

## Alfalfa Fertility Experiment

## Trace Element Fertility:

Two seedings have been made at the Weigand location at Powell Butte, Oregon with different trace elements and concepts involved. The seedings were both made with the aim of gaining insight on the declining yields of alfalfa.

The 1961 seeding contained treatment combinations of boron and molybdenum, alone and with lime or gypsum, lime and gypsum alone, copper and zinc in combinations with lime, gypsum, boron and molybdenum. One treatment with cobalt was included with gypsum, boron, molybdenum, copper and zinc.

Phosphate, and sulfur were included as a base treatment.

Stand counts during the spring of 1962 indicated no significant difference in stand due to treatment and no significant yield differences were obtained. During the spring of 1963, no further trace element applications were made but phosphate, potash and sulfur were added. There were no significant differences by treatment and the average yield of all treatments was 4.90 tons per acre for the season. (See Table No. 11.) This average yield was undoubtedly lowered by the fact the first cutting remained on the field ten to twelve days before it could be removed as a result of heavy rains, thus lowering the second cutting yields. The average yield of all treatments in 1962 was 6.3 tons per acre. It is planned to continue this experiment, not on the basis of trace elements, but rather to determine whether the yields and stand can be maintained by adequate fertilizer applications of potash, phosphate and sulfur. Potash is not generally applied to alfalfa stands in this area. Appendix Table Nos. 11, 12 show yields by replicate for each cutting.

The 1962 seeding received a base treatment of phosphate, potash and sulfur. A good stand was obtained and the tendency for the seedling plants to die was not observed as in the previous year. Gypsum and lime were omitted from this experiment and manganese was added as a trace element. The treatments were boron, copper, zinc, molybdenum, manganese and cobalt, alone and as a complete treatment containing each of the six trace elements. Also the complete treatment minus each of the six trace elements was included. Two deep placement of phosphate were included, one with and one without trace elements.

The trace elements were soil applied in 1962 and were applied at the following rates per acre:

Boron-----1 pound of B as Solubor  
 Copper-----8 pounds of Cu as Copper Sulfate  
 Zinc-----8 pounds of Zn as Zinc Sulfate  
 Manganese---8 pounds of Mn as Manganese Sulfate  
 Molybdenum--4 ounces of Molygrow  
 Cobalt-----8 ounces of Cobalt Nitrate

In 1963 the following foliar applications were made in pounds per acre:

Boron-----1 pound of B as Solubor  
 Copper-----.82 pounds Sequestrene Na<sub>2</sub>Cu, Copper Chelate  
 Zinc-----4 pounds Sequestrene Na<sub>2</sub>Zn, Zinc Chelate  
 Manganese---4 pounds Sequestrene Na<sub>2</sub>Mn, Manganese Chelate  
 Cobalt----- $\frac{1}{2}$  pound of Cobalt Nitrate  
 Molybdenum-- $\frac{1}{2}$  pound of Ammonium Molybdate

The average yield by cutting and season's total yield are shown in Table No. 12. There were no significant differences from treatment. The second cutting was severely reduced in yield by the first crop laying on the field too long. Also, by error, one irrigation was delayed and the crop further set back.

The base treatment of phosphate and potash was omitted from the area adjacent to the plots and during the growth of the second crop this deficiency was quite marked and distinct. The growth was a lighter green and markedly reduced in height. Since the soil test showed a relatively high level of phosphate it is possible that the reduction in growth was due to potash.

The yields by replicate for each cutting may be found in Appendix Table Nos. 13 and 14.

Table No. 11

The Effect of Gypsum and Lime Alone and in Combination with Trace Element Treatment Combinations on the Yield of Alfalfa Hay (1961 Seeding)

