2004 Report to the Oregon Processed Vegetable Commission
TITLE: Cultural management of corn root rot.
Report 1: Rotbusters varietal survey and grower cropping history survey
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SUMMARY:

1. Rotbusters field surveys:

- ✓ Screening fields for radicle rot severity is an easy and rapid method for evaluating root rot potential of sweet corn fields.
- ✓ Radicle rot severity was not significantly related to yield in Jubilee in 2003, although it was in 2002. When the 2002 and 2003 Jubilee data sets were combined, radicle rot severity was significantly related to yield. In contrast, radicle rot severity was not related to yield when the 2003 Jubilee-type fields were evaluated as a group.
- ✓ Coho and SSJ+ were the only varieties sampled in 2004. There were significant relationships between radicle rot severity and gross yield for both Coho and SSJ+.
- ✓ For Jubilee, approximately 3 tons of gross yield are lost in fields of very high root rot potential compared to those of very low root rot potential. Across all fields scouted, about 1.5 tons of gross yield in Coho, and about 1.5 - 2 tons in SSJ+, were lost when these varieties were planted into fields of high root rot potential relative to planting into fields of very low root rot potential. Neither variety appears to lose as much yield to root rot as Jubilee.
- ✓ Coho is much higher yielding than Jubilee and SSJ+, regardless of the root rot potential of the soil.

2. Relationship between cropping history, sweet corn root rot, and yield.

- ✓ An evaluation of root rot potential of fields of known cropping history at the OSU Vegetable Research Farm indicated that sweet corn root rot potential may be related to cropping history (years in corn production).
- ✓ There is a significant negative relationship between rotation length (years since last corn crop) and radicle rot severity.
- ✓ In fields planted to corn within the last 3 years, greater than 50% of fields exhibited radicle necrosis over 30%; in contrast, only 3 out of 24 fields (13%) planted to corn 4 or more years previously were of radicle necrosis values over 30%. These data suggest that a rotation of 4 years or more reduces root rot potential.
- ✓ There is no evidence that rotations including grass generally have higher root rot potential or lower yields than rotations that do not include grass. Rotation with perennial grasses permits longer rotations. In general, corn grown under longer rotations exhibits lower root rot severity and higher yields than corn grown under shorter rotations.

- ✓ There is some evidence that continuous (or nearly continuous) corn production may reduce root rot severity and increase yields relative to corn production in 2 or 3 year rotations, but this phenomenon must be investigated further.

METHODS:

1. Rotbusters field surveys:

Rotbusters 2003 sweet corn field survey:

Corn field locations, varieties, planting dates, and yields were obtained from field representatives from Norpac and National Frozen Foods. A total of 127 fields were evaluated for radicle rot severity and gross yields were collected for 103 of those fields. Varieties include Jubilee, SSJ+, HM 7384, GH 2684, FM 516, Prelude, HM 0395, and WS 3681. Fields were sampled when the corn reached the 6 leaf stage. A total of thirty corn plants were sampled randomly from each field (2 subsamples, 15 plants per subsample). Roots were removed from the field using a garden shovel. Soil was shaken from the root ball and the radicle of each plant was collected. Radicles from each field were bagged, refrigerated, and washed and rated within 48 hours. Each radicle was evaluated on a 0-4 scale, where 0 = 100% healthy, 1 = 1-10% necrotic, 2 = 11-50% necrotic, 3 = 51-99% necrotic, and 4 = 100% necrotic. A mean radicle rot rating was generated for each field. Gross yields for each field were obtained from Norpac and National Frozen Foods.

Rotbusters 2004 sweet corn field survey:

Corn field locations, varieties, planting dates, and yields were obtained from field representatives from Norpac, National Frozen Foods, Stahlbush Island Farms, and New Seasons. A total of 57 fields were evaluated for radicle rot severity and gross yields were collected for all of those fields. Only SSJ+ and HM 7384 (Coho) fields were sampled. Fields were sampled when the corn reached the 6 leaf stage. A total of thirty corn plants were sampled randomly from each field (2 subsamples, 15 plants per subsample). Roots were removed from the field using a garden shovel. Soil was shaken from the root ball and the radicle of each plant was collected. Radicles from each field were bagged, refrigerated, and washed and rated within 48 hours. Each radicle was evaluated on a 0-8 scale, where 0 = 100% healthy, 1 = 1-10% necrotic, 2 = 11-20%, 3 = 21-40%, 4 = 41-60%, 5 = 61-80%, 6 = 81-90%, 7 = 91-99%, and 8 = 100% necrotic. A mean radicle necrosis (percent necrosis) was generated for each field. Gross yields for each field were obtained from the processors.

