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## Spring or fall applied granular picloram and dicamba for leafy spurge control in North Dakota<sup>1</sup>

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Granular and liquid formulations of picloram and dicamba were compared for leafy spurge control in two experiments established in 1980 on June 25 and September 3 near Valley City. Eight experiments to compare picloram 2% and 10%G formulations were established on September 14, 1982 and June 10, 1983 near Sheldon, September 9, 1982, June 21, 1983, and June 13 and September 11, 1984 near Dickinson, and June 14 and September 18, 1984 in the Sheyenne National Grasslands. Blank pellets were included in the experiments conducted at Sheldon so the number of pellets applied per plot was similar to improve uniformity of distribution of the picloram 10%G formulation. All experiments were in a randomized complete block design with four replications and 10 by 30 feet plots. The granules were applied uniformly by hand, while the liquid formulations were applied with a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. Evaluations were based on percent stand reduction compared to the control. A significant interaction on between site and treatments occurred, so experimental sites will be discussed individually.

Leafy spurge control with picloram and dicamba was better from fall than spring applied treatments at Valley City, especially when evaluated 24 to 60 months, after treatment (Table 1). The control averaged across all treatments after 24, 48, and 60 months was 54, 22, and 13% for spring applications and 78, 62, and 26% for fall applications, respectively. Fall applied dicamba at 8 lb/A and picloram at 2 lb/A as liquids provided similar control after 5 years, but control with granular picloram was better than with granular dicamba. Dicamba and picloram applied in the spring of 1980, generally did not give satisfactory leafy spurge control by 1982 and 1983, respectively. The exception was picloram at 2 lb/A which provided satisfactory control until 1984. Only fall applied picloram 2%G at 1.5 and 2 lb/A provided satisfactory leafy spurge control after 48 months at 83 and 86%, respectively, but no treatment provided satisfactory control 60 months after application.

Picloram 2%G and 10%G at equal rates generally provided similar leafy spurge control at both Sheldon and Dickinson (Table 2). Fall applications of picloram 2%G and 10%G at all application rates, except 2.0 lb/A, provided better leafy spurge control after 9 months than spring applications after 3 months. This difference could be due to insufficient moisture to completely disperse the granules following the June application, be-

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cause the treatments generally were similar 12 and 24 months after application. Leafy spurge control in 1985 at Sheldon was similar to control in 1984. However, the treatments at Dickinson did not provide satisfactory leafy spurge control in 1985, so specific evaluations were not taken. The soil at Sheldon is very sandy compared to the mostly clay soil at Dickinson which may have allowed deeper picloram movement in the soil profile and thus better long-term leafy spurge root control at Sheldon than Dickinson.

Leafy spurge control with picloram at 1 and 2 lb/A was similar for the 2%G and 10%G when blanks were added, but was much worse with 10%G than 2%G pellets without blanks (Table 2). The picloram 2%G and 10%G pellets were similar in size and 80% fewer pellets per acre are applied with picloram 10%G than with 2%G. Thus, uniform distribution with hand-held application equipment was difficult which probably accounted for the decreased control. Visible grass injury was negligible with either picloram formulation. In general, leafy spurge control with picloram at 2 lb/A declined more rapidly when the liquid (2S) formulation was used compared to 2%G or 10%G.

Similar experiments were begun in 1984 using a new formulation of picloram 10% with smaller pellets which resulted in more pellets per square foot than the previous 10%G formulation at similar rates. Picloram 2%G and 10%G gave similar leafy spurge control at all application rates except 0.5 lb/A (Table 3). Blanks were not mixed with the new 10%G formulation but a uniform distribution still was obtained. Control was much lower at Dickinson than at Sheyenne which again probably was due to deeper picloram movement in the sandy soil at Sheyenne than in the clay soil at Dickinson. Unlike previous experiments, spring application of picloram granules provided better leafy spurge control than fall application when evaluated 12 months after treatment. Fall precipitation was below normal and the soil was very dry until late October in 1984. The dry soil conditions after application apparently caused poor long-term control despite adequate moisture in 1985.

Granular and liquid formulations of dicamba and picloram generally provided similar control at comparable rates. Picloram 2%G and 10%G provided similar leafy spurge control either when blanks were included with the 10%G pellets or when the number of 10%G pellets per square foot was increased by use of a smaller pellet. Generally spring and fall treatment provided similar long-term control except when application was made during very dry conditions. Picloram granules provided better long-term control in sandy compared to clay soils.

