# PRE- AND POST-EMERGENT HERBICIDES IN CHICKPEAS
## I. CROP TOLERANCE

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*Summary*. Between 1984 and 1989 a series of 29 experiments were conducted to evaluate the selectivity of a range of herbicides in chickpeas, *Cicer arietinum* L. The pre-emergence grass herbicides tri-allate and trifluralin (at 0.56 kg/ha) were safe on chickpeas, as were all the post-emergence grass herbicides. The triazine herbicides, cyanazine, simazine, prometryn and metribuzin, or mixtures of the above have potential for use in chickpeas. Apart from pyridate, all post-emergence herbicides caused unacceptable damage to chickpeas.

## INTRODUCTION

The cropping belt of the north-western plains of N.S.W is predominantly a prime hard wheat growing area, having a total wheat area of over 500,000 ha in 1989. However, nitrogen fertility is declining. Doyle and others have demonstrated widespread and severe soil nitrogen deficiencies throughout the region (2, 3). Chickpeas are an important rotation crop because they can slow the rate of soil nitrogen depletion. High prices and reliable yields have seen the area of chickpeas in the region increase from less that 2,000 ha in 1985 to over 10,000 ha in 1989. Many farmers now regard chickpeas as an integral part of their cropping program.

Chickpeas compete poorly against weeds, and the lack of cheap and effective herbicides, with good crop safety has limited the area sown to chickpeas. Previous herbicide work by Mahoney (4) and Amor (1) was not representative of the northern N.S.W environment and left considerable scope for further herbicide testing.

Between 1984 and 1989 a series of 15 pre-emergence and 14 post-emergence experiments were undertaken to evaluate the selectivity and weed control of a range of herbicides in chickpeas. The aim of the program was to develop recommendations which would give safe and economic control of the major weeds and to facilitate the expansion of chickpeas into weedier situations. This paper reports the crop safety of a range of herbicides to chickpeas.

## METHODS

The trials were at Narrabri Agricultural Research Station and on farms throughout the north-west cropping belt of N.S.W, covering a range of localities and soils. Soil types included grey clays (Ug 5.2), black earth (Ug5.1), red-brown earths (Db1.3), black basalt (Gn3.1) and alluvial (1).

Herbicides screened included simazine 500 g/L, cyanazine 500 g/L, atrazine 500 g/L, metribuzin 700 g/kg, prometryn 500 g/kg, acifluorfen 224 g/L, terbutryne 500 g/L, methabenzthiazuron 700 g/kg, 2,4-DB as the potassium and sodium salts 400 g/L, pyridate 500 g/L, MCPB 400 g/L, glyphosate 450 g/L, quizalofop 88.6 g/L, cycloxydim 200 g/L, fluazifop-p 212 g/L, diclofop-methyl 375 g/L, sethoxydim 185 g/L, haloxyfop 104 g/L, trifluralin 400 g/L, tri-allate 400 g/L, diuron 500 g/L, pendimethalin 330 g/L, bentazone 480 g/L, linuron 500 g/kg, prodiamine 480 g/L, metolachlor 720 g/L, metribuzin 140 g/kg + methabenzthiazuron 560 g/kg, dimethazone 500 g/L, imazethapyr 200 g/L, imazaquin 200 g/L. The rates reported are rates of active ingredient.

Phytotoxicity to the crop was assessed visually on two occassions. For the pre-emergence treatments, tolerance ratings are based on assessments made 37-58 DAT while for the post-emergence applications, they are based on assessments made 18-27 DAT. Phytotoxicity ratings were: tolerant (T); moderately tolerant (MT); moderately susceptible (MS); susceptible (S) and

highly susceptible (HS). Where appropriate, plant counts (plants/$m^2$) were taken. Grain yields were harvested from 21 sites. The chickpea varieties tested were Tyson and Amethyst.

Treatments were applied using with a 3 m handboom operating at 240 kPa and in water rates of 110-156 L/ha through 11005, 80015 and 8002 Teejet$^R$ nozzles. Treatments were applied to plots of 3x10 m or 15 m in size and were replicated in three or four randomized blocks. Results were analysed using the Genstat IV ANOVA program. There were three herbicide use patterns: pre-plant incorporated (2 sites), post-plant pre-emergence (11 sites) [or pre-incorporated and post-plant pre-emergence (2 sites)] and post-emergence (14 sites). Post-emergence treatments were applied 21-78 days after planting when chickpeas were 5-15 cm tall.

## RESULTS

Pre-plant incorporated herbicide treatments. Trifluralin had a narrow safety margin and rates in excess of 0.56 kg/ha were damaging. Pendimethalin produced similar damage at rates of 0.99 kg/ha and 1.98 kg/ha to trifluralin at rates of 0.84 kg/ha and 1.12 kg/ha. These herbicides reduced plant establishment by 15-38% (results not presented), with the greatest reduction at the higher rates.Where trifluralin reduced chickpea stands to below 40 plants/$m^2$, a significant yield reduction (P=0.05) of 14.5% occured.