2. Relationship between cropping history, sweet corn root rot, and yield.

Cropping history and root rot severity on OSU Vegetable Research Farm fields:

Cropping histories of OSU Vegetable Research Farm fields were obtained from Randy Hopson, farm manager. Four soils were selected for root rot evaluation: Field "8" - 16 years of continuous corn; Field "7" - 20 years of continuous beans, Field "14" – corn for 4 of the 7 previous years, and Field "4" – corn in 2001 and 2002 (the previous two seasons) but not in the 10 years previous to 2001. Soils were screened for sweet corn root rot potential through the use of a cone tube bioassay (20 tubes per field) planted to Jubilee and rated at the 6 leaf stage for radicle rot severity (0-4 scale).

Rotbusters 2004 cropping history grower survey:
We developed a grower survey in cooperation with the OSU Survey Center to obtain information from farmers about cropping history and irrigation and tillage practices for all fields scouted for root rot in 2002 and 2003. The survey was sent to farmers in late February 2004. Approximately 90 surveys (representing 90 fields) were returned.

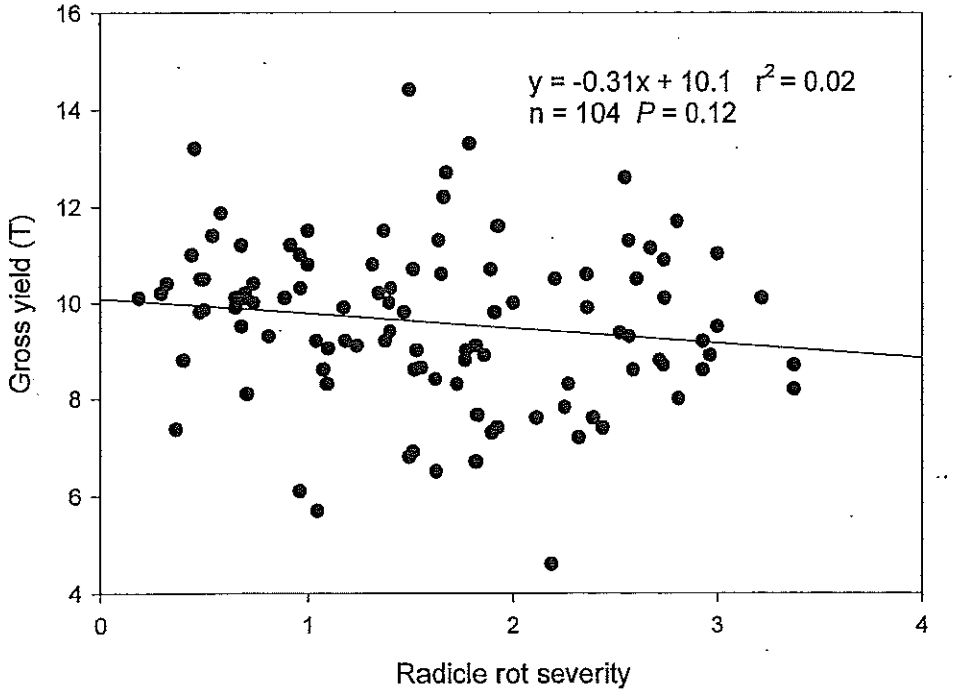
RESULTS:

1. Rotbusters field surveys:

Rotbusters 2003 sweet corn field survey:

Radicle rot severity could explain very little of yield variability across all varieties sampled in 2003 (Fig. 1).

Fig. 1. Rotbusters 2003: Radicle rot severity and gross yield - all varieties



The regression equations for the 2002 and 2003 Jubilee data sets were very similar (Fig. 2). The regression equations predict that, for Jubilee, approximately 3 tons of gross yield are lost in fields of very high root rot potential compared to those of very low root rot potential (Fig. 2).

Jubilee fields from 2002 and 2003 were compared to all Jubilee-type fields sampled in 2003 (Fig.3: Jubilee types - primarily HM 7384 (Coho), Prelude, FM 516, and HM 0395). There was a significant relationship between radicle rot severity and yield in Jubilee (2002 and 2003), and radicle rot severity explained 22% of the yield variability. In contrast, there was no relationship between radicle rot severity and yield in the Jubilee types when considered as a group (Fig. 3), suggesting that for Jubilee-type varieties, in general, no yield loss occurred in fields of high root rot potential.

