Simple Means to Make Silage with Vinyl Materials

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Modernization in labor-saving cultivation and storage of self-sufficing feed is desired owing to the expansion of animal industry, and the importance of utilization of silage has been perceived particularly for the labor saving and intentional storage of abundant self-sufficing feed under the high temperature and rainy humid climate of Japan.

As to the recent type of feed consumption, Hokkaido mainly depends on self-sufficing feed like in Europe and America, while a half of the feed consumption depends on the concentrate and 70 per cent of self-sufficing feed is consumed as soilage in the mainland of Japan; therefore, the utilizatin of silage is yet very little in Japan[8].

When soilage consumption is too much, daily cutting of soiling crop needs much labor and yearly balanced feeding of self-sufficing feed cannot be kept. Also the change of ingredient of soiling crop becomes large resulting in the decline of nutrient yield of feed.

Through the whole year utilization of the silo of self-sufficing feed is urged from these points of view[1),8)], the development of a simple subsidiary silo is desired[5),6)] because the number of fixed silo is quite insufficient at present.

Since 1948, the following subsidiary silos made of plastic film were developed and widely used in Japan; 1) vinyl trench silo[4)], 2) vinyl vacuum silo[3),5)], 3) bag silo[6),7)], and vinyl stack silo[7)].

As the utilization of the vinyl stack silo and bag silo has remarkably been spread recently, they are described briefly hereunder.

Vinyl stack silo

In a vinyl vacuum silo, as is shown in Fig. 1, raw material of silage is covered with vinyl film which is sealed up tightly with many clips, and residual air in the cover is exhausted with a milker or other sucker to compress the material[3),5)]. But in this process, as the covering vinyl is sealed up with clips, the liquid produced from the material of high water content cannot be well drained resulting in lowering the quality of the silage, and the use of clips may be expensive moreover, sealing and air drainage are laborious.

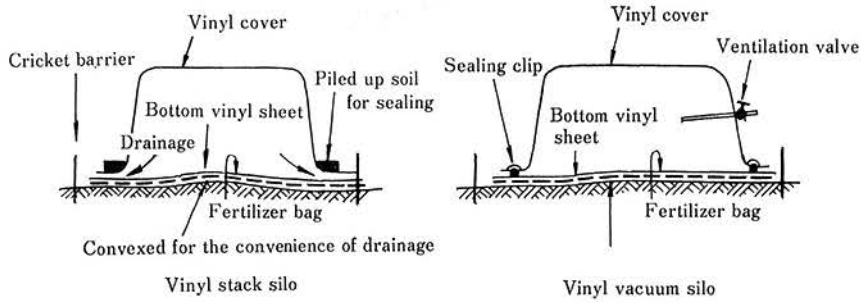


Fig. 1. Outline of used silos

Table 1. Quality of silage

Silo	pH	Organic acids (%)				
		Total acid	Lactic acid	Acetic acid	Butyric acid	Evaluation
Vinyl stack	4.02	3.10 (100)	2.50 (81)	0.58 (18)	0.02 (1)	91
Vacuum silo	4.32	1.30 (100)	0.64 (49)	0.48 (37)	0.18 (14)	22

Analyzed by the Freek method

The vinyl stack silo has been developed to improve these defects. That is, as is shown in Fig. 1, the silo can be sealed up easily with the soils piled up around the lower part of the vinyl film, and no clip is used. The bottom of the silo is made in a convex form to facilitate drainage.

Specificity of the stack silo

Table 1 shows the comparison of quality between the silage made in a vinyl vacuum silo and that made in a stack silo with the same raw grass material of high-water content. The silage made in the vacuum silo was accompanied with ammonium odor produced by stayed liquid owing to the ill drainage, while that of the vinyl stack silo turned into yellowish green accompanied with sweet and sour smell. As to the fermented quality of both silage, the silage made in the stack silo was decidedly superior to that made in the vacuum silo as shown in Table 1.

In general, the vinyl film cover of the stack silo begins to expand owing to the fermentation of raw material about 15 to 20 hours after storage (Plate 1), and this expansion attains to the maximum on the 2nd to 7th day and declines gradually afterwards returning

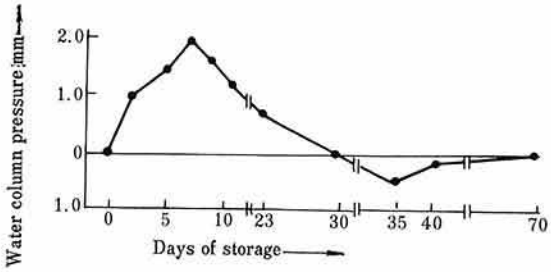


Fig. 2. Change of the pressure inside 50 ton vinyl stack silo after storage

to the normal condition of inside pressure around on the 30th day. Then the inside pressure falls down to negative value around on the 35th day, and comes back again to the normal value on the 50th to 70th day. Fig. 2 shows these changes of the pressure inside the silo.

