ALFALFA HAY–WHO & WHAT DETERMINES "QUALITY"

Don A. Toenjes, Farm Advisor, Glenn-Colusa Counties (retired)

Alfalfa growers, to profit from their enterprise, have to respond to a market that doesn't always send clear signals. The necessity, and technology, for producing weed-free, mold-free hay is known to most. But grower's influence over other factors that control the market's acceptance of their product are not clearly defined or easily controlled.

Alfalfa plant breeders have a long list of requirements of yield, insect and disease resistance that must be met in order to find a place in a very competitive market. Few, if any, of our current alfalfa varieties had "quality" or animal acceptance as a qualification for market introduction.

The academia mainly has seen alfalfa "quality" as something that must be measurable with a test tube or a scale and that will catch the attention of colleagues. The problem has to be within the realm of definition. It must bring him or her grad students to do the work. This will allow him or her, to publish "significant" papers.

Dairyman, perplexed by the reaction of lactating dairy cows to highly touted and "scientifically" tested hay, have gone on chewing, tasting, sniffing and feeling before buying in an effort to predict hay's effect on the level of milk in the bulk tank. All dairymen learn early in their careers that the right hay makes milk and money. So now we come to the ultimate authority of hay "quality"–the lactating dairy cow. The dairy cow has the veto vote and any dairyman that ignores this fact that the cow has the last word is doomed to go down in bad times. Frankly, I believe, despite all the rhetoric to the contrary, that if the lactating dairy cow (given a balanced diet) will totally consume her allotment of alfalfa hay without it making her sick, that if the hay can be produced with a reasonable profit going to the grower, and that if it can be fed by the dairymen with a reasonable profit resulting, it had all the desirable qualities needed.

Dairymen in pursuit of a trophy low fiber alfalfa hay that the cows will relish with enthusiasm, and their coffee house buddies will envy, often ignore the signals that the cow sends which include low butterfat production, a big foot trimming bill, and breeding problems.

We need to avoid the cow health problems associated with extremely low fiber hay. So let's look at what appear to be reasons that might cause a cow to sometimes refuse what we think is good for her and us, maybe the hay doesn't taste good or feel good in the dairy cow's mouth.

Most alfalfa I have tasted have a certain amount of bitterness which may be due to the level of tannins present. I have never seen lactating cows stand in line to eat hay that was extremely bitter. I have seen them stand in line to eat sweet tasting and

smelling hay such as a lot of alfalfa that has a faint tobacco smell. Cows definitely have a sweet tooth. Some dairymen use the attractiveness of a haystack to flies as an indicator of hay acceptance by the dairy cow.

We can try to ascertain the factors that might affect the feel of the hay by examining refused hay organoleptically and then chemically (table 1). We find we can predict the dairy cow's sorting. We find that if we soften the base hard stems that were refused in this study by adding moisture or by sweetening them, the cows will eat them. Now we might conclude that the long base hard stems neither taste good or feel good to the dairy cow. The part of the stem that the refused portions came from are shown in figures 1 and 2.

Some dairymen have profited significantly by utilizing lower cost, coarse, hard-stemmed hay. They present the hay in a shredded, moistened state mixed with tastier feeds. The total mixed ration (TMR) system requires additional management expertise, additional capital and additional energy expenditures. So by and large, most dairymen are reluctant to utilize the TMR system despite its promise of profitability.

So, we are back to the conventional low input method of feeding alfalfa. Anyway you slice it with this method, the base stem seems to be the problem. Dwayne R. Buxton, Plant Physiologist with the USDA Agriculture Research service, looked at the base stem in 68 strains and varieties of alfalfa and compared this with whole plant digestibility and protein levels. He found the lower stem portions lost digestibility twice as fast as the rest of the plant. The good news is that he found significant differences between the alfalfa lines he tested, so he feels that a base stem with higher digestibility and protein level can be selected. The bad news is that it would be an expensive program for the plant breeder.