Fig. 2 Jubilee: 2002 and 2003

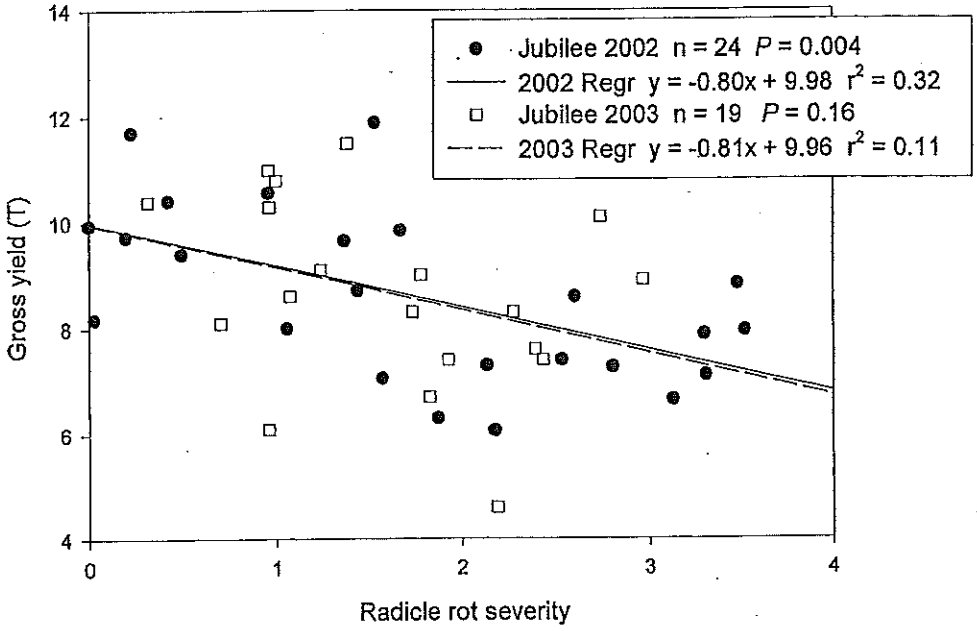
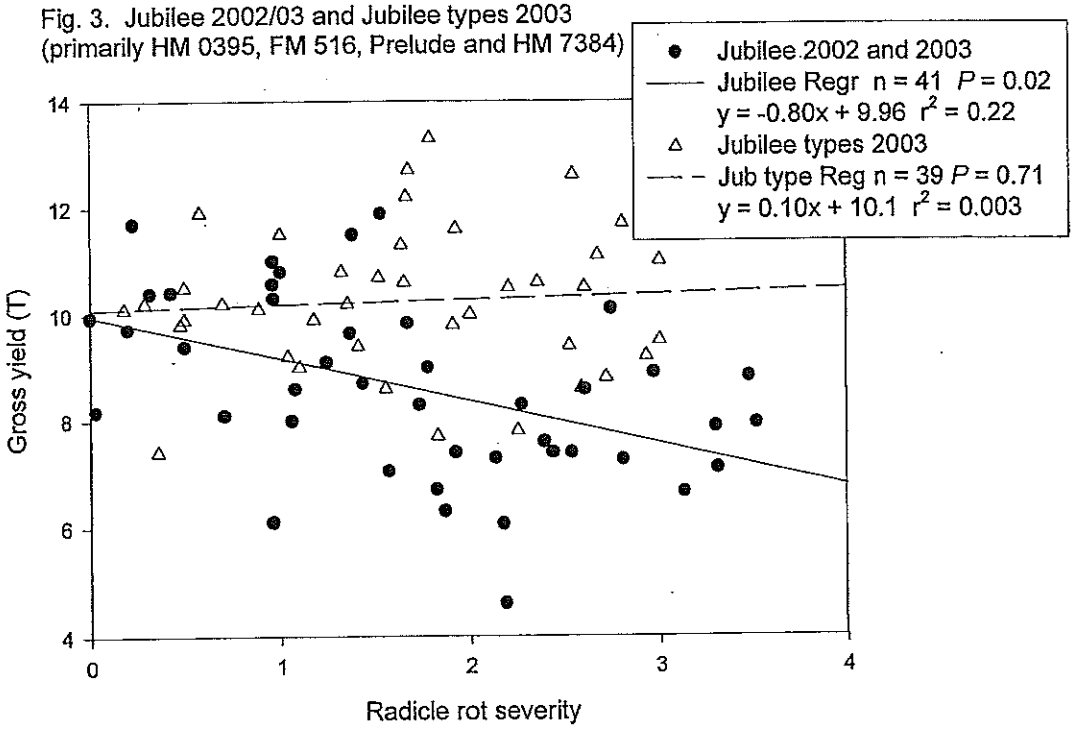