Deep sowing increased the risk of reduction to plant stand. This was particularly evident in an experiment near Narrabri in 1986, on an alkaline grey clay (Ug5.2), where seeds sown deeper than about 6 cm failed to emerge or emerged weakly before dying at ground level in the trifluralin 0.84 and 1.12 kg/ha treatments. Affected shoots were swollen and deformed.

The wild oat herbicide, tri-allate, was safe in chickpeas at rates up to 2.24 kg/ha. When trifluralin was added to tri-allate damage tended to be slightly worse than with trifluralin alone.

Table 1. Tolerance of chickpeas to pre-plant incorporated herbicides.

| Herbicide | Rate (kg a.i./ha) | No. of experiments (all harvested) | Significant reductions* | Average Yield [s.e.] (% site maximum) | Tolerance rating |
|---|---|---|---|---|---|
| tri-allate | 0.56-0.8 | 2 | 0 | 90.5 [2.1] | T |
| | 1.12-2.24 | 2 | 0 | 89.5 [9.2] | T |
| pendimethalin | 0.99 | 1 | 0 | 100 | MT |
| | 1.98 | 1 | 0 | 79 | MS |
| trifluralin | 0.56 | 4 | 0 | 89.8 [5.0] | T-MT |
| | 0.84 | 2 | 0 | 87.5 [4.9] | MT-MS |
| | 1.12 | 2 | 1 | 85.5 [9.2] | MS |
| trifluralin+tri-allate | 0.56+0.56 | 2 | 0 | 84.5 [12.0] | MT |
| cyanazine+trifluralin | 2.0+0.40 | 1 | 0 | 89 | T |
| prodiamine | 0.398 | 1 | 0 | 100 | T |
| unweeded control | - | 4 | 1 | 86.3 [8.4] | |
| handweeded control | - | 3 | 0 | 96.3 [3.2] | - |

Number of experiments where yield < site maximum (P=0.05)

Post-plant pre-emergence herbicide treatments. The herbicides which performed best under this use pattern were all triazines. They include cyanazine, prometryn, simazine, metribuzin and mixtures of these. In one experiment, (8722), mixtures with simazine were more damaging than herbicides applied alone at comparable total rates of the active triazine.

Chickpeas have consistently shown a high tolerance to the registered herbicide cyanazine at rates up to 3.0 kg/ha and to prometryn at rates of 2.0 kg/ha or less. Damage symptoms were

temporary and did not affect yields. Metribuzin was usually safe at a rate of 0.21 kg/ha but in one weedfree experiment a significant yield reduction occurred at this rate.

Table 2. Tolerance of chickpeas post-sowing pre-emergence herbicides.

| Herbicide | Rate (kg a.i./ha) | No. of experiments (all harvested) | Significant reductions* | Average Yield [s.e.] (% site maximum) | Tolerance rating |
|---|---|---|---|---|---|
| acifluorfen | 0.224-0.896 | 7 [7] | 0 | 93.8 [5.4] | T-MT |
| atrazine | 1.0 | 3 [3] | 2 | 49.0 [40.0] | T-S |
| cyanazine | 1.5 | 9 [8] | 0 | 4.9 [4.9] | T |
| | 2.0 | 5 [4] | 0 | 88.0 [1.6] | T-MT |
| | 3.0 | 1 [1] | 0 | 98 | T-MT |
| dimethazone | 0.9 | 1 [1] | 1 | 59 | HS |
| imazaquin | 0.3 | 1 [1] | 1 | 41 | HS |
| imazethapyr | 0.05-0.07 | 2 [2] | 2 | 77.5 [3.5] | S |
| linuron | 1.5 | 1 [1] | 0 | 92 | MT |
| methabenzthiazuron | 1.75 | 2 [1] | 0 | 94 | T-MT |
| metribuzin | 0.21 | 10 [8] | 2 | 88.9 [10.6] | T-MT |
| | 0.28 | 3 [3] | 3 | 61.0 [26.2] | MT-MS |
| | 0.42 | 1 [1] | 1 | 70 | MS |
| prometryn | 0.75 | 3 [3] | 0 | 95.3 [4.0] | T |
| | 1.5 | 9 [8] | 1 | 92.8 [5.8] | T |
| | 2.0 | 2 [2] | 0 | 94.5 [7.8] | T-MT |
| | 3.0 | 1 [1] | 0 | 87 | MS |
| simazine | 0.75 | 6 [5] | 1 | 87.8 [6.3] | T |
| | 1.0 | 3 [3] | 1 | 88.7 [1.2] | T |
| | 1.25 | 1 [1] | 1 | 85 | T-MT |
| | 1.5 | 6 [5] | 2 | 87.0 [8.5] | T-MT |
| | 2.5 | 1 [1] | 1 | 55 | MS |
| terbutryn | 2.0 | 2 [2] | 1 | 78 [2.8] | T-MT |
| cyanazine+metolachlor | 2.0+1.44 | 1 [1] | 0 | 82 | T |
| cyanazine+simazine | 0.75-1.0+0.75 | 6 [5] | 1 | 89.4 [8.7] | T-MT |
| metribuzin+simazine | 0.105-0.14+0.75 | 6 [5] | 0 | 91.6 [6.2] | MT |
| prometryn+simazine | 0.75+0.75 | 6 [5] | 1 | 91 [6.5] | T-MT |
| | 1.5+0.75 | 3 [3] | 0 | 89 [4.2] | MT |
| unweeded control | - | 13 [12] | 5 | 76.9 [23.0] | - |
| handweeded control | - | 10 [9] | 0 | 94.6 [4.7] | - |

