COVER CROPS AND THEIR EFFECTS ON DISEASE CONTROL AND YIELD

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Our investigations demonstrate the suppression of potato early dying (caused by V. dahliae) with a wide variety of green manure treatments. Among these, results with sudangrass have been outstanding. Following the use of sudan grass, both wilt and the colonization of potato roots by V. dahliae have been shown to be greatly reduced, and these observations, combined with a significant increase of saprophytic fungi, have led us to the hypothesis of biological control with treatments.

Cover crops may provide for a variety of benefits, including improvements to soil structure, the addition of organic matter, the addition of nutrients, and finally to the suppression of soilborne pathogens. For several years we have been investigating the relationships of cover crops to soilborne diseases of potato and the following represents an attempt to summarize a portion of our results.

Our initial studies were designed to "screen" the effects of green manures as they influence the diseases of potato. These investigations were made in the field and in each case these studies involved the planting of a crop for 1, 2, or 3 consecutive years within the same plot location. Depending on the year, green manures were incorporated into the soil either by discing or rotovating during early August, and the Russet Burbank potato was then planted into these same respective plot locations during the year following cover-crop incorporation.

With every experiment, green-manure treatments were shown to suppress Verticillium wilt (caused by V. dahliae). This occurred either by directly reducing populations of the pathogen or by limiting its ability to attack the host. Figure 1 illustrates an effect of several green manure treatments following two years of continuous cropping before planting with Russet Burbank. With green manure treatments of either sudangrass or corn, the colonization of V. dahliae on potato roots was found to be significantly reduced when compared with plots that had been allowed to remain fallow. Figure 2 shows the effect of treatments on the incidence of wilt and demonstrates a close relationship with the pathogn colonization of roots, while Figure 3 illustrates the beneficial effect of treatments on potato yield. With wilt reduction, yields were increased and with increases to total yield, there occurred increases of U.S. #1 potatoes - a relationship that was particularly evident with increases to tuber size (Fig. 5).

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Figures 6-12 summarize the effects of an additional study comparing the effects of sudangrass with two varieties of rape, Austrian winter peas, and with a treatment that was allowed to remain fallow. These green manure treatments had been continuously cropped for three consecutive years within the same plot sites before planting a crop of Russet Burbank potatoes. Figure 6 shows the effect of treatments on soilborne inoculum of V. dahliae, and following sudangrass, populations of V. dahliae in soil were significantly reduced. Similar relationships were also observed following observations of root-colonization (Fig 7). Treatments involving either sudangrass or rape showed significantly less root colonization by V. dahliae than treatments that had been allowed to remain either fallow or cropped with pea. Figure 8 illustrates wilt data from these plots - again showing a close relationship between root colonization and wilt incidence as was previously demonstrated in Figures 1 and 2. Figure 9 reveals the percentage of yield increase over the fallow treatment with wilt suppression, while figure 10 illustrates a substantial increase in tuber size of potatoes in plot areas that had been previously cropped with sudangrass.

Additional data, however, point to problems that may arise with cover crops. Figure 11 shows what can occur to early yield following the use of green manure treatments - tuberization may be inhibited and with this inhibition, yields may be actually reduced. Early in the growing season (24 July) all green manure treatments with the exception of Austrian winter pea were shown to significantly reduce potato yields. Similarly, the number of tubers/plant was also found to be significantly less than tubers grown in plots that had previously been fallow. As late as the 21st of August, yields of potato among the green-manure plots did not differ from the locations that had been fallow. Shortly following the 21st of August, however, wilt symptoms first became evident, and with the advent of wilt, the relationship of cover crops to yield started to change. At season-end, the final increases of yield were highly correlated with wilt severity. Without the problem of Verticillium it is questionable that the final benefits to yield would have occurred.

Another potential problem with green manure treatments may involve root lesion nematode populations. Figure 12 demonstrates this very clearly. All of the green manure treatments significantly increased Pratylenchus neglectus populations. This was particulary true for varieties of sudangrass and rape. The apparent lack of an adverse effect of this nematode on potato yield may have been due to the fact that aldicarb had been applied to each plot with the potato planter at time of planting.

Following the use of green manure treatments, a problem was also shown to occur with specific gravity. Specific gravities of the Russet Burbank potato were reduced when preceded by green manures of either of the two rape varieties (Dwarf Essex and Bridger).