Fig. 3. Jubilee 2002/03 and Jubilee types 2003 (primarily HM 0395, FM 516, Prelude and HM 7384)



Rotbusters 2004 corn survey:
Coho (7384) and SSJ+ were the only varieties sampled in 2004 (Fig. 4). There were significant relationships between radicle rot severity and gross yield for both Coho (P=0.06) and SSJ+ (P=0.02). When data from 2003 and 2004 were combined, there was a significant relationship between radicle rot severity and yield for Coho but not for SSJ (Fig. 5). The 2004 regression equations predict that overall, approximately 1.5 tons of gross yield in Coho, and 1.5 - 2 tons in SSJ+, are lost when these varieties are planted into fields of high root rot potential relative to planting into fields of very low root rot potential (Fig. 4). These data suggest that neither Coho nor SSJ are strongly tolerant to root rot of sweet corn, as both likely lose some yield in fields of high root rot potential; however, neither variety appears to lose as much yield to root rot as Jubilee (Figs 2, 4 and 5). Coho is much higher yielding than Jubilee and SSJ+ (Figs. 2, 4 and 5) regardless of the root rot potential of the field in which it is planted.

Fig. 4. Coho and SSJ+: 2004

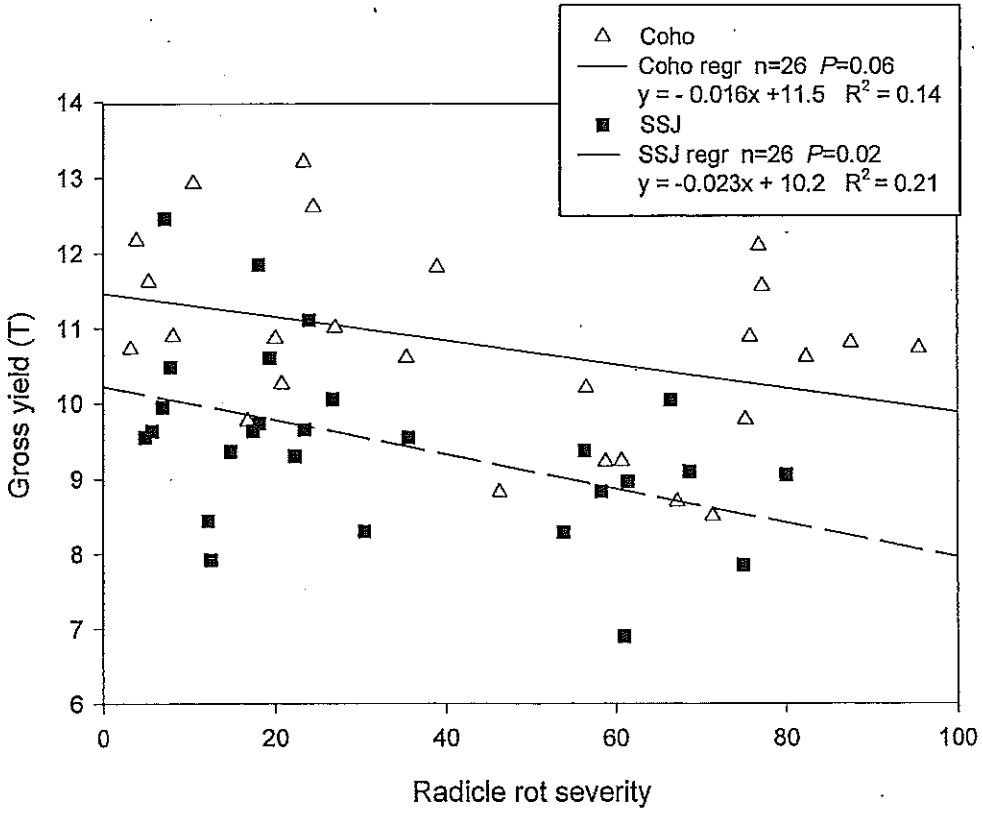
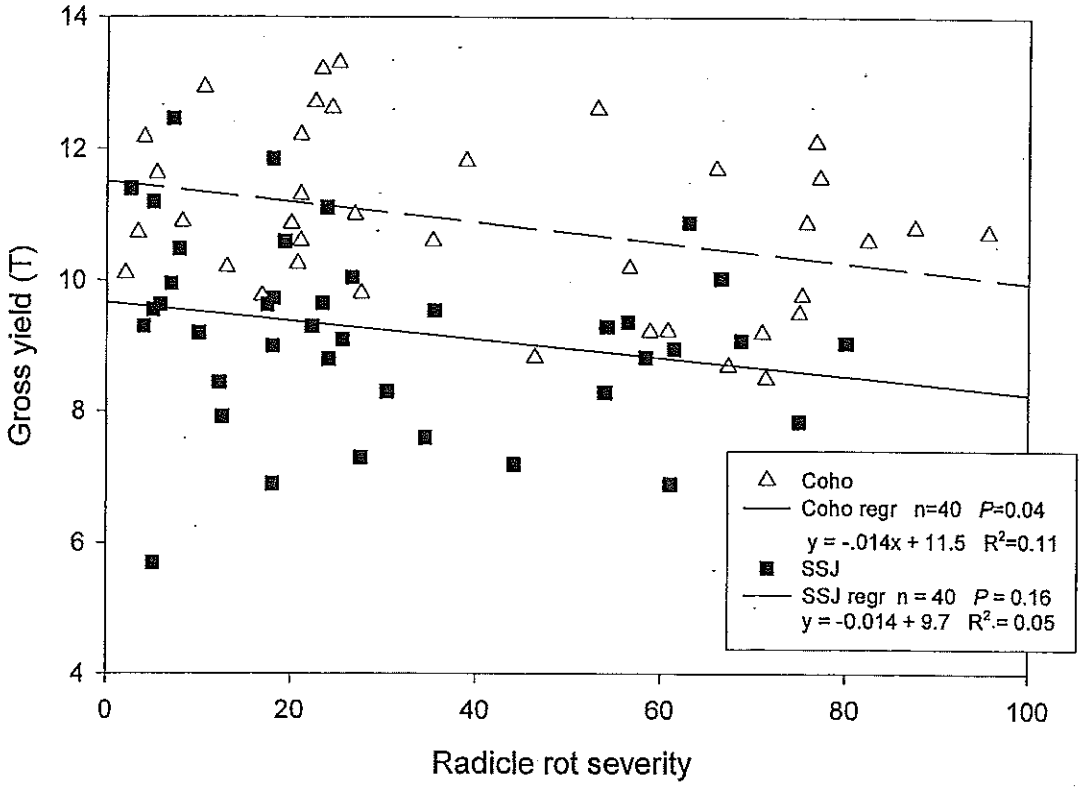