Data published by B. M. Jenkins, D.A. Toenjes, and S. Tang (Table 2), Western Alfalfa Improvement Conference Proeedings, 1987, compared the grams of force per cubic centimeter required to double shear alfalfa stem internodes of Caliverde, reputed to be an old timer dairymen's favorite that all bugs, diseases and cows liked, to a modern variety, Washoe, that has significant disease and insect resistances. The conclusion was drawn that variety had some influence on stem strength. This study possibly lends a shade of credence to the dairymen's observation: bug proof–cow proof. Until growers convince plant breeders that the cost of development would be returned with profit, growers are stuck with the varieties that are available.

Cutting early is the most common method growers use to meet the market demands on fiber levels. By cutting early the grower reduces the total yield and the proportion of base stem harvested. If you refer to Table 3, you will see the results of a study I made on the development of base stem in the spring cut. These stems were cut at the ground. If we assume that the sickle height is at 3-4 inches, the influence of the base stem in the first cut growth examined took a big jump between the first sampling and the next sampling only one week later. Some growers have raised the

sickle height to 8" in order to leave a higher proportion of the base stem in the field. But this really works for only one cutting.

I have taught growers several methods to determine the length of the base hard stem in windrowed hay and in growing alfalfa. The methods are subjective but the results are consistent, easy to do and require no more equipment than a pair of hands. It gives you a method to make more informed cultural decisions and to compare varieties.

The test for windrowed hay is to select representative, dry, whole stems. Start at the top and break the stem into short lengths. As you progress down the stem you will find it takes increasing strength to break it. In addition, the point of separation will be different. In the "soft" zone the stem will shatter, the "medium" zone will produce a clean break, the "hard" zone, the one the cows will not prefer, will splinter so that the break appears to have sharp jagged edges and what appears to be "strings" may be attached to the broken ends (see figure 3). Anymore than 20% of the total length of stem in the last category spells problems in the manger. Not all lots of hay has this type of hard base stem.

Green stems can be evaluated by holding the stem firmly in one hand while pulling the stem apart with the other hand. You must avoid cutting the stem with your fingernails while doing this. If 50% of the stems resists your efforts, lactating dairy cows will refuse a significant portion of the hay. It only requires average strength or less to do this test.

Dirty Hay

Dairy cows generally object to dirty hay. But properly adjusted equipment and control of gophers, ground squirrels and other rodents should eliminate this problem.

Moldy Hay

Only under rare occasions is there any justification for production of dusty or moldy alfalfa hay in the interior of California. Moisture meters can be installed in the baler. The Canadas bale ventilator (presented in 1989 California Alfalfa Symposium) can reduce the mold-spores causing "dusty" hay condition to nil. Various commercial products are available that will allow the baling of higher moisture alfalfa hay without mold. Bales caught in a thundershower can be roadsided in stacks 5 bales high, covered with plastic film and ammoniated at the rate of 1 to 1-1/2 lbs. per ton of hay. (See Proceedings California Alfalfa Symposium 1984.) Of course, mechanical windrow fluffers and hay bind windrower conditioners all speed up drying (see proceedings California Alfalfa Symposium 1984). Urea solution can be an effective mold retardant and has been used at baling by Alaskan hay growers to control mold in grass hay.

Weeds

Broadleaf weed control is a must. A good portion of the broadleaf weeds found growing in alfalfa produce toxins that over time may harm the vital organs of the

cow. Some such as curly dock have been linked to the off feed and sudden death of penned cattle forced to eat it in chopped and mixed diets. Some of the other broadleaf weeds, such as groundsel and fiddleneck, may cause slow death or degenerative effects. Grassy weeds may be less of a threat to the animal's health, but some can cause sore mouths or abscesses if the seedheads are mature.

A Look at the Plant Problem

Getting back to the alfalfa plant, we find that stem diameter, a major palatability factor, is influenced by soil type and water availability. Frequent irrigations in the summer but in insufficient amounts to sustain rapid stem elongation will increase stem palatability and decrease % modified crude fiber. Figure 4 is an example of such hay highly acceptable to cattle but chemically significantly insignificant. However, untimely irrigations in adequate amounts can significantly increase the length of the base hard stem. Irrigation delayed by poor hay drying condition can often result in significant increases in base hard stem length despite the adequacy and timeliness of the subsequent irrigations in meeting the crop's needs.