Rhizoctonia (caused by Rhizoctonia solani Ag-3) - Evidence was provided that green manure treatments had an effect on the Rhizoctonia disease of potato. Green manure treatments involving the use of pea, sudangrass, and rape varieties (Dwarf Essex and Bridger) showed a significant reduction of cut-off on potato stems from the Rhizoctonia disease.

When indices of infection were calculated for each treatment, both the Bridger and Dwarf Essex (rape) green manures were shown to have significantly less Rhizoctonia on underground potato stems than other treatments. When the two rape varieties were compared, however, the Dwarf Essex variety had significantly less Rhizoctonia than the Bridger variety.

These differences carried through to the end of the season and when tubers were evaluated for scurf (caused by R. solani Ag-3), the tubers showing the least problem with scurf had originated from plots that had been preceded by green-manure treatments of rape, and tubers originating from Dwarf Essex plots were shown to have significantly less scurf than tubers originating from Bridger plots.

With a reduction of scurf, the appearance of tubers from rape plots was greatly improved.

In final summary, an understanding of cover crops may provide a powerful tool for improvements to both yield and quality. Cover crops will not create miracles, but they will and can solve problems when properly used.

Figure 1.

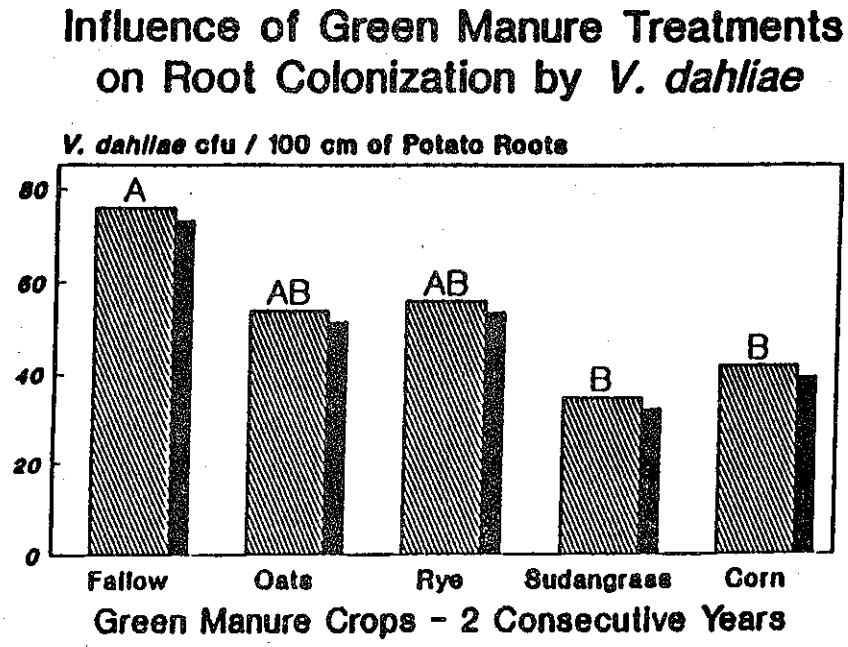
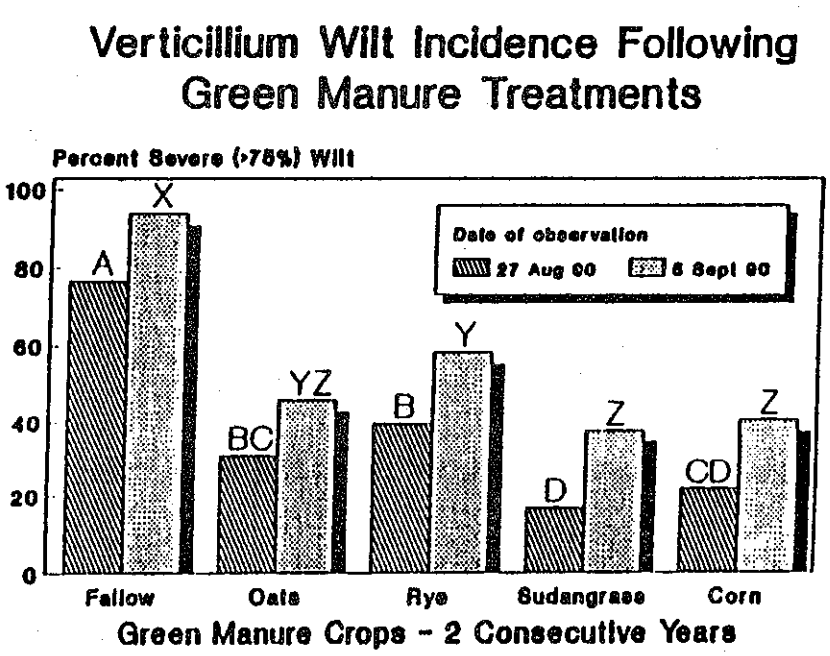