The strength of the inside pressure can be controlled with the amount of soils piled up to seal up the silo, and 15 to 20 kg of soil piled up per 1 m seemed adequate.

It was found that 86 per cent of the dry matter of raw material can be obtained at the end of 150 days storage when the material grass of silage was harvested timely, water content of material was controlled adequately (by preliminary drying and drainage of grass juice), material grass of high-water content

Table 2. Quality of the grass silage made in a vinyl stack silo

Harvest* time of grass	Duration of storage (day)	Capacity of silo (ton)	Harvesting method	pH	Organic acids (%)				Evaluation	Water content
					Total acid	Lactic acid	Acetic acid	Butyric acid		
Heading stage	107	30	Chopper	3.88	3.30	2.68	0.62	0	100	82.5
Flowering stage	40	30	Chopper	4.75	1.80	0.94	0.88	0	60	79.7
Heading stage	190	50	Packing	5.72	4.50	4.36	0.14	0	100	62.6

* Italian ryegrass (mainly)

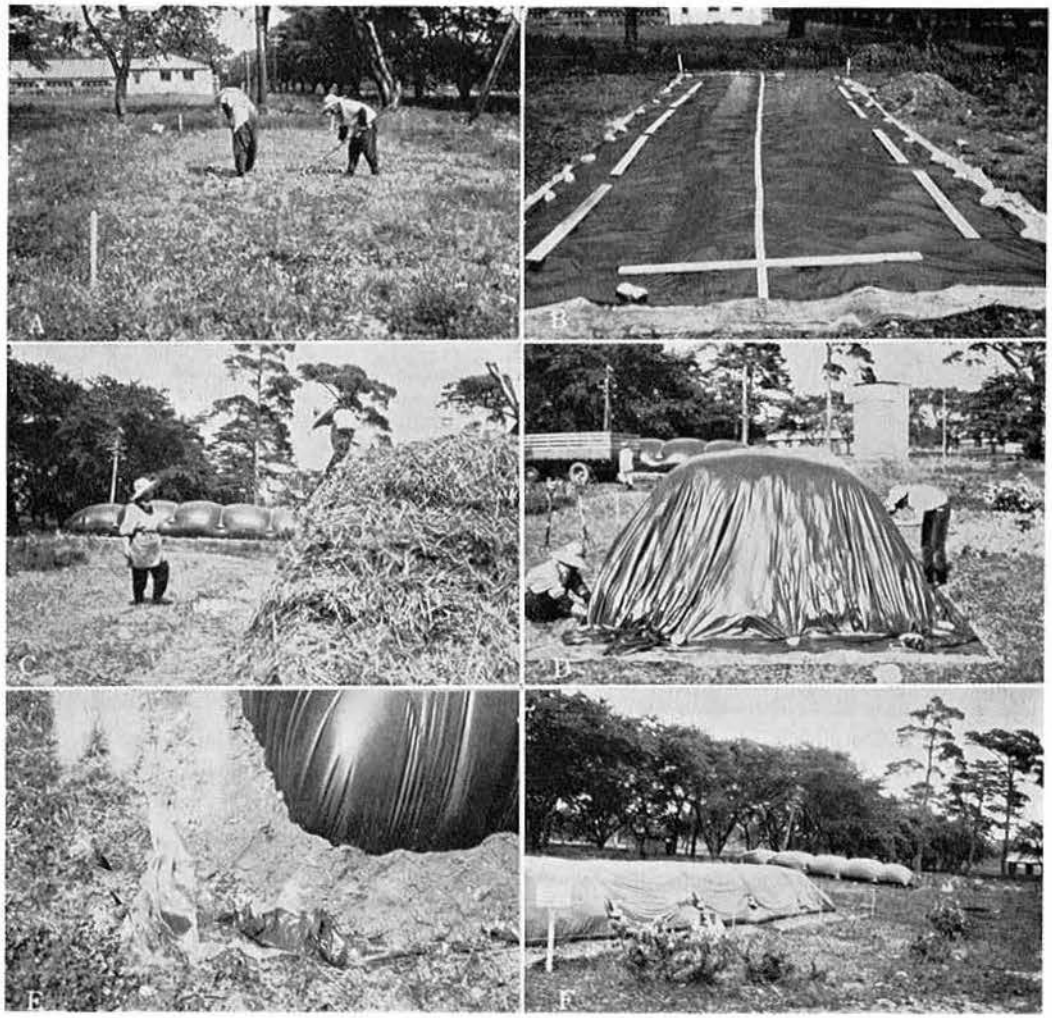


Plate 1. Establishment process of the vinyl stack silo (A~F)

