Table 3. Evaluation of banding P+Mn, and foliar Mn and P applications for improving productivity of onions grown on muck soils – small-plot field trial: Soil nutrient analysis results, CY in Batavia muck.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **June 15, 2010 2-3 leaf stage** | | | | | | | | | | | |
| **Treatment** | **pH** | | **Mn (lb/A)** | | **P (lb/A)** | | **K (lb/A)** | | | **NO3 (lb/A)** | |
| ***Pre-plant*** | ***7.0 (v.high)*** | | ***9 (low)*** | | ***35 (low)*** | | ***760 (v.high)*** | | | ***48*** | |
| Broadcast NP | 6.6 | | 4.0 | | 100 | | 302 | | | 600 | |
| Broadcast NP + foliar Mn | 6.5 | | 3.0 | | 111 | | 340 | | | 575 | |
| Broadcast NP + foliar P | 6.6 | | 3.2 | | 112 | | 339 | | | 539 | |
| Band P+Mn\* | 6.5 | | 3.4 | | 121 | | 340 | | | 555 | |
| Band P+Mn\* + foliar Mn | 6.6 | | 2.8 | | 99 | | 326 | | | 503 | |
| Band P+Mn\* + foliar Mn + P | 6.5 | | 3.0 | | 130 | | 363 | | | 500 | |
| ***P Value (α=0.05)*** | ***NS*** | | ***NS*** | | ***NS*** | | ***NS*** | | | ***NS*** | |
| Broadcast NP | 6.5 | | 3.4 | | 108 | | 327 | | | 571 | |
| Band P+Mn\* | 6.5 | | 3.1 | | 117 | | 343 | | | 519 | |
| ***P Value (α=0.05)*** | ***NS*** | | ***NS*** | | ***NS*** | | ***NS*** | | | ***NS*** | |
| **Location** | **row** | **middle** | **row** | **middle** | **row** | **middle** | **row** | **middle** | | **row** | **middle** |
| Broadcast NP | 6.6 | 6.6 | 4.0 | 3.6 | 160 a | 75 b | 284 | 310 | | 404 | 562 |
| Band P+Mn\* | 6.5 | 6.6 | 4.0 | 4.2 | 160 a | 69 b | 319 | 318 | | 453 | 596 |
| ***P Value (α=0.05)*** | ***NS*** | | ***NS*** | | ***0.0115*** | | ***NS*** | | | ***NS*** | |
| **Summary of soil test results for other nutrients (June 15, 2010)** | | | | | | | | | | | |
| **lb/A** | **Pre-plant** | | **average** | | **minimum** | | **maximum** | |  | | |
| Mg | 2,445 | | 2,666 | | 2,270 | | 2,950 | |  | | |
| Ca | 19,070 | | 24,570 | | 21,570 | | 29,000 | |  | | |
| Al | 46 | | 38.3 | | 31.0 | | 52.0 | |  | | |
| Fe | 20 | | 15.3 | | 9 | | 20 | |  | | |
| Zn | 9 | | 10.9 | | 7.4 | | 13.9 | |  | | |
| **August 18, 2010 8-10 leaf stage** | | | | | | | | | | | |
| **Location** | **pH** | | **Mn (lb/A)** | | **P (lb/A)** | | **K (lb/A)** | | | **NO3 (lb/A)** | |
| **row** | **middle** | **row** | **middle** | **row** | **middle** | **row** | **middle** | | **row** | **middle** |
| Broadcast NP | 6.6 b | 6.5 ab | 5.8 a | 4.6 b | 140 b | 76 c | 343 | 361 | | 440 | 538 |
| Band P+Mn\* | 6.5 b | 6.6 a | 4.8 b | 4.6 b | 175 a | 59.5 c | 469 | 377 | | 442 | 523 |
| ***P Value (α=0.05)*** | ***0.0127*** | | ***0.0084*** | | ***0.0001*** | | ***NS*** | | | ***NS*** | |
| **Summary of soil test results for other nutrients (August 18, 2010)** | | | | | | | | | | | |
| **lb/A** | **Pre-plant** | | **average** | | **minimum** | | **maximum** | | |  | |
| Mg |  | | 2,785 | | 2,505 | | 3,125 | | |  | |
| Ca |  | | 23,847 | | 21,350 | | 26,260 | | |  | |
| Al |  | | 321 | | 26 | | 40 | | |  | |
| Fe |  | | 18.5 | | 10 | | 25 | | |  | |
| Zn |  | | 11.3 | | 8.1 | | 13.8 | | |  | |