Table 1. Spring and fall applied granular picloram and dicamba for leafy spurge control at Valley City, ND.

|              |    |        |      |                |        |          |                          |          |      | Api  | plication | Application and evaluation date | uation d | ate  |           |         |                              |      |      |      |      |
|--------------|----|--------|------|----------------|--------|----------|--------------------------|----------|------|------|-----------|---------------------------------|----------|------|-----------|---------|------------------------------|------|------|------|------|
|              |    |        |      |                | Spring | ; treatm | treatment (25 June 1980) | June 19. | 80)  |      |           |                                 |          | F    | all treat | ment (3 | Fall treatment (3 Sept 1980) | (08) |      |      |      |
| Herbicide    |    | Rate   | 6-81 | 6-81 9-81 6-82 |        | 9-82     | 6-83                     | 6-83     | 6-84 | 9-84 | . 9-82    | 6-81                            | 9-81     | 6-82 | 9-82      | 6-83    | 9-84                         | 5-84 | 9-84 | 9-85 | 8-85 |
|              | (1 | (lb/A) |      |                |        |          |                          |          |      |      | (g)       | (% control)                     |          |      |           |         |                              |      |      |      |      |
| Picloram 2%G |    | 1.0    | 26   | 80             | 53     | 25       | 4                        | 22       | 10   | 8    | 3         | 95                              | 98       | 84   | 55        | 9/      | 52                           | 51   | 52   | 18   | 10   |
| Picloram 2%G |    | 1.5    | 86   | 68             | 87     | 22       | 77                       | 38       | 29   | 26   | =         | 66                              | 100      | 100  | 96        | 86      | 26                           | 87   | 83   | 59   | 48   |
| Picloram 2%G |    | 2.0    | 66   | 86             | 06     | 53       | 85                       | 72       | 99   | 62   | 28        | 100                             | 100      | 66   | 100       | 100     | 86                           | 93   | 98   | 89   | 63   |
| Dicamba 5%G  |    | 4.0    | 74   | 55             | 6      | 33       | 4                        | 0        | 4    | 0    | 0         | 94                              | 74       | 43   | 31        | 31      | 29                           | 18   | 20   | 17   | 6    |
| Dicamba 5%G  |    | 0.9    | 82   | 54             | 25     | 33       | 16                       | 5        | 4    | 3    | _         | 96                              | 66       | 68   | 28        | 55      | 55                           | 41   | 40   | 22   | 9    |
| Dicamba 5%G  |    | 8.0    | 91   | 75             | 45     | 19       | 29                       | 9        | 5    | 9    | 0         | 66                              | 100      | 86   | 83        | 84      | 78                           | 99   | 29   | 39   | 20   |
| Picloram     | 2S | 2.0    | 100  | 66             | 86     | 06       | 94                       | 62       | 64   | 71   | 54        | 100                             | 100      | 100  | 100       | 86      | 94                           | 79   | 78   | 20   | 28   |
| Dicamba      | 4S | 8.0    | 94   | 74             | 28     | 12       | 42                       | 13       | 7    | 2    | 4         | 66                              | 66       | 100  | 26        | 92      | 83                           | 69   | 72   | 47   | 33   |
| LSD (0.05)   |    |        | 6    | 14 21          | 21     | 17       | 20                       | 11       | 11   | 12   | 20        | 3                               | 10       | 22   | 29        | 24      | 24                           | 29   | 23   | 26   | 23   |

Table 2. Leafy spurge control using picloram 2%G and 10%G of similar size.