Figure 2.



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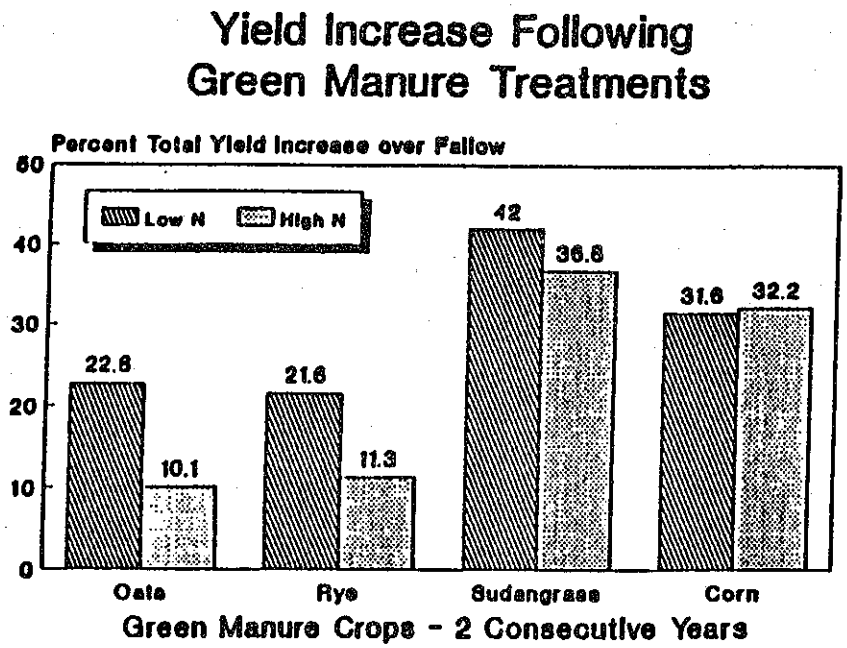

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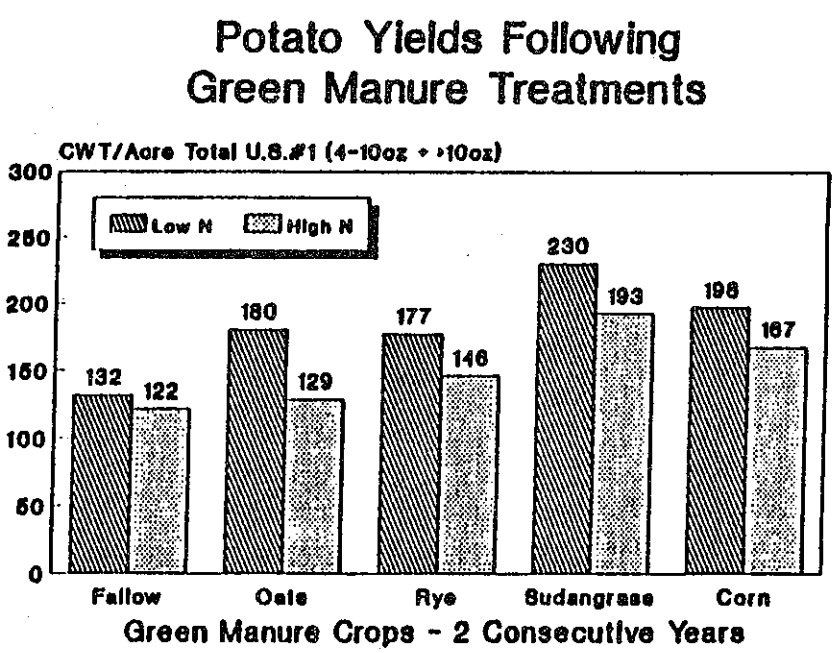

