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Spring Grazing on Icelandic Rangelands: a Review of Factors to Consider

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ABSTRACT

Cropping of vegetation by animals upsets and alters normal plant growth and development. Preliminary results from Icelandic grazing trials in Solvaholt and Kelduhverfi indicate that heavy grazing early in the growing season can dramatically decrease plant vigor and production. Gaps in our knowledge of range plant physiology are currently limiting the accuracy and precision with which we can predict productivity of grazed rangelands. These gaps also represent "unknowns" with regard to predicting and assessing the degree to which key range plants can tolerate biotic and abiotic stresses while maintaining their productivity on a sustained-yield basis. This article will discuss (1) why proper turnout dates are inportant to plant productivity; (2) why proper tournout dates might optimize financial returns in pasture and rangeland systems; and (3) research needs and priorities in these areas.

INTRODUCTION

The timing of the initiation of spring grazing of hayfields, pastures, and rangelands in Iceland is of vital importance with regard to subsequent plant and animal productivity. Classical grazing system management schemes, such as rest rotation, do not generally apply to Icelandic grazing lands. In Iceland, livestock are typically transferred from winter housing units to hayfields and lowland pastures which are grazed until highland ranges become accessible. These highland ranges are then continuously grazed by livestock, primarily sheep, for the remainder of the growing season. The time or plant developmental (phenological) stage at which grazing can be safely initiated in the spring is a controversial topic among farmers and range managers. Due to lack of quantitative information, there are, at present, no firm guidelines to dictate when to begin spring grazing in Iceland. As a result, grazing is commonly initiated too early in the plant's growing season. The practice of turning sheep and horses onto rangelands before the plants are physiologically suited for grazing can accelerate range deterioration and lead to decreased short- and long-term profits as stocking rates and animal gains will be subsequently reduced.

Fortunately, however, there seems to be a growing awareness and understanding among stockmen that untimely grazing can have a detrimental effect upon both range and animal productivity. As a result, many districts are gaining better control over turnout dates. This article will discuss:

1. why proper turnout dates are important to plant productivity;
2. why proper turnout dates might optimize financial returns in pasture and rangeland systems; and
3. research needs and priorities in these areas.

EFFECTS OF GRAZING ON PLANT PRODUCTIVITY

It is generally acknowledged that the ability of a plant to survive in a given habitat depends upon four basic and interrelated factors:

1. the ability to synthetize and store food for maintaining plant functions;
2. the ability to form vegetative structures for renewal of top growth;
3. the ability to maintain a healthy root system; and
4. the ability to produce reproductive organs (STODDART et al. 1975).

Each of these factors is interrelated and dependent upon there being sufficient foliar tissue to acquire the energy needed for plant growth and development. It is well known that different plant species react differently to environmental stress, including grazing. ARCHER and TIESZEN (1980) for example, describe various strategies observed for graminoid and evergreen and deciduous dwarf shrub lifeforms in an Alaskan arctic tundra with regard to either tolerating or avoiding defoliation. Their results suggest that the ability of various plant lifeforms to tolerate defoliation (Fig 1) is related to a variety of factors, such as the amount of non-photosynthetic supportive tissue and the longevity, photosynthetic rates, and patterns of development of leaf tissue. Because of the wide array of responses of plants to defoliation, a detailed account of the physiological processes of key range plants is needed to form a basis upon which management decisions can be made. Gaps in our knowledge of range plant physiology

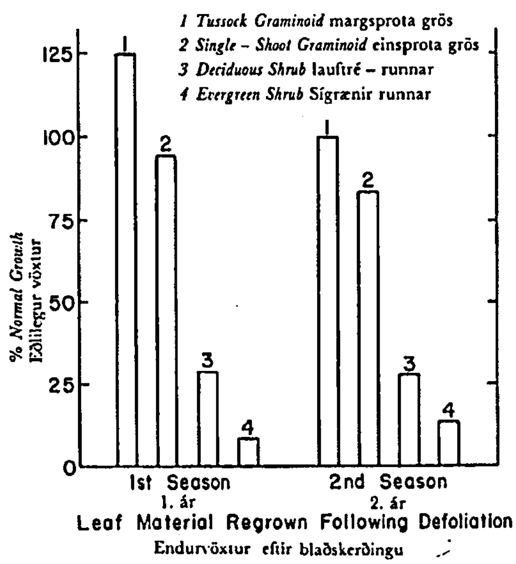

FIGURE 1.
Foliar regrowth of four Alaskan arctic growth forms folowing a single, 100% defoliation imposed in late June. (1) *Eriophorum vaginatum*, (2) *Carex aquatilis*, (3) *Salix pulchra*, (4) *Ledum palustre*.
Endurvöxtur fjögurra jurtategunda frá Alaska eftir 100% blaðskerðingu, seint í júní.

are currently limiting the accuracy and precision with which we can predict rangeland productivity. These gaps also represent "unknowns" with regard to predicting and assessing the degree to which key range plants can tolerate biotic and abiotic stresses while maintaining their productivity on a sustained-yield basis.