**Soil pH across the season**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **June 10**  **(CNAL)** | | **June 30**  **(adjusted CCE)\*\*** | | **July 29**  **(adjusted CCE)\*\*** | | **August 18**  **(CNAL)** | |  |
| **row** | **middle** | **row** | **middle** | **row** | **middle** | **row** | **middle** |  |
| Broadcast NP | 6.6 | 6.6 | 6.4 | 6.6 | 6.5 | 6.6 | 6.5 b | 6.5 ab |  |
| Band P+Mn\* | 6.5 | 6.6 | 6.3 | 6.5 | 6.5 | 6.4 | 6.5 b | 6.6 a | **P Value** |
| ***P Value (α=0.05)*** | ***NS*** | | ***NS*** | | ***NS*** | | ***0.0127*** | | ***(α=0.05)*:** |
| **Average** | **6.6** | | **6.5** | | **6.5** | | **6.5** | | ***NS*** |

\*N applied broadcast and incorporated pre-plant. \*\*Comparisons of pH for the same soil sample showed that on average, the Cornell nutrient analysis lab (CNAL) gave results that were 0.085 units lower than when Cornell Cooperative Extension (CCE) used the Cornell soil test kit. To adjust CCE values to make them comparable to CNAL, 0.085 units were subtracted from CCE values.

Table 4. Evaluation of banding P+Mn, and foliar Mn and P applications for improving productivity of onions grown on muck soils – small-plot field trial: Soil nutrient analysis results, Star Webster muck.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **June 15, 2010 2-3 leaf stage** | | | | | | | | | | | | | | | |
| **Treatment** | | **pH** | | | **Mn (lb/A)** | | | **P (lb/A)** | | | **K (lb/A)** | | **NO3 (lb/A)** | | |
| ***Pre-plant*** | | ***7.0 (high)*** | | | ***27 (med)*** | | | ***362 (v.high)*** | | | ***940 (v.high)*** | | ***154*** | | |
| Broadcast N | | 6.8 | | | 8.4 | | | 301 c | | | 775 | | 322 | | |
| Broadcast N + foliar Mn | | 6.9 | | | 9.8 | | | 316 bc | | | 774 | | 345 | | |
| Broadcast N + foliar P | | 6.8 | | | 8.2 | | | 320 bc | | | 812 | | 324 | | |
| Band P+Mn\* | | 6.8 | | | 8.6 | | | 359 ab | | | 801 | | 382 | | |
| Band P+Mn\* + foliar Mn | | 6.8 | | | 9.2 | | | 346 abc | | | 712 | | 315 | | |
| Band P+Mn\* + foliar Mn+P | | 6.8 | | | 8.8 | | | 384 a | | | 845 | | 408 | | |
| ***P Value (α=0.05)*** | | ***NS*** | | | ***NS*** | | | ***0.0124*** | | | ***NS*** | | ***NS*** | | |
| Broadcast N | | 6.8 | | | 8.9 | | | 312 a | | | 787 | | 333 | | |
| Band P+Mn\* | | 6.8 | | | 8.8 | | | 363 b | | | 786 | | 368 | | |
| ***P Value (α=0.05)*** | | ***NS*** | | | ***NS*** | | | ***0.0006*** | | | ***NS*** | | ***NS*** | | |
| **Location** | | **row** | | **middle** | **row** | | **middle** | **row** | **middle** | | **row** | **middle** | **row** | | **middle** |
| Broadcast N | | 6.6 | | 6.9 | 11.4 | | 9.4 | 362 b | 308 c | | 719 | 750 | 301 | | 353 |
| Band P+Mn\* | | 6.9 | | 6.9 | 12.4 | | 12.0 | 422 a | 475 b | | 758 | 851 | 341 | | 361 |
| ***P Value (α=0.05)*** | | ***NS*** | | | ***NS*** | | | ***0.0003*** | | | ***NS*** | | ***NS*** | | |
| **Summary of soil test results for other nutrients (June 15, 2010)** | | | | | | | | | | | | | | | |
| **lb/A** | **Pre-plant** | | | | **average** | | | **minimum** | | | **maximum** | |  | | |
| Mg | 2,980 | | | | 2,546 | | | 2,225 | | | 3,210 | |  | | |
| Ca | 60,560 | | | | 49,589 | | | 41,070 | | | 60,430 | |  | | |
| Al | 51 | | | | 37 | | | 24 | | | 61 | |  | | |
| Fe | 7 | | | | 4 | | | 0 | | | 9 | |  | | |
| Zn | 25.6 | | | | 21 | | | 11 | | | 38 | |  | | |
| **August 18, 2010 8-10 leaf stage** | | | | | | | | | | | | | | | |
| **Treatment** | **pH** | | | | **Mn (lb/A)** | | | **P (lb/A)** | | | **K (lb/A)** | | **NO3 (lb/A)** | | |
| **row** | | **middle** | | **row** | **middle** | | **row** | | **middle** | **row** | **middle** | **row** | **middle** | |
| Broadcast N | 6.8 | | 6.8 | | 12.0 | 11.2 | | 310 | | 290 | 701 | 642 | 335 | 233 | |
| Band P+Mn\* | 6.9 | | 6.9 | | 12.4 | 11.6 | | 348 | | 337 | 740 | 714 | 284 | 285 | |
| ***P Value (α=0.05)*** | ***NS*** | | | | ***NS*** | | | ***NS*** | | | ***NS*** | | ***NS*** | | |
| **Summary of soil test results for other nutrients (August 18, 2010)** | | | | | | | | | | | | | | | |
| **lb/A** | **Pre-plant** | | | | **average** | | | **minimum** | | | **maximum** | |  | | |
| Mg |  | | | | 2,619 | | | 2,525 | | | 2,715 | |  | | |
| Ca |  | | | | 48,868 | | | 42,380 | | | 58,740 | |  | | |
| Al |  | | | | 26 | | | 18 | | | 37 | |  | | |
| Fe |  | | | | 4.7 | | | 1 | | | 8 | |  | | |
| Zn |  | | | | 21 | | | 12 | | | 32 | |  | | |