Meeting the dairy cows preferences means selecting a variety for planting that will produce stems a dairy cow will eat. She will eat large diameter base stems that flatten when baled. Large diameter stems that have gone through a heavy sweat are consumed at a higher level, even though it might be difficult to convince the dairyman that the value might have been increased. You may want to sell your hay at higher moisture levels. Cows will consume stems at 15% bale moisture and refuse the same stem at 10% bale moisture. If you are stuck with a field of a variety that produces large diameter stems you can try severely crimping the hay at swathing. It can be done with the windrower-conditioner. You will have to slow the cutting down and make some adjustments but it will work. I have seen large stem diameter hay crimped so severely that it almost looks chopped in the bale slice. Cows generally relished it. If you can't upgrade your haying equipment you'll have to do a better job of selecting varieties.

All alfalfa varieties produce fine stemmed hay under certain conditions. However, not all alfalfa varieties produce fine stemmed hay under all conditions. A few have this reputation. Unfortunately, they are not always the varieties that yield the highest tonnage. You'll have to decide what type of hay you want to market. Have you ever seen a grower's ad describing the hay for sale at the top market price as coarse stems and leafy? No? How about fine-stemmed and leafy at top market price? Yes? (Figure 5.)

Let's look at the other factors that affect the diameter of stems a plant will develop.

Plant population. The higher the population at planting the better. Growers need to do everything possible to maintain stand density throughout the 3 to 7 years of production.

Weed control. Plants lost at stand establishment due to weed competition may not

affect the yield of hay per acre but it can affect stem size.

Mechanical injury to crowns. Swathers with dull sickles, non-aligned guards, poor relationship between ground speed and header speed or driven at just too high a ground speed can and will reduce plant population and reduce stem density. Let's not forget the damage the bale wagon does to crowns, tearing them as some "hot dog" turns it in mid-field.

Water management. There are few varieties on the market today that will resist scald. While varieties are sold as highly resistant, moderately resistant or resistant to other root diseases this does not mean 100% of the plants will survive a challenge. Actually, the challenge you create for highly resistant plants may reduce your stand to 20 or 30% of its former population. With so much less competition stem diameter probably will increase.

Variety crown size. The size and type of crown will somewhat determine the stem density of your field as the stand ages. Erect type crowns are much more vulnerable to mechanical damage. One of the advantages of many semi-dormants and dormant alfalfa plants is the ability to develop large crowns that fill in the spaces left by less resistant neighboring plants. However, coarse stemmed hay often is the result. Varieties do differ in their ability to maintain small diameter stems as stands thin.

Variety. Variety influence is obvious on stem diameter. Alfalfa varieties gain a reputation for small diameter stems, but since soil type and management does influence stem diameter, it may be best to see the variety in its 3rd or 4th year on soils and management similar to yours before committing large acreages to it. No one's come up with a miracle new variety.

If after reading this you are still a bit confused about hay "quality", ask your customer's lactating dairy cow–she knows what she likes–of course it may make her sick.

Table 1.

REFUSED HAY MILKING COW MANGERS VS ORGANOLEPTIC TESTING

STEMS DRAWN FROM ALFALFA BALE SLICES WERE COMPARED TO REFUSED STEM WHICH WERE PART OF THE SAME LOT OF HAY.

