Ensiling of Potato Vines

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Introduction

Potato vines are currently killed with herbicides before potatoes are harvested. However, the vines could be used as cattle feed if they could be properly stored. Furthermore, the harvesting of the vines would not only reduce herbicide use but also minimize the carryover of potato diseases and vectors in the field to the next potato crop. The most likely means of storing the vines is ensiling. The vines have a high moisture content, and the hills or ridges in the field on which potatoes are grown would make harvesting wilted vines difficult. The purpose of the current work was to find the best methods to preserve the potato vines by ensiling.

Methods

Experiment 1. Vines of 4 potato varieties were harvested with a flail forage harvester set at three different heights to obtain high, medium and low soil contamination levels. The chopped vines were ensiled in pint (~ 0.5 l) canning jars, alone or in combination with chopped alfalfa hay or barley grain at a ratio of 3 vines:1 amendment (w/w). Four replicates per treatment were ensiled. The silages were stored at room temperature for three months and then subjected to an aerobic stability test.

Experiment 2. A single variety (Russet Norkotah) of vines was hand harvested. Half of the vines were chopped fresh with a stationary chopper and ensiled in pint canning jars alone or in various combinations with chopped whole-plant corn (0:1, 1:1, 1:2 and 1:4 vines to corn, w/w). The other half of the vines were wilted in a greenhouse for 24 h and ensiled alone, inoculated with 10^5 lactic acid bacteria/g crop, and in mixtures with whole-plant corn at ratios of 0:1, 3:1, 1:1, 1:3 vines to corn. Three silos per treatment were opened after 1, 2, 6, 14 and 90 d of ensiling and analyzed. The 90 d silages were tested for aerobic stability.

Results and Discussion

Experiment 1. Analysis of the fresh vines (low soil) is given in Table 1. The pH values of the final silages were 5.6-6.2, 4.5-5.2 and 3.8-4.0 for vines alone and amended with hay and barley, respectively. The major microbial populations in the final silages were lactic acid bacteria, bacilli and acetic acid bacteria (10^8, 10^5 and 10^4-10^7 per gram, respectively). Yeast and mold populations were generally below detectable level. Soil level had no discernible effects on fermentation despite increasing ash contents to approximately 50% dry matter (DM) in the high soil contamination treatments. The silages with hay and barley had DM contents of 29.3 ± 0.7% and 28.8 ± 1.3%, respectively, and had pleasant aromas. In contrast, many of the vine-alone silages were noticeably clostridial. Over five days of aerobic exposure, the silages comprising vines only were the least stable with most replicates heating within that period. Several barley-amended replicates heated whereas the alfalfa hay-amended treatments were stable.

Experiment 2. Wilting the potato vines for 24 h in a greenhouse under good drying conditions increased DM contents only from 11.7% to 16.1%. Figures 1and 2 shows the changes in pH throughout the ensiling period. Silage pH increased after 1 to 2 weeks of fermentation in all of the vine-only treatments. In the unwilted vines, this was caused by clostridial fermentation. In the wilted vines, alone or inoculated, pH increased because of the fermentation of lactic acid to acetic acid, most likely by lactic acid bacteria. The mixtures of vines and corn resulted in high quality silages with pHs less than 4.5 except for the 3:1 mixture of wilted vines to corn. The silages comprising only vines or corn were the least stable upon aerobic exposure whereas none of the mixed silages heated over five days of aerobic exposure.

Conclusions

Potato vines have a potential to be used as feed because the high crude protein contents and low NDFs compensate for high ash contents. However, the harvested vines alone were consistently too low in DM and sugar contents to achieve a sufficiently low pH to prevent secondary fermentation. Also, silage effluent would be a significant concern in such unamended silages. Wilting the vines for 24 h under good drying conditions in a greenhouse made only modest increases in DM content and still did not permit adequate preservation.