**Soil pH across the season**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **June 15**  **(CNAL)** | | **June 30**  **(adjusted CCE)\*\*** | | **July 30**  **(adjusted CCE)\*\*** | | **August 18**  **(CNAL)** | |  |
| **row** | **middle** | **row** | **middle** | **row** | **middle** | **row** | **middle** |  |
| Broadcast N | 6.6 | 6.9 | 6.6 | 6.6 | 6.6 | 6.7 | 6.8 | 6.8 |  |
| Band P+Mn\* | 6.9 | 6.9 | 6.7 | 6.7 | 6.7 | 6.8 | 6.9 | 6.9 |  |
| ***P Value*** | ***NS*** | | ***NS*** | | ***NS*** | | ***NS*** | | **P Value:** |
| **Average** | **6.8 A** | | **6.7 B** | | **6.7 B** | | **6.8 B** | | ***0.0062*** |

\*N applied broadcast and incorporated pre-plant. \*\*Comparisons in pH between the Cornell nutrient analysis lab (CNAL) and Cornell Cooperative Extension (CCE) using Cornell soil test kit from the same soil sample, on average CNAL results were 0.035 units higher than CCE. To adjust CCE values to make them comparable to CNAL, 0.035 units were added to CCE values.

Table 5. Evaluation of banding P+Mn, and foliar Mn and P applications for improving productivity of onions grown on muck soils – small-plot field trial: Soil nutrient analysis results, Mortellaro Elba muck.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **June 8-9, 2010 2-3 leaf stage** | | | | | | | | | | | | | | | | | | | | | |
| **Treatment** | | **pH** | | | | **Mn (lb/A)** | | | | **P (lb/A)** | | | | **K (lb/A)** | | | | **NO3 (lb/A)** | | | |
| ***Pre-plant*** | | ***4.7 (low)*** | | | | ***98 (high)*** | | | | ***49 (low)*** | | | | ***655 (high)*** | | | | ***48*** | | | |
| Broadcast NPK | | 4.7 | | | | 125 | | | | 156 | | | | 839 | | | | 485 a | | | |
| Broadcast NPK + foliar Mn | | 4.7 | | | | 130 | | | | 147 | | | | 755 | | | | 500 a | | | |
| Broadcast NPK + foliar P | | 4.6 | | | | 135 | | | | 166 | | | | 827 | | | | 500 a | | | |
| Band PK+Mn\* | | 4.6 | | | | 124 | | | | 120 | | | | 799 | | | | 402 ab | | | |
| Band PK+Mn\* + foliar Mn | | 4.6 | | | | 127 | | | | 125 | | | | 771 | | | | 373 b | | | |
| Band PK+Mn\* + foliar Mn P | | 4.6 | | | | 130 | | | | 125 | | | | 809 | | | | 400 ab | | | |
| ***P Value (α=0.05)*** | | ***NS*** | | | | ***NS*** | | | | ***NS*** | | | | ***NS*** | | | | ***0.0437*** | | | |
| Broadcast NPK | | 4.7 | | | | 130 | | | | 156 a | | | | 807 | | | | 495 a | | | |
| Band PK+Mn\* | | 4.6 | | | | 127 | | | | 123 b | | | | 793 | | | | 392 b | | | |
| ***P Value (α=0.05)*** | | ***NS*** | | | | ***NS*** | | | | ***0.0035*** | | | | ***NS*** | | | | ***0.0006*** | | | |
| **Location** | | **row** | | **middle** | | **row** | | **middle** | | **row** | | **middle** | | **row** | | **middle** | | **row** | | | **middle** |
| Broadcast NPK | | 4.7 ab | | 4.6 c | | 120 bc | | 113 c | | 180 a | | 111 b | | 787 | | 712 | | 433 a | | | 457 a |
| Band PK+Mn\* | | 4.7 a | | 4.6 bc | | 129 a | | 121 b | | 162 a | | 84 b | | 729 | | 717 | | 298 b | | | 428 a |