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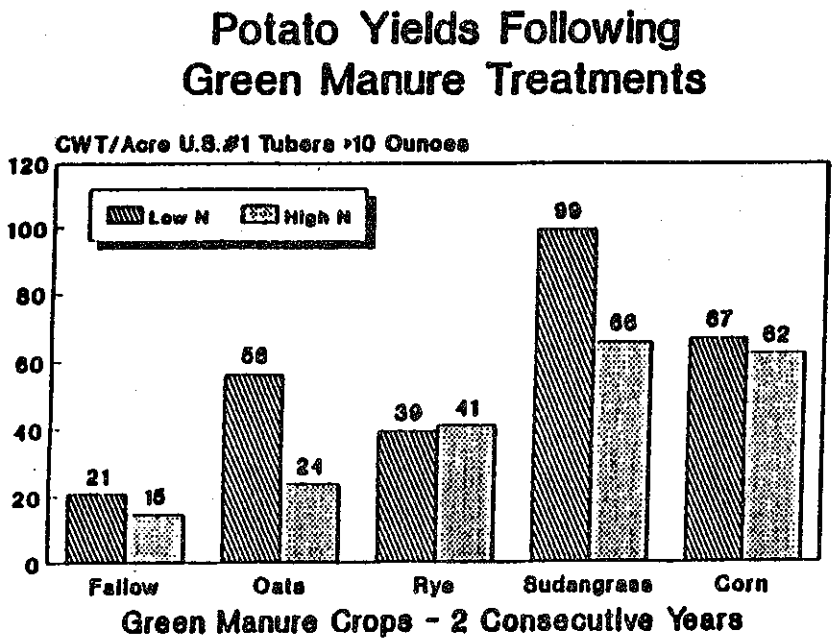

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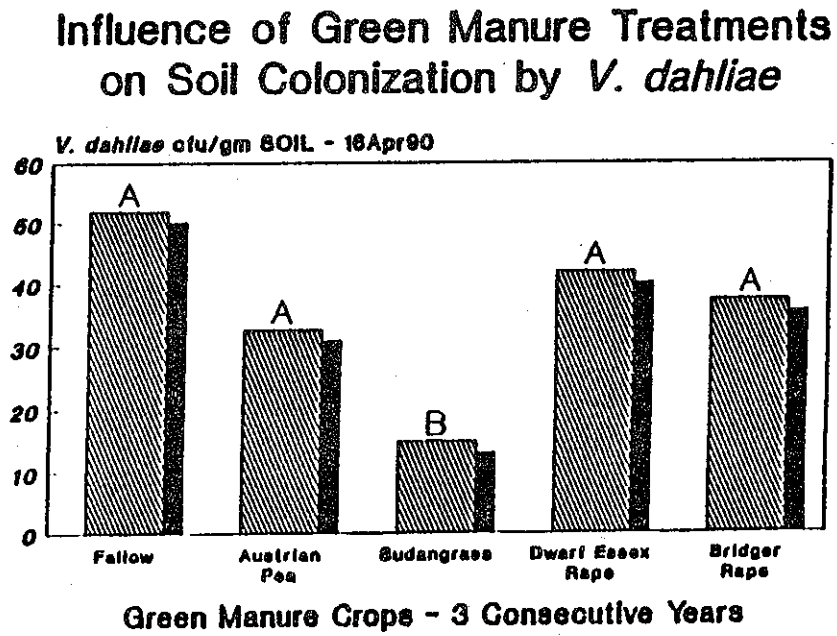