|                     |        |      |     |         |     | Evalu | Evaluation date |      |           |      |     |
|---------------------|--------|------|-----|---------|-----|-------|-----------------|------|-----------|------|-----|
| Picloram            |        | 19   | 983 | 1984    | 4   | 19    | 1985            | 1983 | 83        | 1984 | 4,  |
| formation           | Rate   | June | Aug | June    | Aug | June  | Aug             | June | Aug       | June | Aug |
|                     | (lb/A) |      |     |         |     | ))    | (% control)     |      |           |      |     |
| Applied Fall 1982   |        |      |     | Sheldon |     |       |                 |      | Dickinson |      |     |
| 2%G + blanks        | 0.5    | 99   | 26  | 8       | 21  | 11    | 16              | 38   | 5         | 18   | 5   |
| 2%G + blanks        | 1.0    | 98   | 41  | 29      | 33  | 31    | 18              | 69   | 15        | 42   | 13  |
| 2%G + blanks        | 1.5    | 87   | 29  | 48      | 48  | 47    | 24              | 06   | 37        | 71   | 51  |
| 2%G                 | 2.0    | 66   | 92  | 80      | 99  | 71    | 4               | 96   | 53        | 79   | 64  |
| 10%G + blanks       | 0.5    | 39   | 11  | 3       | 31  | 0     | 0               | 34   | 6         | 19   | 0   |
| 10%G + blanks       | 1.0    | 83   | 09  | 52      | 99  | 39    | 30              | 84   | 21        | 45   | 36  |
| 10%G + blanks       | 1.5    | 81   | 09  | 43      | 58  | 54    | 38              | 88   | 35        | 55   | 47  |
| 10%G + blanks       | 2.0    | 87   | 63  | 77      | 99  | 65    | 45              | 68   | 40        | 75   | 64  |
| 10%G                | 1.0    | 53   | 26  | 11      | 13  | 18    | 13              | 1    | 1         | 1    | ;   |
| 10%G                | 2.0    | 68   | 61  | 45      | 45  | 52    | 57              | 1    | ł         | 1    | 1   |
| Liquid (2S)         | 2.0    | 94   | 29  | 55      | 4   | 30    | 35              | 94   | 42        | 09   | 41  |
| LSD(0.05)           |        | 16   | 30  | 19      | 23  | 24    | 25              | 18   | 28        | 30   | 33  |
| Applied Spring 1983 |        |      |     |         |     |       |                 |      |           |      |     |
| 2%G + blanks        | 0.5    |      | 28  | 27      | 10  | 21    | 8               | !    | 38        | 28   | 12  |
| 2%G + blanks        | 1.0    | ł    | 38  | 58      | 13  | 55    | 14              | 1    | 57        | 53   | 43  |
| 2%G + blanks        | 1.5    | ļ    | 98  | 95      | 36  | 92    | 20              | 1    | 62        | 83   | 09  |
| 2%G                 | 2.0    | 1    | 26  | 94      | 69  | 93    | 62              | 1    | 9/        | 68   | 65  |
| 10%G + blanks       | 0.5    |      | 26  | 11      | 9   | 18    | 4               | 1    | 25        | 20   | 2   |
| 10%G + blanks       | 1.0    |      | 54  | 61      | 16  | 52    | 28              | 1    | 32        | 42   | 23  |
| 10%G + blanks       | 1.5    |      | 74  | 70      | 26  | 58    | 35              | 1    | 78        | 75   | 56  |
| 10%G + blanks       | 2.0    | 1    | 92  | 92      | 99  | 92    | 99              | ł    | 63        | 92   | 70  |
| Liquid (2S)         | 2.0    |      | 93  | 79      | 39  | 92    | 57              | ł    | 96        | 94   | 51  |
| LSD (0.05)          |        |      | 22  | 14      | 14  | 23    | 15              |      | 23        | 19   | 29  |
|                     |        |      |     |         |     |       |                 |      |           |      |     |

Table 3. Leafy spurge control using picloram 2%G, 10%G, and 2S as spring or fall applied treatment.