High quality silages of potato vines were obtained only in mixtures with drier crops, which also dilute ash levels. All three amendments (alfalfa hay, barley grain and whole-plant corn) produced good silages. Of the three amendments, barley grain produced the lowest pH, but these silages were the least aerobically stable of the amended silages. The best option would be to co-ensile the potato vines along with a crop which is harvested at the same time, such as early maturing corn varieties. This would minimize the labor for harvesting and storage. Mixing with corn would also have two advantages: increasing the low crude protein content of the corn silage and improving its aerobic stability.

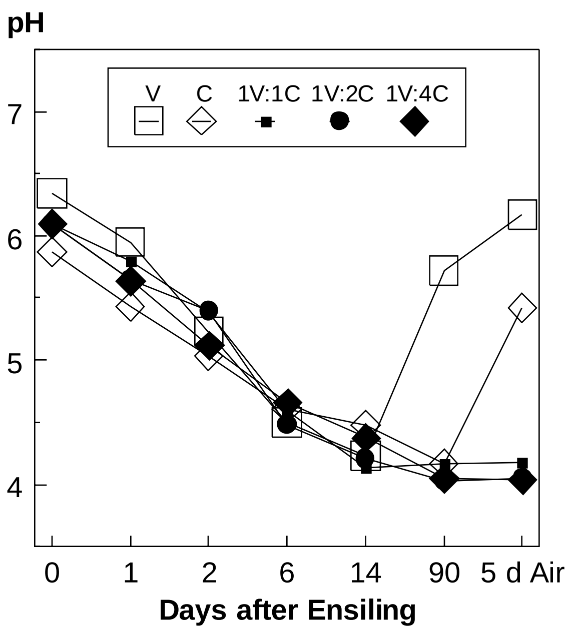

Figure 1. Changes in pH of fresh potato vine silages, alone or amended with whole-plant corn, during ensiling and after 5 d of aerobic exposure. V - vines, C - corn.

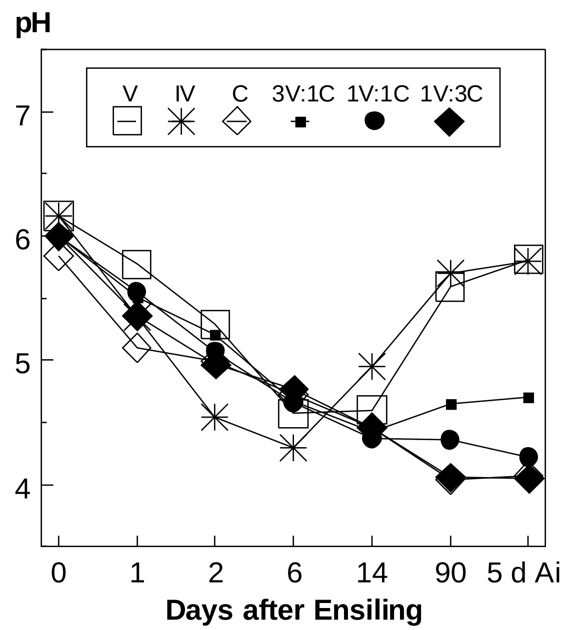

Figure 2. Changes in pH of wilted potato vine silages, alone or amended with whole-plant corn, during ensiling and after 5 d of aerobic exposure. V - vines, C - corn, I - inoculated.

Table 1. Analysis (% DM except as noted) of the fresh potato vines (low soil level) in Experiment 1.

Variety	DM[1]	Ash	NDF	ADF	ADL	CP	WSC[2]	BC[3]	LAB[4]
Norkotah	13.2	26.2	34.8	29.4	5.1	19.4	5.8	376	4.1
Norland	12.6	29.3	31.9	23.5	4.8	22.1	5.2	565	3.7
WI 1005	10.7	22.0	35.9	27.5	4.4	26.0	7.0	380	3.9
WI 1099	12.2	33.0	28.6	24.5	3.5	22.4	4.5	415	3.3

[1]%

[2]Water soluble carbohydrates

[3]Buffering capacity, meq/kg DM

[4]Lactic acid bacteria, log_{10} CFU/g vines