	ASH	ADF	% OF SAMPLE
MARTIN DAIRY			
S,S&L	12	29.6	63
H S	7.02	54.8	36
REFUSED	4.7	49.7	
MCDONALD DAIRY			
S,S&L	11.7	33.4	61
H S	6.32	54.5	39
REFUSED	7.64	53.7	
ZUPPAN DAIRY			
S,S&L	9.34	25.4	70
H S	4.53	51.4	30
REFUSED	6.78	51.5	
GOLLNICK DAIRY			
S,S&L	10.08	28.3	57
H S	6.59	57.6	43
REFUSED	7.64	53.8	
PARKER DAIRY			
S,S&L	11.7	24.4	37
H S	5.8	49.8	63
REFUSED	6.46	50.2	

DON A.TOENJES

S,S&L = Soft Stems & Leaves
HS = Hard Stems (or base stems)
Refused = Stems left in manger

Table 2. Caliverde stem internodes grown under two irrigation regimes are represented in figures 1 and 2. Washoe stem internodes grown under similar irrigation regimes are represented in figures 3 and 4.

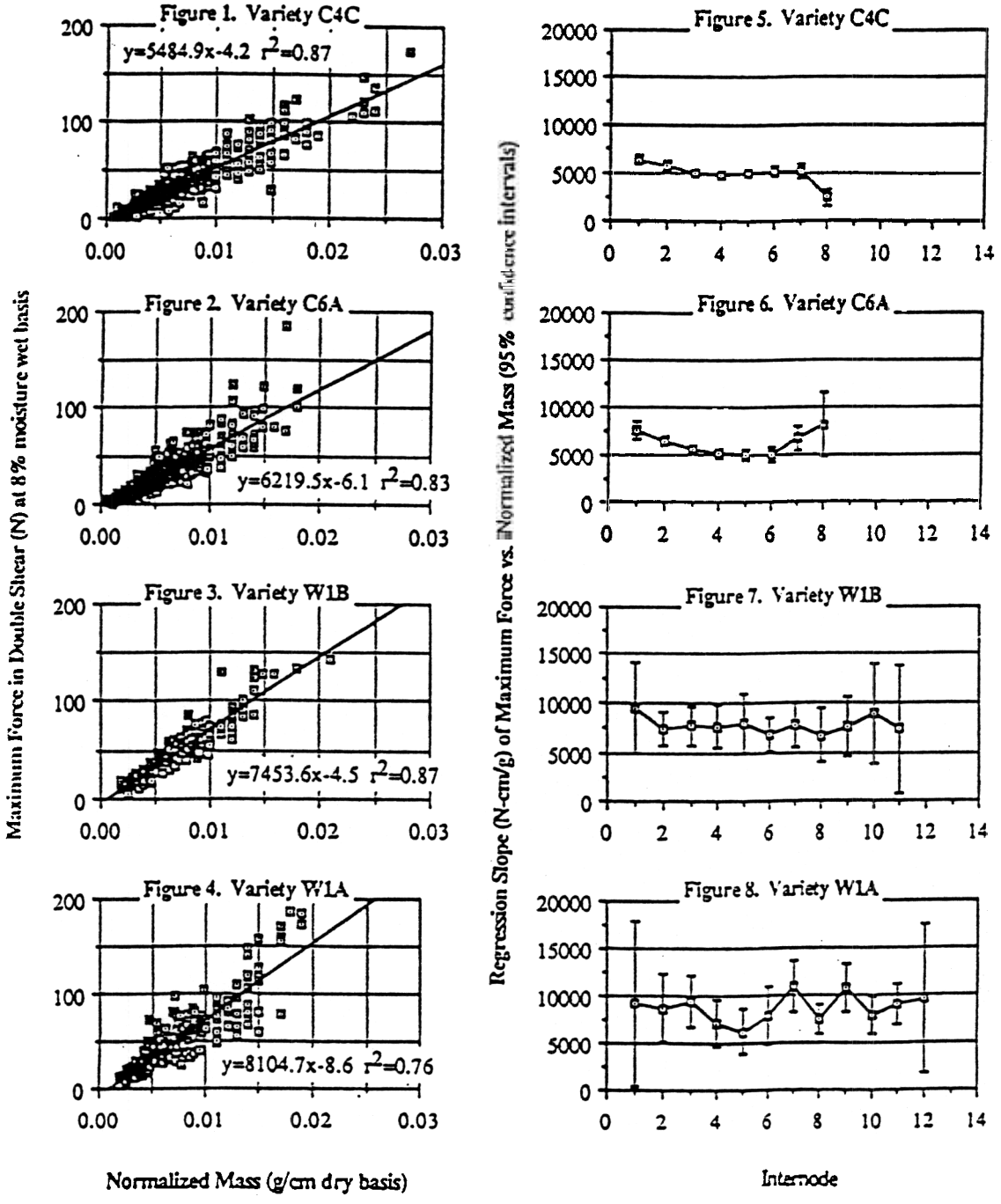


Table 3. ORGANOLEPTIC OBSERVATIONS DRY ALFALFA STEMS USING BREAKING.

Five commercial fields, three samplings observed. Ninety stems randomly selected with 270 stems observed from each field.

Means Total Stem Length (Inches)								
Field	L	H	M	V	Means	H-M	H-E	Means
Variety	WL318	WL318	WL318	WL318		Washoe	Washoe	
Date								
4/14	9.816	7.689	11.634	9.096	9.559	9.356	8.889	9.122
4/21	11.023	11.433	13.268	15.389	12.778	12.067	9.633	10.850
4/28	12.529	14.233	14.927	16.933	14.656	14.567	13.889	14.228
%C.V. 11.46					%C.V. 6.7			
Means Hard Base Stem Length (Inches)								
4/14	6.23	3.3	6.317	3.038	4.721	5.644	5.i7	5.672
4/21	6.885	7.633	7.841	8.962	7.831	7.389	5.9	6.661
4/28	7.851	8.133	9.231	10.956	9.043	8.956	8.4	8.678
%C.V. 21.13					%C.V. 7.67			