Fig. 5. Coho and SSJ+: 2003 and 2004



2. Relationship between cropping history, sweet corn root rot, and yield.
Cropping history and root rot severity on OSU Vegetable Research Farm fields:
Fields at the OSU Vegetable Farm of known corn cropping histories were evaluated for sweet corn root rot potential using a greenhouse bioassay (Table 1). Corn grown in soil from the continuous corn field exhibited the highest root rot severity, corn grown in the continuous bean field the lowest root rot severity, and corn grown in the fields of 2 or 4 years of corn in the previous 7 years exhibited intermediate levels of root rot severity (Table 1).

Table 1. Cropping history and radicle rot severity: OSU Research Farm

Field #	History of corn production	Radicle rot severity (0-4 scale)
4	Corn in 2001 and 2002 but none previously	2.37
7	None: 16 years continuous beans	1.05
8	20 years continuous corn	3.40
14	Corn for 4 of past 7 years	2.84

Rotbusters 2004 cropping history grower survey:
There is a significant negative relationship between rotation length (years since last corn crop) and radicle rot severity (Fig. 6). For fields in which corn was planted in the

sampling year and the year previously (two years of corn in a row), radicle necrosis ranged from close to zero to over 90% (Fig. 6). However, in fields in which corn had not been planted in 8 years or more, radicle necrosis did not exceed 20% (Fig. 6). In fields planted to corn within the last 3 years, greater than 50% of fields exhibited radicle necrosis over 30%; in contrast, only 3 out of 24 fields (13%) planted to corn 4 or more years previously were of radicle necrosis values over 30% (Fig. 6). These data suggest that a rotation of 4 years or more reduces root rot potential. In fields in which corn was planted in the sampling year and the year previously (two years of corn in a row), radicle necrosis ranged from close to zero to over 90% (Fig. 6). What is the reason for this large range in root rot potential? Again, rotation appears to be a strong determinant of root rot potential for these fields, as much of the variability in these fields is explained by the number of years the field was planted to corn over a 10 year period (Fig. 7).