N. L. Weigand Farm - Powell Butte, Oregon - 1963

| Fertilizer Treatment | Alfalfa Hay Yield - Tons Per Acre |        |                  |
|----------------------|-----------------------------------|--------|------------------|
|                      | Cutting                           |        | Seasons<br>Total |
|                      | First                             | Second |                  |
| PKS                  | 2.88                              | 1.98   | 4.85             |
| G                    | 2.65                              | 1.80   | 4.45             |
| G, B                 | 3.19                              | 1.89   | 5.09             |
| G, Mo                | 2.93                              | 1.92   | 4.85             |
| G, B, Mo             | 2.97                              | 1.85   | 4.82             |
| L                    | 2.11                              | 1.85   | 4.96             |
| L, B                 | 2.83                              | 1.99   | 4.82             |
| L, Mo                | 2.70                              | 1.86   | 4.56             |
| L, B, Mo             | 2.93                              | 1.74   | 4.67             |
| G, B, Mo, Cw         | 2.72                              | 1.89   | 4.61             |
| G, B, Mo, Zn         | 3.12                              | 1.73   | 4.84             |
| G, B, Mo, Cw, Zn     | 2.96                              | 2.05   | 5.01             |
| L, B, Mo, Cw         | 3.07                              | 1.97   | 5.04             |
| L, B, Mo, Zn         | 3.24                              | 1.73   | 4.97             |
| L, B, Mo, Cw, Zn     | 2.92                              | 1.77   | 4.69             |
| B                    | 3.05                              | 1.90   | 4.95             |
| Mo                   | 3.34                              | 2.09   | 5.43             |
| B, Mo                | 3.05                              | 1.66   | 4.72             |
| G, B, Mo, Cw, Zn, Co | 2.97                              | 2.08   | 5.05             |
| G, B, Mo, Cw, Zn     | 3.41                              | 2.06   | 5.47             |

Table No. 12

The Effect of Several Trace Element Treatment Combinations  
on the Yield of Alfalfa Hay - 1962 Seeding  
N. L. Weigand Farm, Powell Butte, Oregon - 1963

| Fertilizer Treatment                 | Hay Yield - Tons Per Acre |        |                  |
|--------------------------------------|---------------------------|--------|------------------|
|                                      | Cutting                   |        | Seasons<br>Total |
|                                      | First                     | Second |                  |
| PKS (2)                              | 2.73                      | 1.33   | 4.06             |
| + Boron                              | 3.01                      | 1.15   | 4.16             |
| + Copper                             | 2.77                      | 1.31   | 4.08             |
| + Zinc                               | 2.64                      | 1.26   | 3.90             |
| + Molybdenum                         | 2.78                      | 1.25   | 4.03             |
| + Manganese                          | 2.41                      | 1.26   | 3.66             |
| + Cobalt                             | 2.63                      | 1.49   | 4.12             |
| + Complete (1)                       | 2.54                      | 1.02   | 3.56             |
| + Complete - Boron                   | 3.12                      | 1.20   | 4.32             |
| - Copper                             | 2.62                      | 1.00   | 3.62             |
| - Zinc                               | 3.16                      | 1.14   | 4.30             |
| - Molybdenum                         | 3.27                      | 1.27   | 4.54             |
| - Manganese                          | 2.39                      | 1.30   | 3.69             |
| - Cobalt                             | 2.67                      | 1.29   | 3.97             |
| KS + Deep Placement of Phosphate     | 2.62                      | 1.20   | 3.82             |
| KS + Deep Place. of Phos. + Complete | 2.57                      | .84    | 3.41             |
| Coefficient of Variation             | 14.4%                     | 37.3%  | 14.4%            |
| L.S.D. @ 5%                          | N S                       | N S    | N S              |

(1) Complete = Combination of six trace elements.

(2) Except where noted, each treatment received a similar base treatment of P, K, & S.

Appendix Table No. 11

The Effect of Gypsum and Lime Alone and in Combination with Trace Element Treatment Combinations on the Yield of Alfalfa Hay (1961 Seeding)  
 First Cutting  
 N. L. Weigand Farm - Powell Butte, Oregon - 1963