Figure

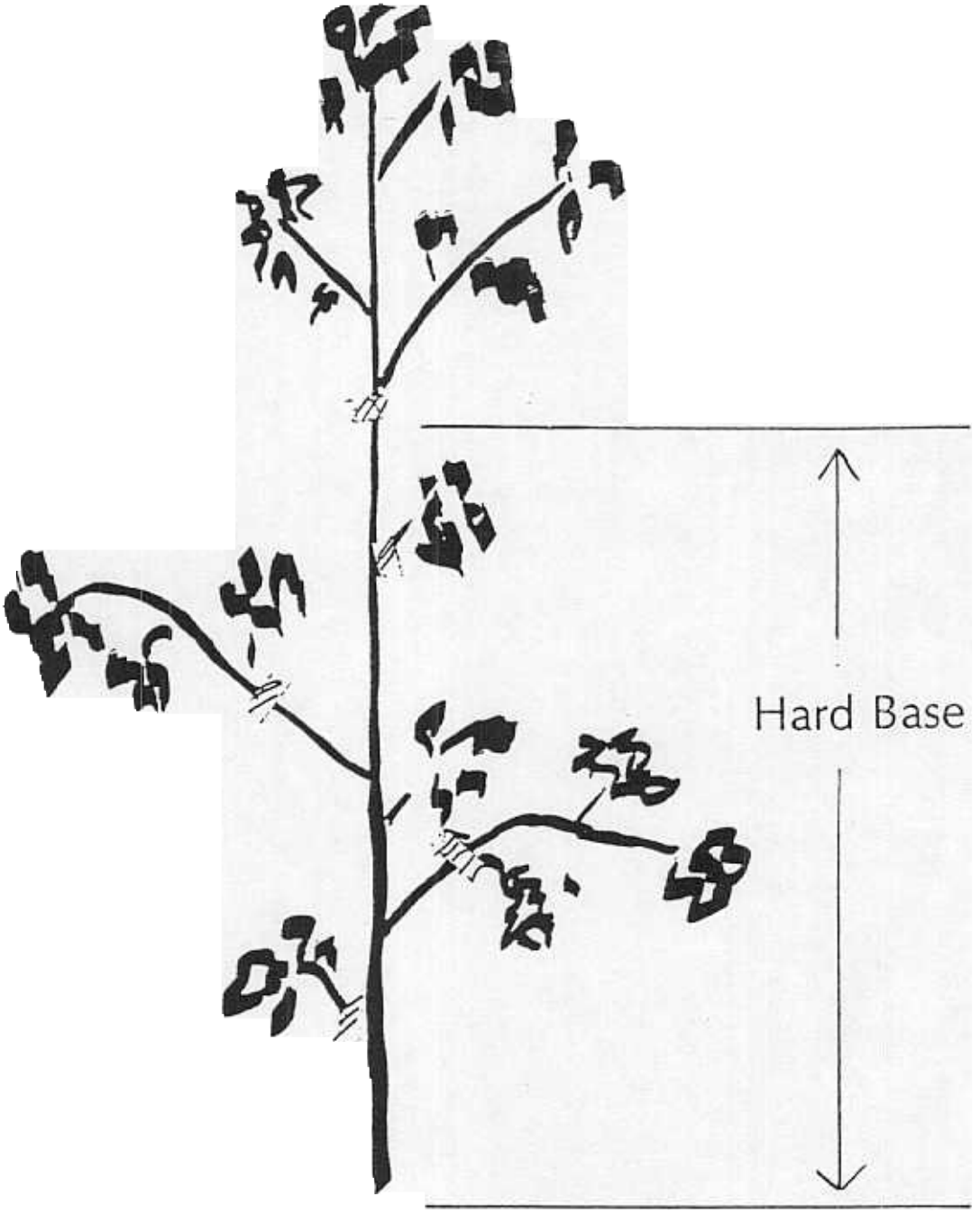