Cropping of vegetation by animals alters normal plant growth and development. Removal of photosynthetic tissue by grazing animals lessens the capacity of the plant to manufacture foods required for growth, maintenance and reproduction. In perennial plants, stored food reserves are diminished as the plant recovers from grazing (WARD and BLASER 1961; DONART and COOK 1970; WHITE 1973; SMITH 1975; BUWAI and TRLICA 1977). As a result, the phenological development of the plant may be retarded and its reproductive capacity reduced. These are some direct effects of grazing that affect plant productivity and vigor. Removal of leaf tissue by grazers also has some indirect effects upon plant productivity. Typically, grazed plants reorganize carbon and nutrient allocation patterns following defoliation in order to replace the foliage lost to herbivores. While such reorganization facilitates the regeneration of photosynthetic tissue, it is generally done at the expense of root growth and activity (DAVIDSON and MILTHORPE 1966; EVANS 1972; HODGKINSON and BAAS BECKING 1977; CHAPIN and SLACK 1979; ARCHER and TIESZEN 1980). Impaired root growth and activity following grazing will reduce the ability of the defoliated plant to extract nutrients and water from the soils. In areas where nutrients are limiting, impaired root growth resulting from grazing may be more detrimental to the defoliated plant than the loss of leaf tissue. In fact, grazing simulations at Barrow, Alaska suggest that leaf growth following defoliation may deplete nutrient reserves more than carbohydrate reserves (CHAPIN 1977).

Fortunately, however, many range plants can withstand a certain amount of grazing without being adversely affected (STRICKLER 1961; VICKERY 1972; CHAPIN and SLACK 1979; DETLING et al. 1979; MCNAUGHTON 1979; TIESZEN and ARCHER 1979). However, the amount of grazing a given plant species or population can tolerate over the long term will depend upon the complex interaction of many factors. The frequency, intensity, and time of season of defoliation are of paramount importance, as is the stage of plant growth (see review by TRLICA and SINGH 1979). A mature plant, for example, can withstand more frequent and intense grazing bouts than can a young plant whose root system is poorly developed and whose levels of stored foods are low. As a result, seedlings and new vegetative propagules are particularly vulnerable to grazing (VALLENTINE et. al. 1963; REYNOLDS and MARTIN 1968). However, any plant, when grazed, will become weakened and eventually die if grazed to frequently or too intensely at a critical stage in its life cycle or at a critical point in the growing season. The physiological processes by which the individual plant grows and the morphological changes that occur over the course of the growing season are then an important consideration when managing grazing systems.

The survival of plants in grazing systems is directly related to their ability to manufacture food via photosynthesis and to acquire nutrients and water via their root systems. Of the factors that influence the rate of food manufacture (photosynthesis), the amount of exposed leaf area is of principal concern, for it is the parameter most subject to manipulation and management. In the following section, the importance of delaying grazing until a minimum leaf area is achieved will be discussed. Grazing in early spring, before the plant has attained a critical leaf area, may delay and reduce plant productivity for the remainder of the growing season and thus reduce carrying capacity.

THE ROLE OF CARBOHYDRATE RESERVES IN PLANT FUNCTION

The foods manufactured by plant leaves in excess of those used by the plant for immediate growth and respiration are stored for later use. Perennial plants commonly store their photosynthetic products in the form of carbohydrates. These carbohydrate reserves are stored in the roots and stem bases of perennial herbaceous plants, in the stems and roots of woody plants, and in the seeds of annual plants. These food reserves are used for (1) respiration and maintenance of perennial structures during dormancy, (2) the initiation of growth following winter dormancy, (3) vegetative and sexual reproduction, and (4) an emergency energy source during times of stress (e. g., drought, frosts, grazing, etc.). Thus, carbohydrate reserve levels are of key importance to the welfare of the plant (see review by GRABER et al. 1927; MAY 1960; JAMESON 1963; WHITE 1973; TRLICA and SINGH 1979). The importance of belowground vascular plant storage structures in tundra systems has been acknowledged for some time (BLISS 1962, 1966, 1970; MOONEY and BILLINGS 1960; SCOTT and BILLINGS 1964; DENNIS and JOHNSON 1970; WIELGOLASKI 1972,; WEBBER 1974, 1977, WEBBER and MAY 1977; DENNIS et al. 1978; MILLER et al. 1978). Carbohydrate concentrations found in arctic tundra graminoids are typically high, often being much greater than those of many alpine and temperate counterparts (FONDA and BLISS 1965; MCCOWN and TIESZEN 1972). Seasonal trends and effect of clipping on carbohydrate and nutrient levels of various age classes of the grass *Dupontia fisheri* at Barrow, Alaska are well documented by MATTHEIS et al. (1976).