A process 1: Ground preparation. Center point of the silo is prepared convexly to make silage with high-water content
B process 2: Ground is covered with vinyl sheet to make the bottom of silo. Circumference part of silo is reserved in a width of 30 cm for soil pile of sealing
C process 3: Cut raw materials are piled up on the ground sheet. The materials of low water content are not cut or packed to be piled up.
D process 4: Materials are covered with vinyl film
E process 5: Lower part of vinyl cover is sealed up with the soils of 15-20 kg/m
F process 6: Aspect of accomplished silos. Attention must be paid sufficiently on the control against cricket in August and September

was cut into small size to eliminate surplus water and the silo was sealed up tightly.

Quality of silage

Table 2 shows the quality of the silage made in silo of which capacity is 30 to 50 tons. It was confirmed that good quality silage can be obtained without any spoilage and used practically when the silage was well prepared and the silo was managed appropriately.

About 4,000 stack silos were used in Japan

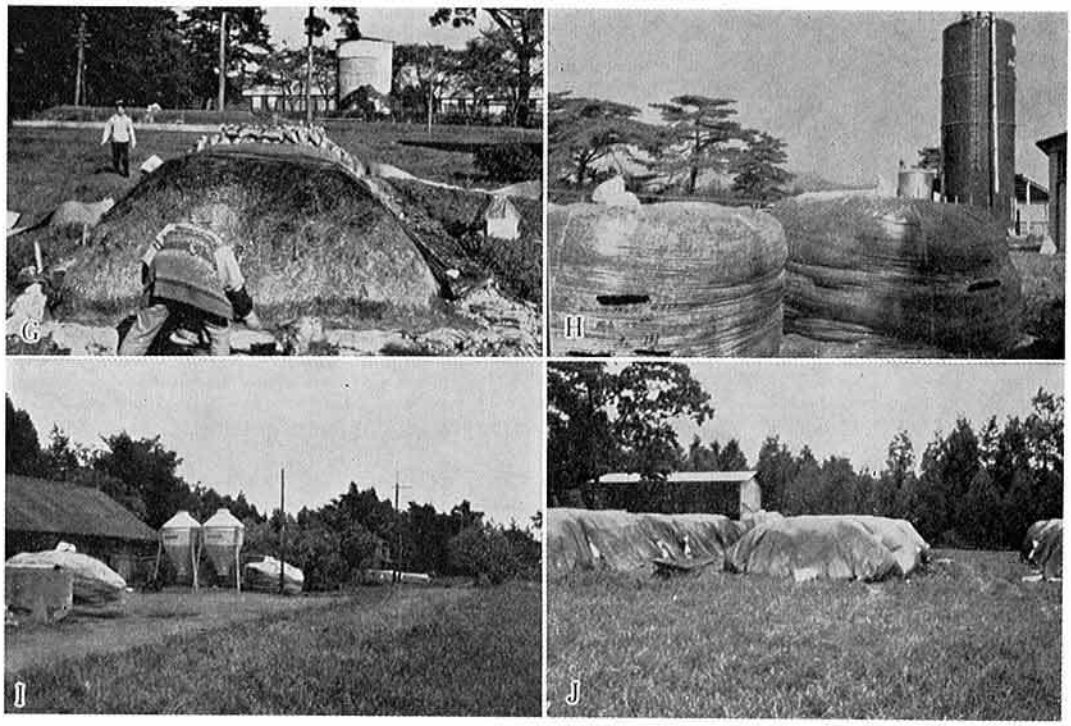


Plate 2. Establishment process of the vinyl stack silo, and the bag silo of large capacity (G~J)

G process 7: An aspect of an opened stack silo. Upper part is dried as haylage but no spoilage is found. The silage is taken out practically with the thickness of more than 30 cm a day. After it is taking out, silo is resealed

H: Bag silos of large capacity (1 ton)

I: Bag silos of eight-ton capacity in a farmer' field

J: At a dairy farmer of Sekiya, Shiobara Town, vinyl stack silo and bag silo of large capacity were set, and whole year silage took the place of soilage

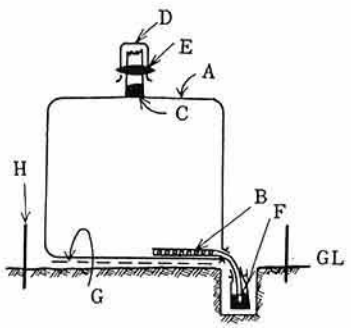
in 1973.