| Fertilizer Treatment | Alfalfa Hay Yields - Tons Per Acre |      |      |      |      |
|----------------------|------------------------------------|------|------|------|------|
|                      | Replicate                          |      |      |      | Ave. |
|                      | I                                  | II   | III  | IV   |      |
| PKS                  | 2.78                               | 2.77 | 3.18 | 2.78 | 2.88 |
| G                    | 2.37                               | 3.27 | 2.26 | 2.70 | 2.65 |
| G, B                 | 3.34                               | 3.19 | 2.89 | 3.36 | 3.19 |
| G, Mo                | 2.95                               | 2.87 | 2.68 | 3.23 | 2.93 |
| G, B, Mo             | 2.88                               | 2.96 | 2.98 | 3.04 | 2.97 |
| L                    | 3.31                               | 3.02 | 2.86 | 3.25 | 3.11 |
| L, B                 | 2.68                               | 3.03 | 2.74 | 2.89 | 2.83 |
| L, Mo                | 2.07                               | 3.43 | 2.01 | 3.30 | 2.70 |
| L, B, Mo             | 3.00                               | 3.03 | 2.71 | 2.98 | 2.93 |
| G, B, Mo, Cw         | 1.96                               | 2.65 | 3.05 | 3.21 | 2.72 |
| G, B, Mo, Zn         | 2.42                               | 3.59 | 3.33 | 3.15 | 3.12 |
| G, B, Mo, Cw, Zn     | 2.84                               | 3.18 | 3.22 | 2.58 | 2.96 |
| L, B, Mo, Cw         | 2.85                               | 3.24 | 3.32 | 2.89 | 3.07 |
| L, B, Mo, Zn         | 3.71                               | 3.03 | 3.21 | 3.01 | 3.24 |
| L, B, Mo, Cw, Zn     | 2.49                               | 2.62 | 3.41 | 3.17 | 2.92 |
| B                    | 3.30                               | 3.36 | 2.93 | 2.64 | 3.05 |
| Mo                   | 3.31                               | 2.56 | 3.52 | 2.97 | 3.34 |
| B, Mo                | 2.97                               | 2.88 | 2.99 | 3.37 | 3.05 |
| G, B, Mo, Cw, Zn, Co | 3.08                               | 3.15 | 2.54 | 3.10 | 2.97 |
| G, B, Mo, Cw, Zn     | 3.70                               | 3.58 | 3.34 | 3.03 | 3.41 |

Appendix Table No. 12

The Effect of Gypsum and Lime Alone and in Combination with Trace Element Treatment Combinations on the Yield of Alfalfa Hay (1961 Seeding)  
Second Cutting  
N. L. Weigand Farm - Powell Butte, Oregon - 1963

| Fertilizer Treatment | Alfalfa Hay Yields - Tons Per Acre |      |      |      |      |
|----------------------|------------------------------------|------|------|------|------|
|                      | Replicate                          |      |      |      | Ave. |
|                      | I                                  | II   | III  | IV   |      |
| PKS                  | 1.07                               | 1.89 | 2.65 | 2.31 | 1.98 |
| G                    | 1.24                               | 2.05 | 1.75 | 2.15 | 1.80 |
| G, B                 | 1.39                               | 2.06 | 1.61 | 2.50 | 1.89 |
| G, Mo                | 1.39                               | 2.45 | 1.72 | 2.13 | 1.92 |
| G, B, Mo             | 1.66                               | 1.59 | 1.74 | 2.43 | 1.85 |
| L                    | 1.71                               | 2.16 | 2.20 | 1.33 | 1.85 |
| L, B                 | 1.62                               | 2.12 | 2.13 | 2.08 | 1.99 |
| L, Mo                | 1.70                               | 1.96 | 1.70 | 2.08 | 1.86 |
| L, B, Mo             | 1.41                               | 1.75 | 1.77 | 2.03 | 1.74 |
| G, B, Mo, Cw         | .92                                | 1.85 | 1.94 | 2.86 | 1.89 |
| G, B, Mo, Zn         | 1.25                               | 1.92 | 1.61 | 2.12 | 1.73 |
| G, B, Mo, Cw, Zn     | 1.47                               | 2.17 | 2.05 | 2.52 | 2.05 |
| L, B, Mo, Cw         | 1.30                               | 2.27 | 1.97 | 2.32 | 1.97 |
| L, B, Mo, Zn         | 1.16                               | 1.47 | 2.15 | 2.17 | 1.73 |
| L, B, Mo, Cw, Zn     | 1.20                               | 2.25 | 1.69 | 1.92 | 1.77 |
| B                    | 1.36                               | 1.86 | 2.22 | 2.16 | 1.90 |
| Mo                   | 1.87                               | 1.79 | 1.63 | 3.06 | 2.09 |
| B, Mo                | 1.12                               | 1.14 | 2.18 | 2.22 | 1.66 |
| G, B, Mo, Cw, Zn, Co | 2.05                               | 1.86 | 1.82 | 2.60 | 2.08 |
| G, B, Mo, Cw, Zn     | 2.05                               | 2.05 | 1.83 | 2.31 | 2.06 |