Figure 2 shows the generalized pattern of seasonal trends in carbohydrate levels in storage organs known to occur in many temperate zone plants. Three phases of this seasonal curve are of particular interest: (1) during the dormant season there is a gradual decline in carbohydrate levels due

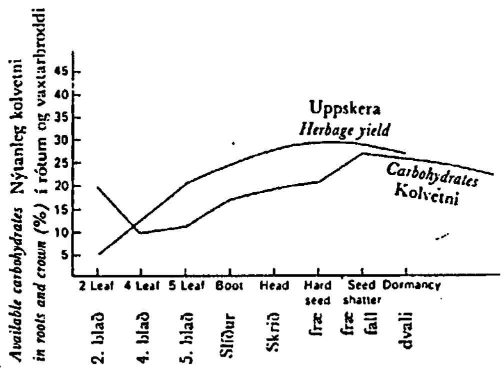

Figure 2 Carbohydrate balance and herbage yield of a typical grass species throughout the annual cycle. Árlegt kolvetnajafnvægi og uppskera dæmigerðra grasategunda.

to continued respiration; (2) at the beginning of the growing season there is a dramatic decline in reserve levels corresponding to the onset of new growth; and (3) this "spring drawdown" continues until a certain leaf area is produced (TRLICA and SINGH 1979). When the plant has reached a critical leaf area the input of photosynthetic foodstuffs exceeds maintenance and growth expenditures and carbohydrate reserves begin to accumulate as the plant matures and enters dormancy. With the onset of dormancy, the cycle repeats itself.

It is during the spring drawdown period that plants are susceptible to heavy grazing. After winter dormancy and during the initial flush of spring growth, reductions in stored carbohydrates of 50 to 75% have been reported for mountain forage plants (McCARTY and PRICE: 1942; MOONEY and BILLINGS 1960). Removal of the early spring leaves at this time would delay the incorporation of photosynthetic energy and result in a futher depletion of food reserves. DONART (1969) related carbohydrate reserve cycles of six mountain species to growth and development and noted that minimum reserve levels were reached during early spring growth after approximately 15% of the total annual growth had been produced. It was further noted (DONART and COOK 1970) that defoliation of these herbaceous plants early in the season was considerably more detrimental than defoliation later in the season. If grazing pressure is maintained throughout the spring the plant may never recoup its reserve losses and will enter winter in a state of reduced vigor. The result may be an increased mortality rate during the winter, especially among young age classes of plants, or a delayed and reduced productivity the subsequent growing season (McCARTY and PRICE 1942; SMITH 1964; MOONEY and BILLINGS 1965; OWENSBY et al. 1970; ARCHER and TIESZEN 1982). Also, early spring grazing likely alters the reserve carbohydrate allocation patterns within the plant such that energy normally expended for root productions is diverted to replacing leaf tissue lost to grazers. As a result, root growth is often suppressed and the ability of the plant to take up water and nutrients is impaired (CRIDER 1955; DAVIDSON and MILTHORPE 1966; EVANS 1972; CHAPIN and SLACK 1979). In this regard, ARCHER and TIESZEN (1982) noted that early season defoliations affected root initiation, elongation, and biomass to a greater extent than did defoliations imposed later in the season. Reduced root growth, at a time when the plant is normally growing rapidly, may retard not only rate at which recovery from defoliation may occur, but may also reduce the soil holding capability of the plant. Also, early turnout dates would allow grazing during periods when soils are wettest and would increase the likelihood of trampling damage via destructive hoof action (THILENIUS 1975).