There has been some speculation that the grass rotation increases root rot potential. However, there is no evidence that rotations including grass have higher root rot potential or lower yields than rotations that do not include grass. Rotation with perennial grasses permits longer rotations (Fig. 6). In general, corn grown under longer rotations exhibits lower root rot potential (Fig. 6) and higher yields (Fig. 8) than corn grown under shorter rotations.

Fig. 6. Years since previous corn crop and radicle rot severity: rotations with and without grass

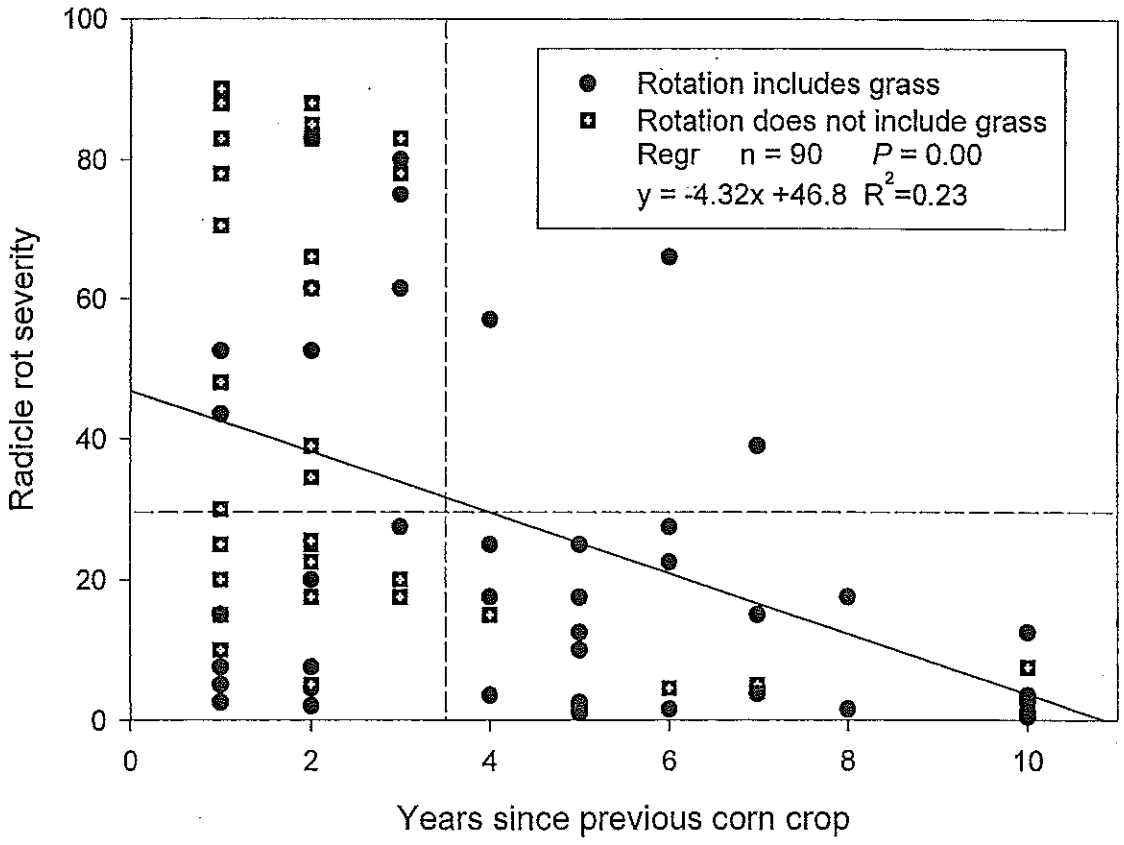


Fig. 7. For fields in corn the previous year: rotation intensity and radicle rot severity

