- | --- | 0.1 e |
| Dual Magnum | 0.5 | 1-Wk POST | --- | --- | --- | 0.0 | 0.0 | 0.0 | --- | --- | --- | 0.0 e |
| Dual Magnum | 0.65 | 1-Wk POST | --- | --- | --- | 0.0 | 0.5 | 0.0 | --- | --- | --- | 0.0 e |
| Pyridate +X-77 NIS | 0.47 +0.25% v/v | POST  | --- | --- | --- | --- | --- | --- | 3.6 b | 3.5 b | 4.0 b | 4.0 b |
| Pyridate +X-77 NIS | 0.62 +0.25% v/v | POST | --- | --- | --- | --- | --- | --- | 4.4 a | 4.6 a | 5.3 a | 5.3 a |
| LSD (P = .05) |  |  | 0.88 | 0.53 | 0.34 | 0.00 | 0.54 | 0.20 | 0.52 | 0.69 | 0.82 | 0.69 |
| Treatment Prob (F) |  |  | 0.0666 | 0.0221 | 0.0982 | 1.0000 | 0.1869 | 0.4363 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |

**¹** Rating scale: 0 = no injury, ≤2=safe, 10 = complete crop death.

**Table 3**. Broccoli raab crop injury estimates**¹**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Rate****(lbs. ai/A)** | **Timing** | **JUN 16****14-DAT** | **JUN 30****28-DAT** | **JUL 14****42-DAT** | **JUN 18****3-DAT** | **JUN 22****7-DAT** | **JUN 29****14DAT** | **JUN 22****3-DAT** | **JUN 26****7-DAT** | **JUL 2 13DAT** | **All Trts****14DAT** |
| **0 – 10 Scale** |
| NonTreated | 0 | --- | 0.0 d | 0.0 c | 0.0 c | 0.0 b | 0.0 b | 0.0 | 0.0 c | 0.0 c | 0.0 c | 0.0 f |
| Dacthal | 7.5 | PRE | 2.4 bc | 0.9 bc | 0.0 c | --- | --- | --- | --- | --- | --- | 2.4 de  |
| Dual Magnum | 0.33 | PRE | 2.1 c | 1.0 bc | 0.0 c | --- | --- | --- | --- | --- | --- | 2.1 e |
| Dual Magnum | 0.5 | PRE | 3.4 ab | 1.5 ab | 0.8 b | --- | --- | --- | --- | --- | --- | 3.4 cd |
| Dual Magnum | 0.65 | PRE | 3.6 a | 2.3 a | 1.4 a | --- | --- | --- | --- | --- | --- | 3.6 c |
| Dual Magnum | 0.33 | 1-Wk POST | --- | --- | --- | 0.3 b | 0.4 b | 0.5 | --- | --- | --- | 0.5 f |
| Dual Magnum | 0.5 | 1-Wk POST | --- | --- | --- | 0.0 b | 0.3 b | 0.6 | --- | --- | --- | 0.6 f |
| Dual Magnum | 0.65 | 1-Wk POST | --- | --- | --- | 1.0 a | 1.4 a | 0.9 | --- | --- | --- | 0.9 f |
| Pyridate +X-77 NIS | 0.47 +0.25% v/v | POST  | --- | --- | --- | --- | --- | --- | 4.6 b | 5.3 b | 5.6 b | 5.6 b |
| pyridate +X-77 NIS | 0.62 +0.25% v/v | POST | --- | --- | --- | --- | --- | --- | 6.3 a | 6.6 a | 7.1 a | 7.1 a |
| LSD (P = .05) | 1.06 | 1.08 | 0.61 | 0.40 | 0.86 | 0.65 | 1.59 | 1.09 | 1.11 | 1.06 |
| Treatment Prob (F) | 0.0001 | 0.0089 | 0.0009 | 0.0009 | 0.0261 | 0.0740 | 0.0002 | 0.0001 | 0.0011 | 0.0001 |

**¹** Rating scale: 0 = no injury, ≤2=safe, 10 = complete crop death.

**Table 4.** Bok choi and Broccoli raab crop stand

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Rate****(lbs. ai/A)** | **Timing** | **Bok choi** | **Broccoli raab** |
| **JUN 22****22-DAT** | **JUN 22****9-DAT** | **JUN 22****5-DAT** | **All Trts** | **JUN 22****22-DAT** | **JUN 22****9-DAT** | **JUN 22****5-DAT** | **All Trts** |
| **no./10’ bed** |
| NonTreated | 0 | --- | 88.5 | 88.5 | 88.5 | 88.5 | 154.8 | 154.8 | 154.8 | 154.8 |
| Dacthal | 7.5 | PRE | 91.5 | --- | --- | 91.5 | 168.3 | --- | --- | 168.3 |
| Dual Magnum | 0.33 | PRE | 86.3 | --- | --- | 86.3 | 148.3 | --- | --- | 148.3 |
| Dual Magnum | 0.5 | PRE | 82.8 | --- | --- | 82.8 | 132.5 | --- | --- | 132.5 |
| Dual Magnum | 0.65 | PRE | 86.3 | --- | --- | 86.3 | 153.0 | --- | --- | 153.0 |
| Dual Magnum | 0.33 | 1-Wk POST | --- | 84.8 | --- | 84.8 | --- | 135.5 | --- | 135.5 |
| Dual Magnum | 0.5 | 1-Wk POST | --- | 89.8 | --- | 89.8 | --- | 139.3 | --- | 139.3 |
| Dual Magnum | 0.65 | 1-Wk POST | --- | 87.5 | --- | 87.5 | --- | 140.5 | --- | 140.5 |
| Pyridate +X-77 NIS | 0.47 +0.25% v/v | POST  | --- | --- | 90.3 | 90.3 | --- | --- | 144.0 | 144.0 |
| Pyridate +X-77 NIS | 0.62 +0.25% v/v | POST | --- | --- | 82.5 | 82.5 | --- | --- | 127.8 | 127.8 |
| LSD (P = .05) |  |  | 10.80 | 11.71 | 13.15 | 10.63 | 30.52 | 34.92 | 31.25 | 31.59 |
| Treatment Prob (F) |  |  | 0.5214 | 0.7988 | 0.3551 | 0.6915 | 0.2157 | 0.6325 | 0.1766 | 0.5308 |