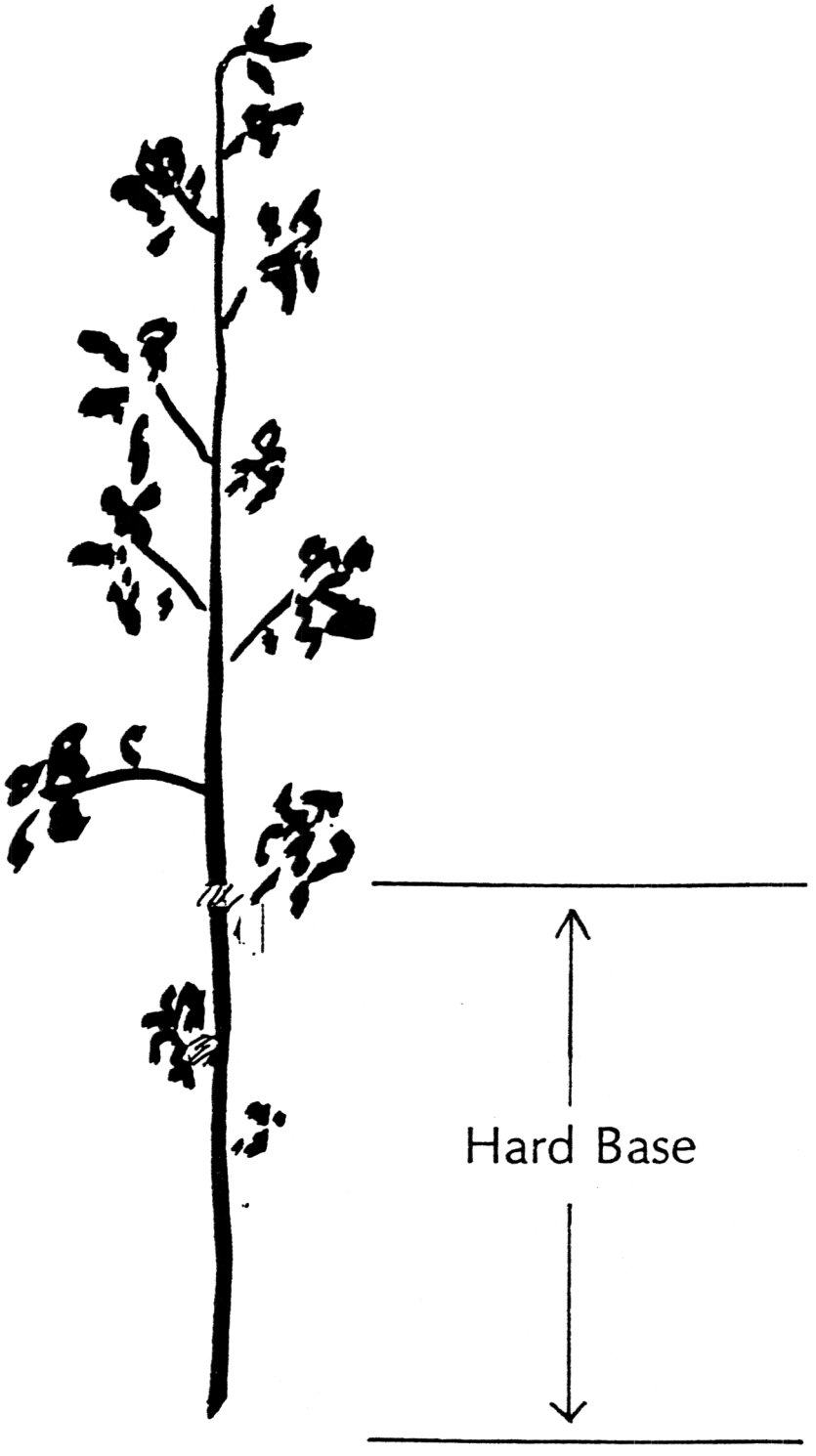