| Rate   1984   1985   1986   1984   1985   1986   1984   1985   1986   1984   1985   1986   1984   1988   1984   1986   1984 |                     |        |      |      |          | Evaluation date | on date |      |           |      |
|---|---------------------|--------|------|------|----------|-----------------|---------|------|-----------|------|
| Rate   Aug   June   Aug   June   Aug   June   Aug   June   Aug   June   Aug   June   June   Aug   June   June | Picloram.           |        | 1984 | 19   | 85       | 198             | 98      | 1984 | 198       | 85   |
| 1984   1986   1986 | formulation         | Rate   | Aug  | June | Aug      | June            | Aug     | Aug  | June      | Sept |
| Ing 1984         Sheyenne         Diekkinson           ng 1984         6.5         83         89         53         56         34         0         0           1.0         96         100         97         97         99         84         86         88         48           2.0         98         100         98         94         88         88         88           1.0         95         99         84         86         86         86         45           1.0         97         99         94         94         88         80           2.0         98         100         99         94         94         88         80           2.0         98         100         99         94         94         88         80           1984         8         10         16         17         24         23         24           1984         8         10         99         94         98         80         80           10         10         94         94         98         80         94         80           10         10         10   |                     | (Ib/A) |      |      |          | (% co           | ntrol)  |      |           |      |
| 0.5         83         89         53         56         34         0         0           1.0         96         99         83         79         54         38         48           1.0         96         100         97         99         94         94         83         88           1.0         95         99         84         86         82         31         43         88           1.0         95         99         84         86         82         31         43         98           2.0         97         99         94         94         86         72         56         45           2.0         97         99         94         94         86         72         56         45           1984         86         10         99         94         94         88         80         45  | Applied Spring 1984 |        |      |      | Sheyenne |                 |         |      | Dickinson |      |
| 1.0     96     99     83     79     54     38     48       1.5     96     100     97     95     91     43     62       2.0     98     100     97     98     94     83     88       1.0     95     99     84     86     86     56     45       2.0     97     99     94     94     86     56     45       2.0     98     100     99     94     94     86     56       2.0     98     100     99     94     94     86     56       1984     10     16     17     24     23     24       1984     57     76     7      7       10      100     91     91     74      97       10      100     91     91     91     91       10      100     96     98     83      98       10      100     97     97     86      99       10      10     99     91     86      99       10      99     91     96   | 2%G                 | 0.5    | 83   | 68   | 53       | 99              | 34      | 0    | 0         | 0    |
| 1.5   96   100   97   95   91   43   62     2.0   98   100   98   98   94   83   88     1.0   95   99   84   86   82   31   43     1.1   95   99   94   93   86   56   45     2.0   97   99   94   94   86   56   45     2.0   98   100   99   98   94   98   80     1.0     10   16   17   24   23   24     1.0       100   91   91   74     85     1.1       100   96   98   83     97     1.2     100   97   97   86     98     1.3     100   97   97   86     98     1.4   26     99   91   96   73     95     1.5     6   16   14   26     99     1.5     6   16   16   17   26     99     1.5     6   16   17   26     99     1.5     6   16   17   26     99     1.5     6   16   17   27   27   27     1.5     7   7   7   7   7   7     1.5     7   7   7   7   7   7   7   7  | 2%G                 | 1.0    | 96   | 66   | 83       | 79              | 54      | 38   | 48        | ∞    |
| 2.0       98       100       98       98       98       88       88       88       88       90       90       94       94       94       93       86       50       90       94       93       86       56       45       95       94       94       98       86       56       45       95       94       94       98       86       72       56       45       56       44       56       <   | 2%G                 | 1.5    | 96   | 100  | 26       | 95              | 91      | 43   | 62        | 13   |
| 0.5     64     75     19     4     4     3     0       1.0     95     99     84     86     82     31     43       1.0     97     99     94     94     86     56     45       2.0     98     100     99     98     86     72     56       3     10     16     17     24     23     24       1984     57     76     7      71       108      94     57     76     7      71       1.0      100     91     91     74      85       1.5      100     96     98     83      97       2.0      100     96     98     83      98       1.5      100     96     98     83      98       1.0      100     96     98     83      98       1.0      100     99     91     89     81      99       2.0      99     91     96     88      99       2.0      6     <  | 2%G                 | 2.0    | 86   | 100  | 86       | 86              | 94      | 83   | 88        | 53   |
| 1.0     95     99     84     86     82     31     43       1.5     97     99     94     93     86     56     45       2.0     97     99     94     94     86     72     56       2.0     98     100     99     98     94     98     80       1984     8     10     16     17     24     23     24       1984     5     7     7     7     7     7       10      100     91     91     74      85       110      100     96     98     83      97       115      100     97     97     86      98       110     91     94     83      98       110     97     97     88      99       110     90     91     89     81      99       110     99     91     96     81      99       110     99     91     96     91     99       110     99     97     88      99       110     99     91 <t< td=""><td>10%G</td><td>0.5</td><td>64</td><td>75</td><td>19</td><td>4</td><td>4</td><td>т</td><td>0</td><td>4</td></t<>   | 10%G                | 0.5    | 64   | 75   | 19       | 4               | 4       | т    | 0         | 4    |