Appendix Table No. 13

The Effect of Several Trace Element Treatment Combinations  
 on the Yield of Alfalfa Hay - 1962 Seeding  
 Yields are Shown for Replicates and Average in Tons Per Acre  
 First Cutting  
 N. L. Weigand Farm - Powell Butte, Oregon - 1963

| Fertilizer Treatment                 | Alfalfa Hay Yields-Tons Per Acre |       |       |       |      |
|--------------------------------------|----------------------------------|-------|-------|-------|------|
|                                      | Replicate                        |       |       |       | Ave. |
|                                      | I                                | II    | III   | IV    |      |
| PKS(2)                               | 2.60                             | 2.55  | 3.00  | 2.79* | 2.73 |
| + Boron                              | 2.96                             | 2.99  | 3.59  | 2.50  | 3.01 |
| + Copper                             | 2.63                             | 2.49  | 3.54  | 2.43  | 2.77 |
| + Zinc                               | 2.06                             | 2.87  | 3.23  | 2.40  | 2.64 |
| + Molybdenum                         | 2.90                             | 2.57  | 3.06* | 2.60  | 2.78 |
| + Manganese                          | 1.91                             | 2.43  | 2.59  | 2.70  | 2.41 |
| + Cobalt                             | 2.08                             | 3.30  | 2.83  | 2.32  | 2.63 |
| + Complete(1)                        | 2.02                             | 2.57  | 2.61  | 2.98  | 2.54 |
| + Complete - Boron                   | 2.51                             | 3.19  | 4.07  | 2.73  | 3.12 |
| - Copper                             | 3.30                             | 2.13  | 2.16  | 2.88  | 2.62 |
| - Zinc                               | 2.87                             | 2.76  | 4.16  | 2.83  | 3.16 |
| - Molybdenum                         | 3.07                             | 3.66  | 2.84  | 3.52  | 3.27 |
| - Manganese                          | 2.03                             | 2.49  | 2.19  | 2.86  | 2.39 |
| - Cobalt                             | 2.33*                            | 2.51  | 2.78  | 3.07  | 2.67 |
| KS + Deep Placement of Phosphate     | 2.38                             | 2.62* | 3.34  | 2.15  | 2.62 |
| KS + Deep Place. of Phos. + Complete | 1.82                             | 2.25  | 2.59  | 3.64  | 2.57 |
| L.S.D. @ 5%                          |                                  |       |       |       | N S  |

\*Corrected Yields

(1) Complete = Combination of six trace elements.

(2) Except where noted, each treatment received a similar base treatment of P, K, & S.

Appendix Table No. 14

The Effect of Several Trace Element Treatment Combinations  
on the Yield of Alfalfa Hay - 1962 Seeding  
Yields are Shown for Replicates and Average in Tons Per Acre  
Second Cutting  
N. L. Weigand Farm - Powell Butte, Oregon - 1963

| Fertilizer Treatment                 | Alfalfa Hay Yields-Tons Per Acre |      |      |      |      |
|--------------------------------------|----------------------------------|------|------|------|------|
|                                      | Replicate                        |      |      |      | Ave. |
|                                      | I                                | II   | III  | IV   |      |
| PKS (2)                              | 1.55                             | 1.41 | .91  | 1.45 | 1.33 |
| + Boron                              | 1.09                             | 1.10 | 1.18 | 1.24 | 1.25 |
| + Copper                             | 1.83                             | 1.21 | 1.38 | .82  | 1.31 |
| + Zinc                               | 1.57                             | 1.24 | 1.03 | 1.19 | 1.26 |
| + Molybdenum                         | 2.47                             | 1.41 | .63  | .49  | 1.25 |
| + Manganese                          | 1.38                             | 1.30 | .87  | 1.48 | 1.26 |
| + Cobalt                             | 1.55                             | .94  | 1.39 | 2.10 | 1.49 |
| + Complete (1)                       | .90                              | 1.05 | 1.26 | .86  | 1.02 |
| + Complete - Boron                   | 1.05                             | 1.25 | 1.20 | 1.29 | 1.20 |
| - Copper                             | 1.07                             | 1.05 | 1.29 | .60  | 1.00 |
| - Zinc                               | 1.35                             | 1.03 | 1.08 | 1.11 | 1.14 |
| - Molybdenum                         | 1.73                             | .99  | 1.31 | 1.05 | 1.27 |
| - Manganese                          | 1.01                             | 1.79 | 1.19 | 1.21 | 1.30 |
| - Cobalt                             | 2.56                             | 1.16 | .44  | 1.01 | 1.29 |
| KS + Deep Placement of Phosphate     | 1.41                             | 1.02 | 1.39 | .99  | 1.20 |
| KS + Deep Place. of Phos. + Complete | 1.12                             | .76  | 1.10 | .38  | .84  |
| L.S.D. @ 5%                          |                                  |      |      |      | N S  |

(1) Complete = Combination of six trace elements.

(2) Except where noted, each treatment received a similar base treatment of P, K, & S.