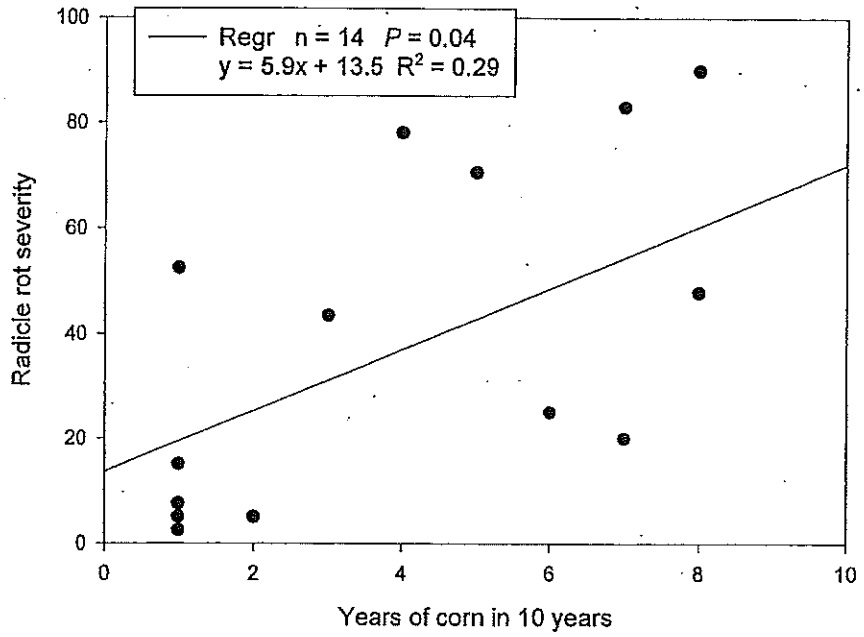


Fig. 8. Years since previous corn crop and gross yield

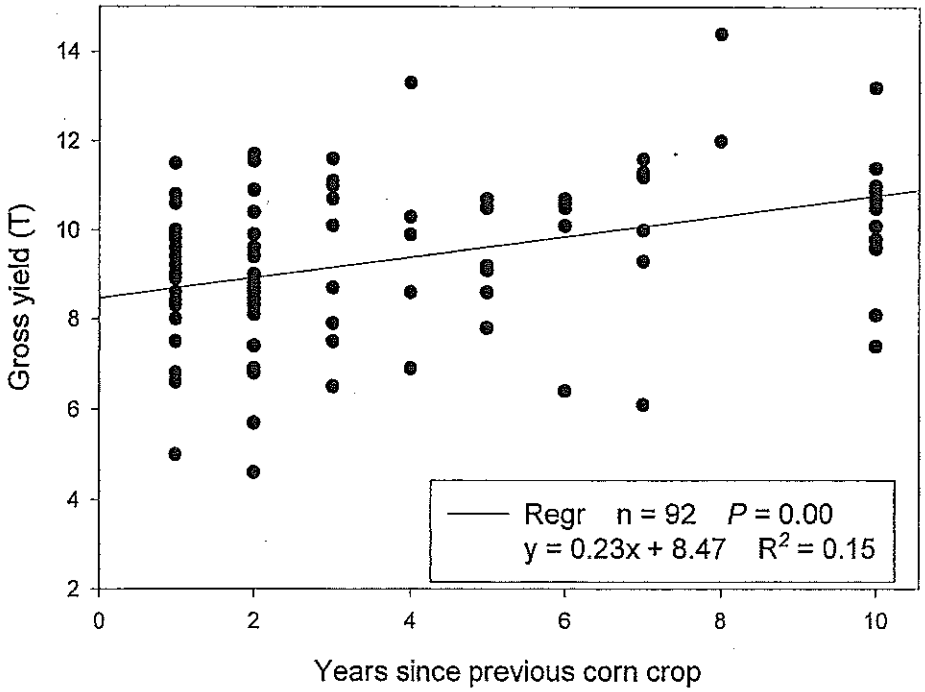
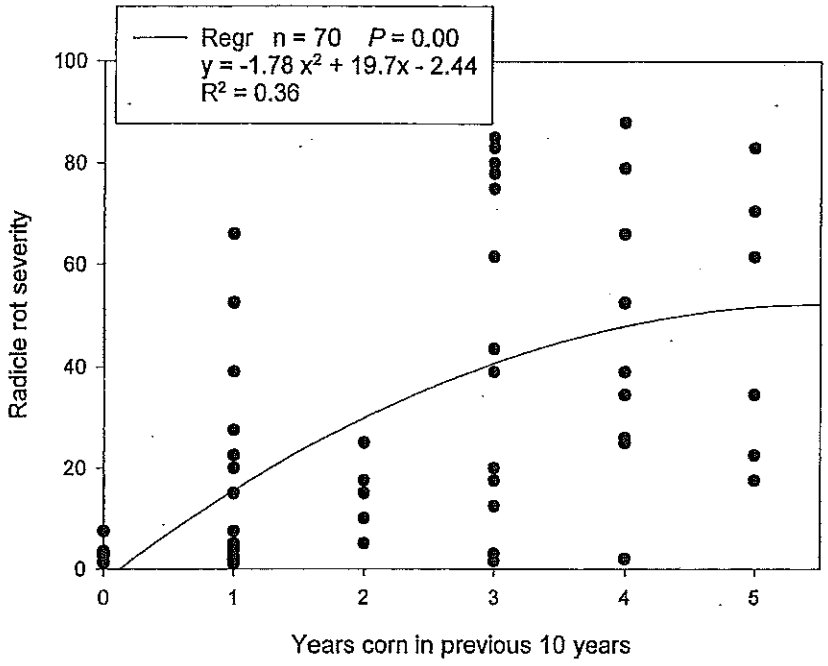