Reproductive vigor may also be substantially reduced as a result of excessive defoliation. Vegetative reproduction in graminoids, the primary mode of plant propagation in most perennial grassland systems, is often markedly reduced by grazing (TROUGHTON 1957; ELLISON 1960; JAMESON 1963; ARCHER and TIESZEN 1982) although, there may be a stimulation of tillering if apical meristematic tissue is disturbed (YOUNGER 1972). Sexual reproduction may also be affected. PEARSALL

(1950) and SPETZMAN (1959) noted a direct loss of reproductive primordia because of preferential grazing by deer, sheep and caribou in northern latitudes. Indirect supression of sexual reproduction may also occur as a result of grazing which lowers plant vigor and causes a depletion of stored energy and nutrient reserves (ARCHER and TIESZEN 1982). In this regard TIKHOMIROV (1959) and SMIRNOV and TOKAMAKOVA (1971, 1972) observed that lemming grazing suppressed flowering in several arctic graminoids. In northern environments where sexual reproduction is already severely limited by abiotic factors, such grazing induced losses either direct or indirect, may be of some significance.

From a plant community standpoint, excessive early spring grazing may also confer a competitive advantage upon less desirable species. Species escaping early spring grazing will gain an advantage over species subjected to grazing since the former can maintain shoot and root growth (MUEGGLER 1972, 1975; ARCHER and DETLING 1982). This early spring competitive advantage may then carry over throughout the growing season resulting in a decrease in the relative productivity of desirable forage species. If the desirable species are kept at a competitive disadvantage long enough, plant community composition will eventually be altered in favor of the less desirable species. The recovery of plants from setbacks induced by grazing may be quite slow, especially in northern latitudes where growing seasons are short and cool, soils are young and poorly developed, and nutrient availability is limited. MENKE and TRLICA (1983) observed that abusively defoliated shrubs required more than one year of rest and COOK and CHILD (1971) found that desert plants required more than seven years of nonuse for recovery of vigor when defoliated to the extent that vigor was moderately reduced. ARCHER and TIESZEN (1982) working in the Alaskan arctic and TRLICA et al. (1977) working in the shortgrass steppe observed that heavily grazed graminoid tillers required two or more years of rest to attain carbohydrate and biomass levels in storage organs comparable to those of undefoliated plants.

Finally, it should be pointed out, that changes in the carbohydrate status of various storage organs are not necessarily a direct function of time of season in arctic or Alpine plants. HALOWAY and WARD (1965) noted that in Colorado's alpine areas the date of initiation of various phenological stages varied considerably from site to site, and from year to year at a given site. Thus, phenological stage is likely a better indicator of range readiness than is date (WEST and GASTO 1978).

Few specific details are available regarding the seasonal trends in shoot and root growth and carbohydrate levels in important Icelandic range plants. Even less is known about how grazing at various times of the growing season affects these trends and how long it takes a plant to recover from grazing at various frequencies and intensities at various times in the growing season. At this point, we can only speculate using the results of studies conducted in other parts of the world. Future research on Icelandic rangelands would do well to address these questions directly if retrogression of Icelandic rangelands (THORSTEINSSON et. al. 1971; MITCHELL 1979) is to be arrested.

EFFECT OF UNTIMELY SPRING GRAZING ON CARRYING CAPACITY AND ANIMAL GAINS

Several studies in Iceland have demonstrated that heavy or untimely spring grazing of rangelands and hayfields can reduce plant productivity (JONSSON 1974; ARNALDS 1981; GEIRSSON 1981; ÓSKARSSON 1982). Although the qualitative relationship between seasonal plant productivity and rangeland carrying capacity is generally well known, there is little quantitative data available to clarify just how much herbage should be allowed to accumulate in spring before grazing can be safely initiated. Good management does not imply that we should manage plants in such a way that carbohydrate reserve levels and leaf areas are maximized. But, on the other hand care should be taken not to exceed critically low levels. By deferring grazing in spring until plants have sufficient leaf area to be in a positive carbon balance, plant vigor and productivity can be maitained at higher levels throughout the remainder of the growing season. As a result, the overall carrying capacity of the range will be enhanced.

In addition, animal performance is often quite poor when grazing is initiated too early in the growing season. Table 1 summarizes the results obtained in an Ireland study (COLLINS et al. 1977) in which animal performance was evaluated for various spring turnout dates. These data illustrate that even a short delay in initiation of grazing can have dramatic positive effects on daily animal gains. On the other hand, forage quality is highest earliest in the growing season. Delaying the initiation of grazing for too long might then result in reduced animal gains. Thus, it is desirable to accurately ascertain plant growth in the spring, and to discover the point at which animal performance can be opttimized with minimal detrimental effects to key forage plants. While the results from the Ireland study (Table 1) may hold conceptually for Icelandic ranges, they should not be interpreted literally, for Icelandic ranges are generally much lower in productivity. Further, the time at which plants can be best utilized in the spring will differ from year to year as climatic conditions vary from locality to locality. Thus, the vigor of key forage species should be monitored and turnout dates and stocking rates adjusted accordingly.