| ***P Value (α=0.05)*** | | ***0.0144*** | | | | ***0.0058*** | | | | ***0.0115*** | | | | ***NS*** | | | | ***0.0011*** | | | |
| **Summary of soil test results for other nutrients (June 8-9, 2010)** | | | | | | | | | | | | | | | | | | | | | |
| **lb/A** | **Pre-plant** | | | | **average** | | | | | **minimum** | | | | **maximum** | | | | |  | | |
| Mg | 1,450 | | | | 1,432 | | | | | 1,235 | | | | 1,860 | | | | |  | | |
| Ca | 25,150 | | | | 25,712 | | | | | 24,540 | | | | 27,150 | | | | |  | | |
| Al | 45 | | | | 54 | | | | | 42 | | | | 64 | | | | |  | | |
| Fe | 2 | | | | 7 | | | | | 3 | | | | 13 | | | | |  | | |
| Zn | 16.7 | | | | 15.6 | | | | | 14.5 | | | | 16.8 | | | | |  | | |
| **August 18, 2010 8-10 leaf stage** | | | | | | | | | | | | | | | | | | | | | |
| **Treatment** | **pH** | | | | **Mn (lb/A)** | | | | **P (lb/A)** | | | | **K (lb/A)** | | | | **NO3 (lb/A)** | | | | |
| **Location** | **row** | | **middle** | | **row** | | **middle** | | **row** | | **middle** | | **row** | | **middle** | | **row** | | | **middle** | |
| Broadcast NPK | 4.6 | | 4.7 | | 134 | | 121 | | 172 a | | 117 bc | | 630 | | 575 | | 380 | | | 412 | |
| Band PK+Mn\* | 4.6 | | 4.7 | | 133 | | 118 | | 134 ab | | 84 c | | 573 | | 581 | | 315 | | | 364 | |
| ***P Value (α=0.05)*** | ***NS*** | | | | ***NS*** | | | | ***0.0038*** | | | | ***NS*** | | | | ***NS*** | | | | |
| **Summary of soil test results for other nutrients (August 18, 2010)** | | | | | | | | | | | | | | | | | | | | | |
| **lb/A** | **Pre-plant** | | | | **average** | | | | | **minimum** | | | | **maximum** | | | | |  | | |
| Mg |  | | | | 1,476 | | | | | 1,205 | | | | 1,985 | | | | |  | | |
| Ca |  | | | | 27,490 | | | | | 26,040 | | | | 29,260 | | | | |  | | |
| Al |  | | | | 54 | | | | | 44 | | | | 66 | | | | |  | | |
| Fe |  | | | | 12 | | | | | 7 | | | | 20 | | | | |  | | |
| Zn |  | | | | 18 | | | | | 17 | | | | 19 | | | | |  | | |

**Soil pH across the season**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **June 8-9**  **(CNAL)** | | **June 25**  **(adjusted CCE)\*\*** | | **July 29**  **(adjusted CCE)\*\*** | | **August 18**  **(CNAL)** | |  |
| **row** | **middle** | **row** | **middle** | **row** | **middle** | **row** | **middle** |  |
| Broadcast NPK | 4.7 ab | 4.6 c | 4.7 | 4.7 | 4.6 | 4.7 | 4.6 | 4.6 |  |
| Band PK+Mn\* | 4.7 a | 4.6 bc | 4.7 | 4.7 | 4.6 | 4.6 | 4.6 | 4.6 | **P Value:** |
| ***P Value (α=0.05)*** | ***0.0144*** | | ***NS*** | | ***NS*** | | ***NS*** | | ***(α=0.05)*** |
| **average** | **4.7 AB** | | **4.7 A** | | **4.6 B** | | **4.6 B** | | ***0.0323*** |

\*N applied broadcast and incorporated pre-plant. \*\*In side by side comparisons for pH between the Cornell nutrient analysis lab (CNAL) and Cornell Cooperative Extension (CCE) using Cornell soil test kit, on average CCE results were 0.4 units higher than CNAL. To adjust CCE values to make them comparable to CNAL, 0.4 units was subtracted from CCE values.