**Table 5**. Bok choi crop yield (stand, fresh weight and size) at harvest (7/15/20)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment** | **Rate****(lbs. ai/A)** | **Timing** | **Stand** | **Fresh Weight** | **Size** |
| **(1000s/Ac)** | **(Tons/Ac)** | **(gm/head)** |
| NonTreated | 0 | --- | 17.8 | 19.7 a | 547 ab |
| Dacthal | 7.5 | PRE | 15.5 | 18.4 a | 581 a |
| Dual Magnum | 0.33 | PRE | 17.5 | 18.2 a | 503 abc |
| Dual Magnum | 0.5 | PRE | 15.5 | 18.8 a | 591 a |
| Dual Magnum | 0.65 | PRE | 15.5 | 18.1 a | 572 a |
| Dual Magnum | 0.33 | 1-Wk POST | 16.0 | 18.0 a | 551 ab |
| Dual Magnum | 0.5 | 1-Wk POST | 14.3 | 16.2 ab | 555 ab |
| Dual Magnum | 0.65 | 1-Wk POST | 17.3 | 19.8 a | 562 ab |
| Pyridate +X-77 NIS | 0.47 +0.25% v/v | POST  | 14.3 | 13.8 b | 469 bc |
| Pyridate +X-77 NIS | 0.62 +0.25% v/v | POST | 14.0 | 12.3 b | 423 c |
| LSD (P = .05) | 2.85 | 4.09 | 97.7 |
| Treatment Prob (F) | 0.0832 | 0.0105 | 0.0288 |

**Table 6**. Broccoli raab crop yield (stand, fresh weight and size) at harvest (7/9-17/20)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment** | **Rate****(lbs. ai/A)** | **Timing** | **Stand** | **Fresh Weight** | **Size** |
| **(1000s/Ac)** | **(Tons/Ac)** | **(gm/plant)** |
| NonTreated | 0 | --- | 45.8 a | 0.66 ab | 19.4 |
| Dacthal | 7.5 | PRE | 53.6 a | 0.76 a | 19.5 |
| Dual Magnum | 0.33 | PRE | 43.9 a | 0.77 a | 23.5 |
| Dual Magnum | 0.5 | PRE | 47.4 a | 0.74 a | 21.0 |
| Dual Magnum | 0.65 | PRE | 48.4 a | 0.68 a | 19.2 |
| Dual Magnum | 0.33 | 1-Wk POST | 53.6 a | 0.79 a | 20.3 |
| Dual Magnum | 0.5 | 1-Wk POST | 53.3 a | 0.81 a | 20.7 |
| Dual Magnum | 0.65 | 1-Wk POST | 44.9 a | 0.74 a | 22.4 |
| Pyridate +X-77 NIS | 0.47 +0.25% v/v | POST  | 28.3 b | 0.43 bc | 20.7 |
| Pyridate +X-77 NIS | 0.62 +0.25% v/v | POST | 17.6 b | 0.29 c | 21.3 |
| LSD (P = .05) | 14.05 | 0.23 | 3.63 |
| Treatment Prob (F) | 0.0001 | 0.0008 | 0.3331 |

**Table 7**. Weed control (density)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Rate****(lbs. ai/A)** | **Timing** | **Shepherds-Purse** | **Purslane** | **Hairy Nightshade** | **Sow thistle** | **Total Weeds** |
| **Weed Density (No./2.8ft²)** |
| NonTreated | 0 | --- | 27.8 a | 18.3 | 11.3 | 16.8 a | 80.3 a |
| Dacthal | 7.5 | PRE | 15.9 a-d |  7.1 |  6.5 |  1.9 bcd | 36.3 cd |
| Dual Magnum | 0.33 | PRE |  3.0 cd |  4.0 |  5.6 |  1.6 bcd | 20.1 de |
| Dual Magnum | 0.5 | PRE |  4.6 bcd |  2.6 |  2.4 |  1.0 cd | 14.6 de |
| Dual Magnum | 0.65 | PRE |  1.4 d |  0.5 |  1.6 |  0.0 d |  6.5 e |
| Dual Magnum | 0.33 | 1-Wk POST | 21.4 abc |  9.5 |  9.3 | 11.3 abc | 55.4 abc |
| Dual Magnum | 0.5 | 1-Wk POST | 24.0 a | 12.1 | 10.5 |  8.5 a-d | 59.6 abc |
| Dual Magnum | 0.65 | 1-Wk POST | 33.0 a | 15.3 | 11.3 | 12.1 ab | 79.4 ab |
| Pyridate +X-77 NIS | 0.47 +0.25% v/v | POST  | 23.3 ab | 12.8 |  9.5 |  3.4 bcd | 53.0 bc |
| Pyridate +X-77 NIS | 0.62 +0.25% v/v | POST | 33.1 a |  9.1 |  8.4 |  5.5 bcd | 58.6 abc |
| LSD (P = .05) | 18.9 | 12.7 | 7.1 | 10.7 | 26.4 |
| Treatment Prob (F) | 0.0062 | 0.1453 | 0.0783 | 0.0383 | 0.0001 |