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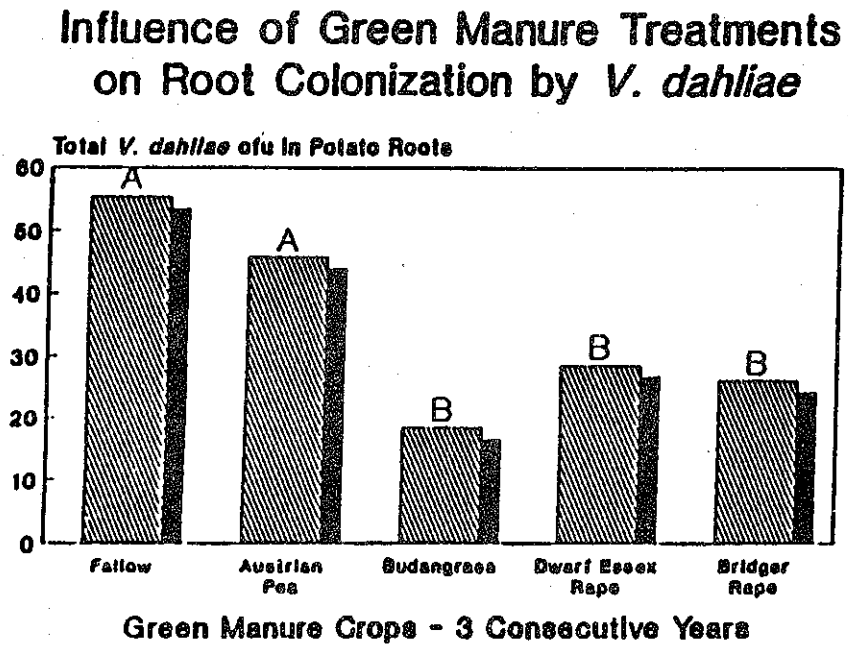

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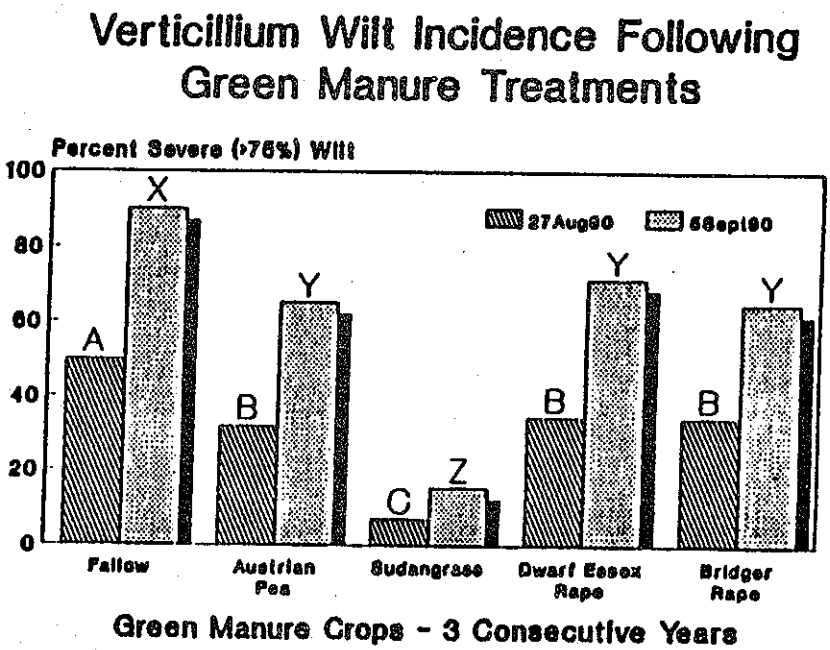

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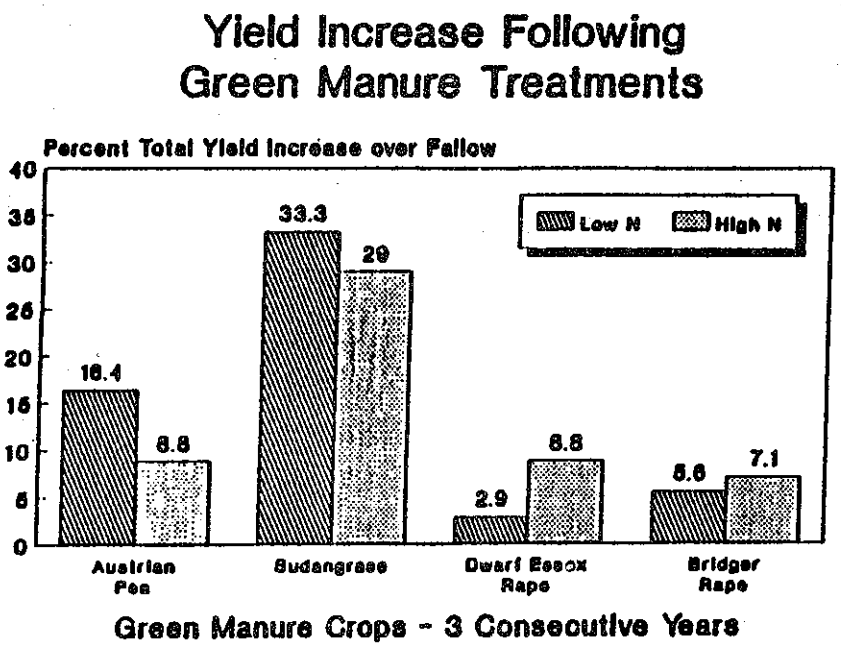

