# DOES ALFALFA FOLLOWING ALFALFA AFFECT SEEDLING GROWTH?

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When yields of alfalfa decline as the stands become older the grower has the options of: 1) plowing the old stand and replanting alfalfa, 2) planting to an alternate crop and then seeding it to alfalfa, 3) attempt to increase the productivity of the existing stand by overseeding with alfalfa, or 4) retain the stand in its declining condition and suffer the losses. The practice of seeding alfalfa into depleted stands or into alfalfa sod usually has been unsuccessful. This may be due to a high level of pathogenic organisms in the soil, auto-toxicity or both and to competition when seeding into existing stands.

The reasons why one cannot successfully pursue these practices is not fully known and this is the topic of this report.

The detrimental effect of diseases when establishing alfalfa is widely recognized. In recent studies at Nevada, Thyr, Hartman and Hunt (1979-1981) show that damping off seriously reduced stand density of newly seeded alfalfa in a field which has been in alfalfa for seven preceeding years as well as in a field which had not been seeded to alfalfa for 11 years. Fumigation with methyl bromide and a soil drench with the systemic fungicide Ridomil increased stand establishment by 80 and 200% respectively over the control. First cut dry matter yields (tons/acre) averaged 0.63, 1.18 and 1.73 for the control, Ridomil and methyl bromide, respectively. The difference in yield between soil treatments diminished with time. These dramatic increases in stand density and yield have not always been repeated in subsequent trials, which indicate soil and other environmental factors affect the severity of disease damage when establishing alfalfa.

Another reason why alfalfa may not be successfully established in alfalfa sod or depleted stands may be auto-toxicity. Auto-toxicity is when a plant inhibits the growth of the same species. Neilsen et al (1960) studied the influence of extracts of some crops and soil residues on germination and growth of six species. Using sand cultures and standard germination techniques, they found alfalfa extracts significantly increased days to germination, reduced percent germination and root and shoot length of alfalfa more than from other plant extracts or deionized water. In contrast, Grant and Sallans (1964) who also studied the influence of plant extracts on germination and growth of four grasses and legumes found alfalfa tends to inhibit other species but is least inhibitory to itself.

Webster, Khan and Moore (1967) attributed poor growth of alfalfa on some Alberta soils to be related to some biological toxic agents. Yield reduction of alfalfa occurred when as much as six years elapsed between alfalfa stands, but alsike clover and red clover grew reasonably well in these soils.

Klein and Miller (1980) at Illinois found that after six years the yield of alfalfa after alfalfa was 1.90 tons/acre compared to 3.78 and 3.48 tons/acre when the crop rotation was corn-alfalfa and corn-soybeans-alfalfa, respectively. They state that their studies support the production of autophytotoxins by alfalfa.

## Experimental Procedure

At Reno, Nevada 'Moapa 69' and 'Lahontan' alfalfa were grown in six-inch pots in two soils in the greenhouse. One soil had alfalfa grown in it for two years (alfalfa soil) and the other was a fallow soil of the same origin which had not been planted to alfalfa or any other field crop. To each soil dried alfalfa foliage or roots were added at 0.5% by weight either before or after steam pasteurization or fumigation of the soil. The amount added was equal to the dry weight of roots per unit area that were present in the alfalfa soil. Both soils were either: 1) steam pasteurized (82C for 30 minutes) or fumigated with Dowfume MK-2[1] (Methyl bromide and chloropicrin)either before or after foliage

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or roots were added to the soil. Twenty seeds were planted in each pot and a complete fertilizer was applied to each pot weekly after planting so nutrients were not limiting. After eight weeks the number of plants, average root and shoot length and average volume per plant from each pot was determined. The experiment was set up in a randomized complete block design with four replications and was analyzed as a factorial.

## Results

There were significantly fewer plants established of both 'Lahontan' and 'Moapa 69' when grown in untreated soil when compared to those grown in soil which was either steam pasteurized or fumigated (Table 1). This was expected as there probably was a large number of pathogens in the untreated soil. The plants grown in the untreated soil were significantly smaller in most instances as determined by length of shoot and root (centimeters, cm) and volume (microliters, µl) of both shoot and roots when compared to those grown in pasteurized (steam) and fumigated soil (Tables 2,3).

When 'Lahontan' or 'Moapa 69' were grown in soil where alfalfa was the previous crop, they were significantly smaller than when grown in similar fallow soil, even though both soils were either steam pasteurized or fumigated (Tables 2,3). The exceptions were shoot and root length of 'Lahontan' grown in pasteurized soil and volume of 'Lahontan' and 'Moapa 69' grown in fumigated and pasteurized soils, respectively. We believe this reduction in growth of the alfalfa grown in soil in which alfalfa was the previous crop could be due to auto-toxicity, even though there may have been some pathogens remaining after steam pasteurization or fumigation. The number of plants established was not significantly affected by previous crop.

There was a significant reduction in the size of plants as measured by length of shoot and root due to addition of ground dry foliage or roots to both fallow or alfalfa soils which had been steam pasteurized or fumigated, except where foliage was added after fumigation in 'Moapa 69' (Table 2,3). In most cases, a significant reduction in volume occurred after either roots or foliage were added after fumigation or pasteurization. The addition of plant material to steam pasteurized or fumigated soil significantly reduced the percentage of 'Lahontan' plants established but not of 'Moapa 69' (Table 1).