Figure 2.



igure

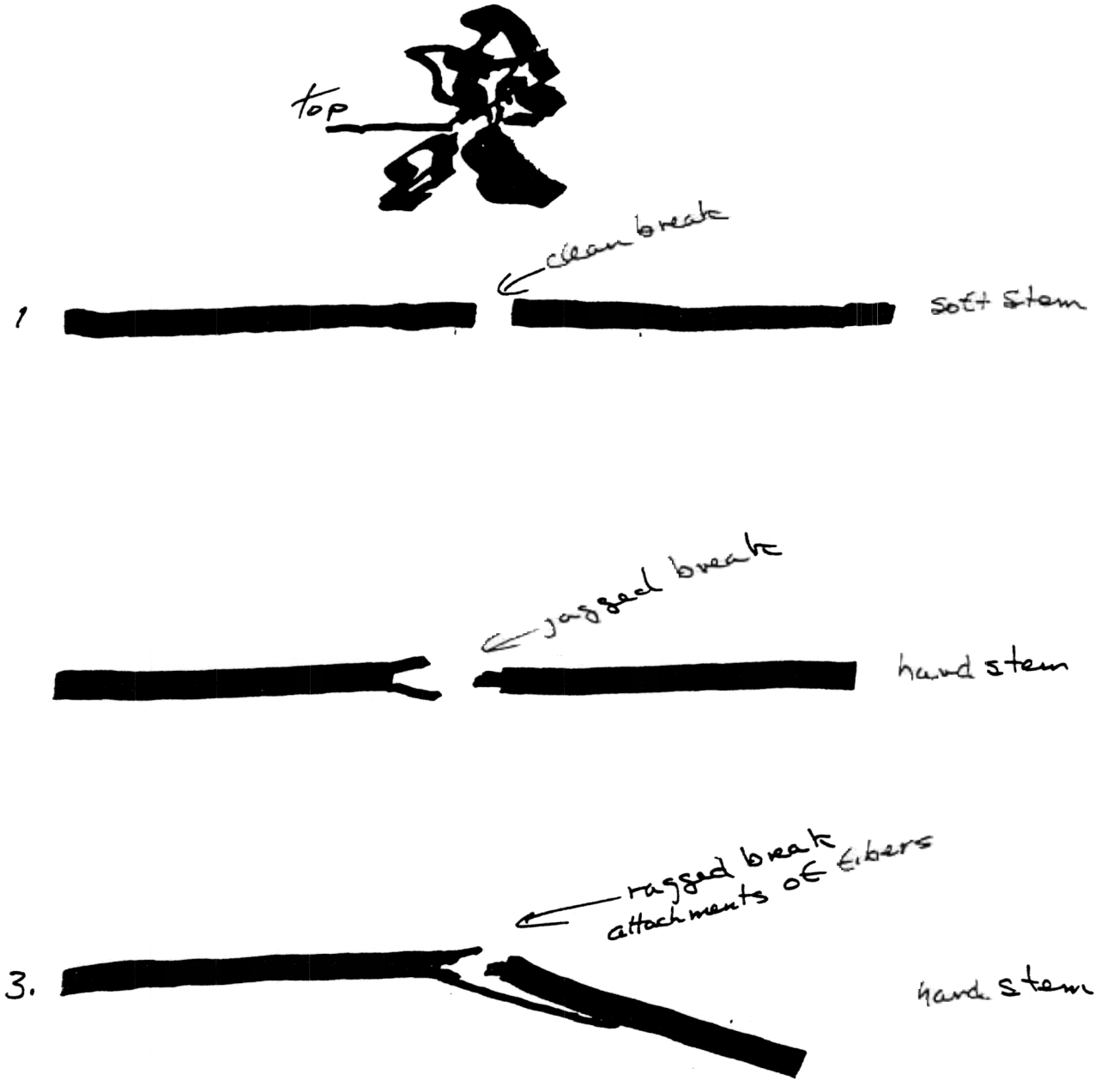

top
clean break
1
soft stem
jagged break
hard stem
ragged break
attachments of fibers
3.
hard stem

Figure 4.

UNIVERSITY OF CALIFORNIA, DAVIS

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO

SANTA BARBARA • SANTA CRUZ

DEPARTMENT OF ANIMAL SCIENCE
PHONE: (916) 752-1250

DAVIS, CALIFORNIA 95616

MATHIS' 1ST YEAR FIELD OF WASHOE, 3RD CUT AUG. 1983, 35 DAYS GROWTH APPROXIMATELY 1.5 TON/ACRE YIELD.

12 April, 1984

Mr. D. A. Toenjes
PO Box 697
County Building
Orland, California 95963

Dear Don:

Just a short note to give you the analysis of the "soft" hay bales you brought to dairy.

	% dry basis
dry matter	91.63
nitrogen	3.37
crude protein	21.05
ADF	29.68
cellulose	23.85
NDF	39.53
lignin	6.11
MCF	24.99
ash	10.97
ether extract	3.60

Sincerely,

Ed

Ed DePeters

EJD/jh

Figure 5. Sept. 1986

Feed, Fuel, Fertilizer 140

ALFALFA: BARN clean-out. Some 1st & 2nd cutting hay. $55/ton. $5/ton discount for 2 ton or more. Gene Fenn. 345-7938 or 891-8430.

GRASS HAY: 2 wire bales. $45 ton or $1.90 a bale. 865-9215, Orland.

3RD CUTTING fine stemmed alfalfa & Calif. red oat hay, fine stemmed. 865-3668 or 865-4270.

ALFALFA 3RD & 4th cutting, clean & green, fine stemmed, leafy & soft. Guaranteed to your liking or your money back. $85 ton; $80 ton for 2 ton or more. Gene Fenn. 891-8430 or 345-7938.

ALFALFA HAY, oat hay. Top quality, leafy hay for horses or cattle. M&T Ranch, River Rd. 342-2954.

HORSE HAY of the year. Oat & alfalfa mix. Soft & green. $65 ton; $5/ton discount for 2 ton or more. Gene Fenn, 345-7938 or 891-8430.

ALFALFA HAY for sale. Clean & leafy, top of the line horse feed. Call Bill McEnespy, 865-3923, 345-8638

ALFALFA HAY. Fresh cut, fine stem. 3 wire bales. $75 per ton. roadside 342-3868 or 865-2754.