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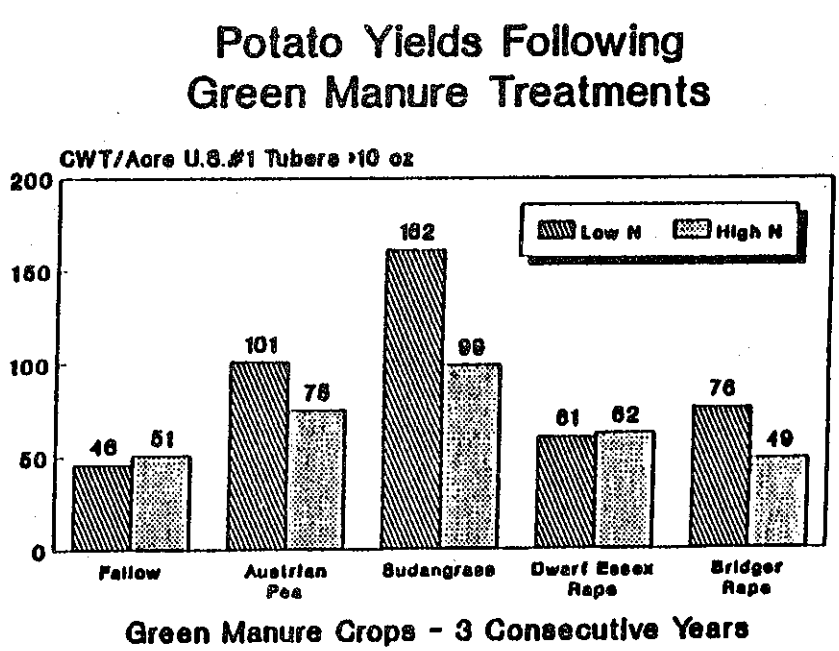

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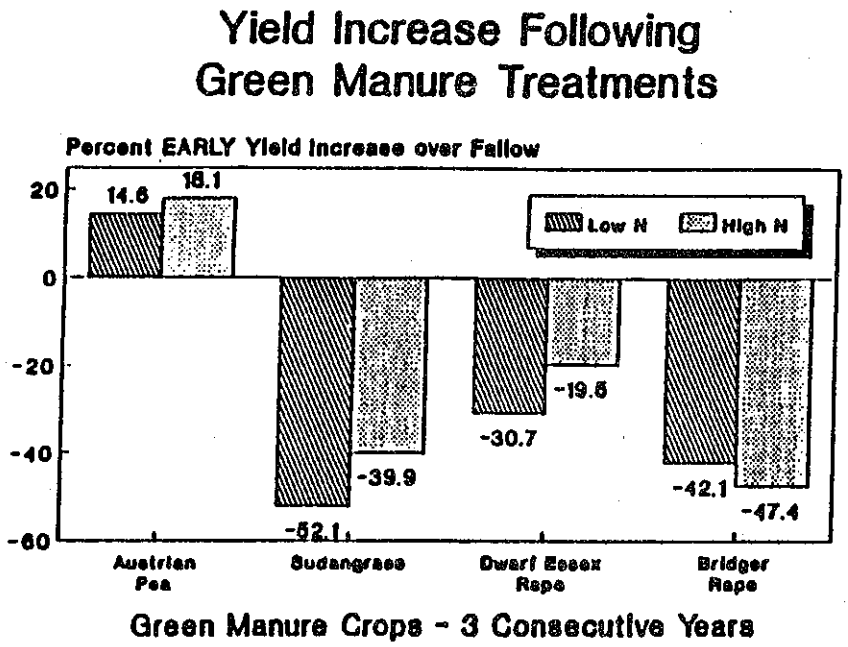

Figure 12.