The addition of either foliage or roots to fallow or alfalfa soil, which was then steam pasteurized or fumigated, had no significant affect on the average percent of plants established or size of the plants except when foliage was added prior to pasteurization. There was, however, a trend for plants grown in the alfalfa soil to be smaller than those grown in the fallow soil even though plant material was added to both soils before pasteurization or fumigation.

There is evidence that auto-toxicity was a factor in reduction of growth of seedling alfalfa grown in soils in which alfalfa had been the previous crop. Field studies are being initiated at four locations in Nevada to further investigate the role of both pathogens and auto-toxicity when establishing alfalfa in depleted stands or where alfalfa has been the previous crop. Greenhouse studies will also be conducted to further study auto-toxicity of alfalfa.

[1] Mention of a trade name or proprietary product does not constitute a guarantee or warranty of the product by the USDA or University of Nevada, Reno, nor does it imply its approval to the exclusion of other products that may also be suitable.

Table 1
Effect of Soil, Steam Pasteurization, Fumigation and Plant Additives on Percent Plants Established of Lahontan and Moapa 69

| | FALLOW SOIL | | ALFALFA SOIL | | |
|---|---|---|---|---|---|
| | Lahontan | Moapa 69 | Lahontan | Moapa 69 | Average |
| | % | % | % | % | % |
| Untreated | 15 | 44 | 35 | 39 | 33 |
| Steam | 60 | 68 | 49 | 66 | 60 |
| Steam then foliage | 38 | 69 | 28 | 56 | 47 |
| Steam then roots | 39 | 57 | 29 | 56 | 45 |
| Foliage then steam | 50 | 65 | 61 | 70 | 61 |
| Roots then steam | 58 | 70 | 60 | 75 | 65 |
| Fumigation | 65 | 81 | 66 | 70 | 70 |
| Fumigation then foliage | 26 | 74 | 35 | 76 | 52 |
| Fumigation then roots | 48 | 68 | 48 | 70 | 58 |
| Foliage then fumigation | 50 | 70 | 54 | 60 | 58 |
| Roots then fumigation | 60 | 82 | 45 | 72 | 64 |

L.S.D. (.05)=12

Table 2
Effect of Soil, Steam Pasteurization, Fumigation and Plant Additives on Root and Shoot Length of Lahontan and Moapa 69

| | FALLOW SOIL | | ALFALFA SOIL | | |
|---|---|---|---|---|---|
| | Lahontan | Moapa 69 | Lahontan | Moapa 69 | Average |
| | cm | cm | cm | cm | cm |
| Untreated | 30 | 34 | 23 | 26 | 28 |
| Steam | 31 | 36 | 31 | 31 | 32 |
| Steam then foliage | 24 | 32 | 20 | 23 | 25 |
| Steam then roots | 19 | 25 | 19 | 24 | 21 |
| Foliage then steam | 26 | 30 | 26 | 28 | 28 |
| Roots then steam | 31 | 33 | 28 | 31 | 31 |
| Fumigation | 34 | 38 | 29 | 29 | 32 |
| Fumigation then foliage | 22 | 29 | 24 | 26 | 25 |
| Fumigation then roots | 28 | 33 | 28 | 29 | 30 |
| Foliage then fumigation | 29 | 34 | 26 | 28 | 30 |
| Roots then fumigation | 29 | 35 | 29 | 30 | 30 |

L.S.D. (.05)=3

Table 3
Effect of Soil, Steam Pasteurization, Fumigation and Plant Additives on Root and Shoot Volume per Plant of Lahontan and Moapa 69

| | FALLOW SOIL | | ALFALFA SOIL | | |
|---|---|---|---|---|---|
| | Lahontan | Moapa 69 | Lahontan | Moapa 69 | Average |
| | µl | µl | µl | µl | µl |
| Untreated | 625 | 670 | 340 | 355 | 500 |
| Steam | 725 | 805 | 490 | 905 | 730 |
| Steam then foliage | 400 | 505 | 370 | 450 | 430 |
| Steam then roots | 185 | 530 | 220 | 525 | 365 |
| Foliage then steam | 475 | 870 | 550 | 770 | 670 |
| Roots then steam | 515 | 920 | 435 | 730 | 650 |
| Fumigation | 720 | 1110 | 530 | 875 | 810 |
| Fumigation then foliage | 290 | 590 | 380 | 555 | 450 |
| Fumigation then roots | 265 | 980 | 340 | 605 | 550 |
| Roliage then fumigation | 610 | 1070 | 440 | 740 | 715 |
| Roots then fumigation | 620 | 930 | 580 | 720 | 715 |

L.S.D. (.05)=215

## Summary

In a greenhouse study 'Lahontan' and 'Moapa 69' alfalfa were grown in soil in which alfalfa had been grown the two previous years and in a fallow soil of the same origin. Dried alfalfa shoots or roots at 0.5% of the weight of the soil were added either before or after steam pasteurization or fumigation. Seedlings of both 'Lahontan' and 'Moapa 69' were smaller when grown in soil which alfalfa had been the previous crop when compared to those grown in fallow soil even though both soils were either steam pasteurized or fumigated. Addition of ground foliage or roots to both soils after steam pasteurization or fumigation also reduced the size of the plants when compared to soils where plant tissue was not added. Addition of foliage and roots prior to soil treatment had a lesser effect on growth. The smaller seedling size is attributed mainly to auto-toxicity of alfalfa even though some pathogens may have been present after steam pasteurization or fumigation or were introduced by the addition of plant material to the treated soil.

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