* Number of experiments where yield < site maximum (P=.05)

Results with simazine suggest that chickpeas were tolerant to rates of less than 1.0 kg/ha but significant yield reductions due to poor weed control occurred at these rates in two experiments. Some variation was found on different soil types. In trial 8719, at Moree, on a grey clay, chickpea yield was reduced by 0.4 t/ha (P=.05) in the simazine 1.25 kg/ha treatment but on other soil types, no yield reduction occurred at 1.5 kg/ha. Damage symptoms developed slowly and usually increased as the season progressed. Yield losses from simazine were greater than would be expected from visual damage ratings.

Post-emergence herbicide treatments. All post-emergence grass active herbicides were safe to chickpeas and results are not presented in table 3. Pyridate is selective in chickpeas, even at rates up to 4.0 kg/ha. Visual damage was recorded once when 4.0 kg/ha was applied just before flowering.

All other herbicides produced variable and/or unacceptable damage to chickpeas. Results show that although 2,4-DB treatments caused severe twisting and height reduction, yield recovery was often surprisingly good.

Table 3. Tolerance of chickpeas to post-emergence herbicides.

| Herbicide | Rate (kg a.i./ha) | No. of experiments (all harvested) | Significant reductions* | Average Yield [s.e.] (% site maximum) | Tolerance rating |
|---|---|---|---|---|---|
| acifluorfen | 0.448 | 1 [0] | - | - | HS |
| bentazone | 0.96 | 1 [0] | - | - | HS |
| 2,4-DB | 0.4 | 2 [1] | 0 | 100 | T |
| | 0.5-0.8 | 7 [4] | 1 | 79.7 [15] | T-S |
| | 1.0-1.12 | 4 [3] | 0 | 90.5 [4.0] | MS-S |
| 2,4-DB+pyridate | 0.56+2.0 | 3 [2] | 1 | 80.0 [6.0] | S |
| pyridate | 0.5-1.0 | 7 [3] | 0 | 99.6 [0.7] | T |
| | 2.0 | 8 [5] | 0 | 94.1 [6.3] | T |
| | 3.0-4.0 | 4 [5] | 0 | 94.8 [5.3] | T-MT |
| 2,4-DB+diuron | 0.5+0.125 | 1 [0] | - | - | MT |
| diuron | 0.5 | 1 [0] | - | - | S |
| MCPB | 1.0 | 2 [2] | 1 | 65.2 [10.3] | S |
| | 2.0 | 2 [2] | 1 | 61.9 [27.9] | S |
| glyphosate | 0.18 | 2 [0] | - | - | S-HS |
| | 0.36 | 1 [0] | - | - | HS |
| linuron | 0.425 | 1 [0] | - | - | HS |
| methabenzthiazuron | 0.35 | 1 [1] | 0 | 99 | T |
| | 0.595-0.7 | 4 [2] | 1 | 81.7 [8.2] | T-S |
| | 1.05 | 1 [1] | 1 | 78 | HS |
| metribuzin/ methabenzthiazuron | 0.105/0.42 | 1 [0] | - | - | HS |
| metribuzin+pyridate | 0.07+2.0 | 1 [1] | 1 | 30 | HS |
| | 0.035+2.0 | 1 [2] | 1 | 78 | MS |
| simazine | 1.0 | 6 [4] | 2 | 90.6 [7.9] | T-MS |
| | 1.5-2.0 | 3 [1] | 1 | 78 | T |
| terbutryn | 0.25-0.425 | 4 [2] | 0 | 93.3 [1.8] | MT-MS |
| | 0.5 | 2 [1] | 1 | 79 | T |
| | 0.75 | 1 [1] | 1 | 81 | S-HS |
| unweeded control | - | 14 [7] | 1 | 88.4 [14.8] | - |
| handweeded control | - | 2 [1] | 0 | 100 | - |

* number of experiments where yield < site maximum (P=.05)

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