Fig. 9a. Years corn (<6) in previous 10 years and radicle rot severity



There is a significant positive relationship between the number of years a field has been in corn over a 10 year period (if less than 6 in 10 years) and radicle rot severity (Fig. 9a). However, root rot severity does not increase linearly as rotation intensity increases; as intensity increases from 3 yrs of corn in 10 years to 5 or 6 yrs of corn in 10 years, average radicle rot severity levels off (Fig. 9a).

Furthermore, as rotation intensity increases from 6 in 10 years to 10 in 10 years (continuous corn), average radicle rot severity decreases; however, in several fields it remains very high (Fig. 9b). It is possible, as has been shown in other cropping systems like wheat, that continuous single species cropping can generate disease suppression, or "monoculture decline". However, it is unclear from this data set whether this phenomenon is at work. There are two few data points and, in addition, these fields represent even fewer farms, so it is difficult to determine the relative influences of management and cropping history. The impact of rotation intensification on gross yield is represented in Fig. 9c, with trends complementary to those in Fig. 9b. Gross yields significantly decline as rotation intensity increases from 0 – 5 yrs corn in 10 years (Fig. 9c). Yields then increase as rotation intensity increases from 5 years corn in 10 years to continuous corn (Fig. 9c.). However, as noted previously, trends in disease severity and yields for intensive rotations require further investigation, as there are few fields and they represent even fewer farms/farm management systems.

Fig. 9b. Years corn in previous 10 years and radicle rot severity

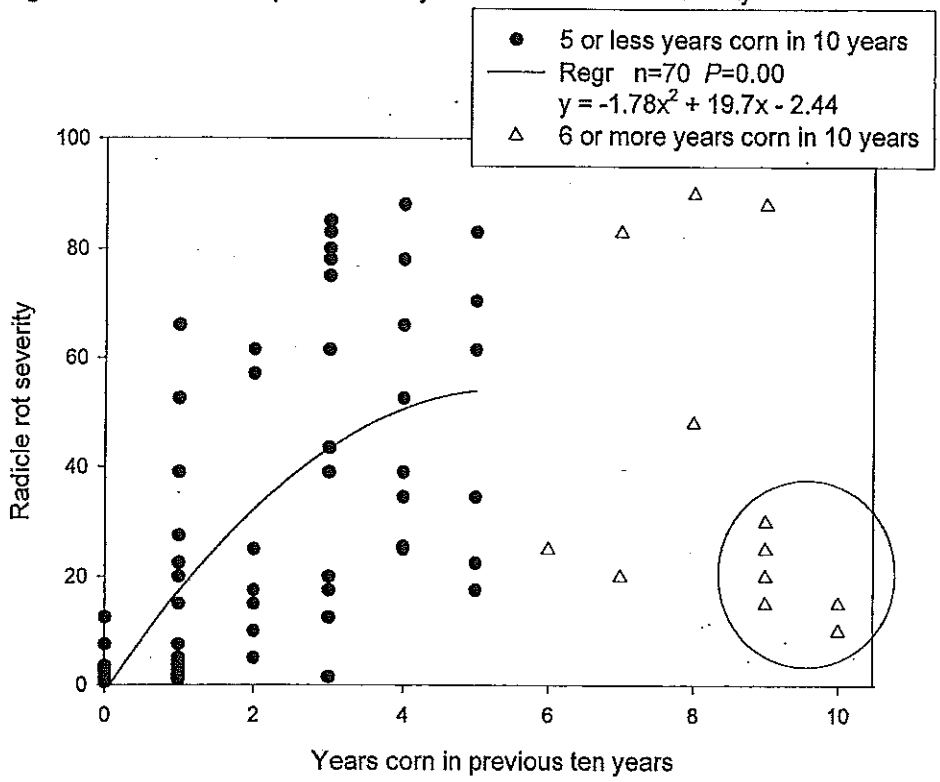


Fig. 9c. Years corn in previous 10 years and gross yield