| 1.5       97       99       94       93       86       56       45         2.0       97       99       94       94       86       72       56         2.0       98       100       99       98       89       80       80         1984       8       10       16       17       24       23       24         1984       57       76       7        7        71         1.0        100       91       91       74        85         1.0        100       96       98       83        97         2.0        100       97       97       86        98         0.5        100       97       97       86        46         1.0        96       81       66       52        79         1.5        99       91       96       73        99         2.0        99       97       88        99         2.0        6       16  | 10%G                | 1.0    | 95   | 66   | 84       | 98              | 82      | 31   | 43        | 23   |
| 2.0       97       99       94       94       86       72       56         2.0       98       100       99       98       94       98       80         1984       8       10       16       17       24       23       24         1984       57       76       7        24       85         1.0        100       91       74        85         1.5        100       96       98       83        97         2.0        100       97       97       86        98         0.5        100       97       97       86        46         1.0        96       81       66        79         1.5        96       81       6        79         1.5        99       91       96       81        99         2.0        99       91       96       97       99         2.0        6       16       14       26        99  | 10%G                | 1.5    | 26   | 66   | 94       | 93              | 98      | 56   | 45        | 16   |
| 2.0     98     100     99     98     94     98     80       1984     8     10     16     17     24     23     24       1984     7     7     7     7     7       10     94     57     76     7     7     71       1.0      100     91     91     74      85       1.10      100     96     98     83      97       2.0      100     97     97     86      98       1.0      96     81     66      98       1.15      99     91     89     81      99       2.0      99     91     96     73      99       2.0      6     16     14     26      99       99     99     97     88      99       99     97     88      99       99     97     88      99       99     97     88      99       99     97     88      99       9  | 10%G                | 2.0    | 76   | 66   | 94       | 94              | 98      | 72   | 56        | 31   |
| 1984     10     16     17     24     23     24       1984     57     76     7      71       1.0      100     91     91     74      85       1.5      100     96     98     83      97       2.0      100     97     97     86      98       0.5      100     97     97     86      98       1.0      96     81     66     52      79       1.5      99     91     89     81      91       2.0      99     91     96     73      99       2.0      6     16     14     26      99  | Liquid (2S)         | 2.0    | 86   | 100  | 66       | 86              | 94      | 86   | 80        | 28   |
| 1984       57       76       7       —       71         1.0       —       100       91       74       —       85         1.0       —       100       96       98       83       —       97         2.0       —       100       97       97       86       —       98         0.5       —       100       97       97       86       —       98         1.0       —       96       81       66       —       79         1.5       —       99       91       89       81       —       91         2.0       —       99       91       96       73       —       99         2.0       —       99       91       96       73       —       99         2.0       —       6       16       14       26       —       99   | LSD (0.05)          |        | ∞    | 10   | 16       | 17              | 24      | 23   | 24        | 21   |
| 0.5      94     57     76     7      71       1.0      100     91     91     74      85       1.5      100     96     98     83      97       2.0      100     97     97     86      98       0.5      82     42     43     6      46       1.0      96     81     66     52      79       1.5      99     91     89     81      91       2.0      99     91     96     73      99       2.0      6     16     14     26      99  | Applied Fall 1984   |        |      |      |          |                 |         |      |           |      |
| 1.0      100     91     74      85       1.5      100     96     98     83      97       2.0      100     97     97     86      98       0.5      82     42     43     6      98       1.0      96     81     66     52      79       1.5      99     91     89     81      91       2.0      99     91     96     73      95       2.0      6     16     14     26      99   | 2%G                 | 0.5    |      | 94   | 57       | 92              | 7       | !    | 71        | 16   |
| 1.5      100     96     98     83      97       2.0      100     97     97     86      98       0.5      100     97     97     86      98       1.0      96     81     66      79       1.5      99     91     89     81      91       2.0      99     91     96     73      95       2.0      6     16     14     26      99   | 2%G                 | 1.0    |      | 100  | 91       | 91              | 74      | 1    | 85        | 39   |
| 2.0      100     97     97     86      98       0.5      82     42     43     6      46       1.0      96     81     66     52      79       1.5      99     91     89     81      91       2.0      99     91     96     73      95       2.0      6     16     14     26      99  | 2%G                 | 1.5    |      | 100  | 96       | 86              | 83      | 1    | 26        | 99   |
| 0.5      82     42     43     6      46       1.0      96     81     66     52      79       1.5      99     91     89     81      91       2.0      99     91     96     73      95       2.0      100     99     97     88      99        6     16     14     26      9   | 2%G                 | 2.0    |      | 100  | 26       | 26              | 98      | !    | 86        | 81   |
| 1.0      96     81     66     52      79       1.5      99     91     89     81      91       2.0      99     91     96     73      95       2.0      100     99     97     88      99        6     16     14     26      9   | 10%G                | 0.5    |      | 82   | 42       | 43              | 9       | !    | 46        | 15   |
| 1.5      99     91     89     81      91       2.0      99     91     96     73      95       2.0      100     99     97     88      99        6     16     14     26      99   | 10%G                | 1.0    | 1    | 96   | 81       | 99              | 52      | 1    | 79        | 36   |
| 2.0 99 91 96 73 95<br>2.0 100 99 97 88 99<br>6 16 14 26 9   | 10%G                | 1.5    | ;    | 66   | 91       | 68              | 81      | 1    | 91        | 45   |
| 2.0 $100$ 99 97 88 99 6 $16$ $14$ $26$ 9  | 10%G                | 2.0    | 1    | 66   | 91       | 96              | 73      | 1    | 95        | 89   |
| 6 16 14 26  | Liquid (2S)         | 2.0    | 1    | 100  | 66       | 26              | 88      | 1    | 66        | 47   |
|   | LSD(0.05)           |        | 1    | 9    | 16       | 14              | 26      | !    | 6         | 17   |