Bag silo

The small size plastic bag silo (mini-silo) with the capacity of 50 to 500 kg contents was fairly widely used because of the easiness and simplicity in preparation and transportation of silage and of the possibility of short-period storage[6].

But on the other hand, it revealed some defects that its management is rather laborious because it is too small and the grass juice of high water content silage cannot be well drained.

Therefore, as shown in Fig. 3, a large type bag silo, which has one to eight tons capacity and a drainage apparatus, has been developed



A: Bag silo (0.2 mm)
B: Thick rubber hose for drainage
C: First sealing of bag
D: Small vinyl bag
E: Second sealing
F: Back air current preventer
G: Used vinyl sheet for bottom
H: Barrier plate

Fig. 3. Big size bag silo

keeping the advantage of short-period storage and the possibility of re-sealing after partial use of silage.

Specificity of the bag silo

Table 3 shows the specificity of the silage made with high water content material of Italian ryegrass which was cut and put in three bag silos, each of which has three ton-capacity. Only one of the bags was refrigerated, the second one kept as it was for 14 days and the third for 90 days in the same way as the second.

In result, refrigerated raw grass was superior to the silage in feed intake of dry matter and digestibility, and the silage of short-period storage was superior to that of long-period storage in fermented condition and in feed take and digestibility of dry matter. And the quality of silage of which one part had been taken out was kept in good condition without secondary fermentation by means of resealing of the silo.

Table 4 shows the quality of the grass silage (principally of Italian ryegrass) made in the bag silo. It was manifested that silage of fairly good quality with various grade of water content can be made even by means of short-period storage in the bag silo of which capacity is one to eight tons.

Preparation of silage

For the effective utilization of the subsidiary silo, it is necessary, as is already reported[4),10),11)], to keep the standard rule of silage preparation which may be outlined as follows;

1) Raw material of good quality should be used; that is, graminaceous grass is desired to be harvested in heading time, and dead leaves, earth and sand should be eliminated.

2) As to control of water content, the raw material of high-water content should be cut into pieces and the silo must be well drained or dried substance (cut rice straw, beet pulp or wheat bran) should be added, and the water content of the material should be kept less than 70% by means of preliminary drying before storage.

3) As to cutting of raw material, the cutting of raw material (into 2 to 5 cm) is difinitely needed for the raw material of more 70 per cent water content, and as for the material of which water content had been

Table 3. Days of storage in a bag silo and characteristic of silage

Days of storage	pH	Organic acids (%)		Evaluation	Recovery rate in dry matter (%)	Digestibility of dry matter (%)	Feed intake of silage in dry matter (kg/day/head)
		Lactic acid	Acetic acid				
Raw grass*	3.94	1.20	0.32	95	100	64	10.0
14th day	3.94	1.66	0.35	95	91	59	7.1
90th day	4.15	1.37	0.85	80	86	56	7.6

* On the first day

Table 4. Characteristics of silage made in the bag silo

Days of storage	Silo (ton)	Treatment	Water content of raw material	pH	Organic acids (%)			Evaluation
					Lactic acid	Acetic acid	Butyric acid	
150	1	Preliminary drying	48	5.2	4.49	0.51	0	100
22	8	High water content Wheat bran 2%	77	4.0	2.24	0.52	0	95
25	3	High water content	84	3.9	2.76	0.36	0	100
29	1	High water content	83	4.0	2.04	0.56	0	100

reduced to below 65 per cent by means of preliminary drying, no cutting procedure is needed.

4) As to sealing up of the silo, spoilage of silage can be prevented utterly by sealing.

5) As to additional substance, though certain good quality silage could be obtained when the four conditions described above were accomplished, the application of additional substances may secure the quality of silage since the quality is apt to decline when the raw material with too little sugar content was stored or the storage temperature was too high. Recently the addition of formalin of 85 per cent in concentration is found to be effective to control unfavorable fermentation.

Furthermore, special research on the pasture plants in the tropics may be needed in the future because fermentable sugar content of these plant is rather little, physical property of raw material is coarse and hard, their taste is less suitable and digestibility is low, and the temperature during storage is too high.

Besides, attention must be paid to protect the vinyl silo from the damage of cricket; that is, the silo must be located in a sunny place, the area around the silo must be well weeded and insecticide should be applied in the season of cricket in August and September.

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