TABLE I.
Forage standing crop (dry weight) and weight gain of cattle on Irish pastures in early spring
1. Tafla
Uppskera á rót (þurrvigt) og þyngdaraukning nautgripa á írsku graslendi í byrjun gróanda

	Starting date of grazing *Upphaf beitar*			
	Apr 1	Apr 8	Apr 15	Apr 22
Forage standing crop (kg/ha) *Uppskera á rót (kg/ha)*	254	508	1261	1608
Animal live weight gain (kg/ha) *Þyngdaraukning dýra (kg/ha)*	833	976	1046	891
% animal weight gain relative to April 1 *Hlutfallsleg þyngdaraukning miðað við 1. apríl*	100	117	126	107

(from Collins et al. 1977)

SUMMARY

Preliminary results from Icelandic grazing trials in Solvaholt and Kelduhverfi indicate that heavy grazing early in the growing season year after year can dramatically decrease plant vigor and production (ARNALDS 1978). In Iceland, where the growing seasons are short and the winters long and severe, it is imperative to achieve optimum gains per animal. The initiation of grazing too early in the spring, on a repeated basis, will typically lead to reduced plant productivity which will manifest itself in reduced rates of weight gain in livestock and an overall reduction in future pasture carrying capacity. If pastures are subjected to early spring grazing on a yearly basis, plant species composition of the pastures will eventurally change, as undesirable plants gain a competitive advantage. Both short- and long-term economic returns from grazing operations can thus be significantly reduced when grazing is initiated too early in the growing season.

ÍSLENZKT YFIRLIT

Um vorbeit á Íslandi.

Yfirlit um þætti, sem huga þarf að í þessu sambandi.

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ANDRÉS ARNALDS

Landgræðslu ríkisins

INNGANGSORÐ

Það skiptir miklu máli um vöxt og viðgang beitarplantna og afurðagetu búfénaðar, hvenær beit er hafin að vori, hvort sem um ræðir tún, úthaga eða afrétti. Sem betur fer, þola allmargar beitarplöntur talsverða beit án þess að bíða af tjón. Meira að segja getur hófleg beit aukið plöntuframleiðslu. Þó fer svo, að mikið beitarálag ár eftir ár dregur að lokum einnig úr þrótti þeirra plantna, sem mest hafa beitarþolið. En það er háð margþættu samspili umhverfis og nýtingar, hvernig þol tiltekinnar plöntu eða gróðurfélags reynist gagnvart mikilli beit um árabil.

Veigamestir þeirra þátta, sem ráða má yfir í þessu sambandi, eru þeir, hversu oft er beitt, hve mikið er beitt og hvenær á gróðrartímabilinu.

Fáar leiðbeiningar liggja enn fyrir um það, hvenær hagkvæmast er að hefja vorbeit á Íslandi. Afleiðing þessa er sú, að beit er að jafnaði hafin of snemma að vorinu. Sauðfé og hrossum er oftlega hleypt á úthaga eða tún, áður en gróður hefur náð því líffræðilega vaxtarstigi, að hann þoli beit. En hætt er við, að slík meðferð spilli gróðri og dragi með því úr afrakstri búfjárafurða af landinu í bráð og lengd. Sem betur fer, virðist skilningur bænda vaxandi á því, að ótímabær beit getur skaðað beitilönd og dregið um leið úr afurðum búfjárins. Í grein þessari er tekið til athugunar:

1. Hvers vegna það er mikilvægt fyrir afrakstur beitilanda, að búpeningi sé sleppt á landið á réttum tíma,
2. hvers vegna hámarksafrakstur beiti-

lands fæst með því að sleppa búpeningi á landið á réttum tíma,

3. að frekari rannsóknir þessara þátta ættu að njóta forgangs til að fá áreiðanleg svör varðandi umrædd atriði.

Það liggur nokkurn veginn ljóst fyrir, að vöxtur og viðgangur tiltekinnar plöntu í tilteknu umhverfi er háður, fjórum grundvallarþáttum, sem raunar hafa innbyrðisáhrif hver á annan:

1. hæfni plöntunnar til að framleiða og geyma orku til viðhalds lífsstarfsemi sinni,
2. hæfni til að endurnýja vöxt stönguls og blaða,
3. hæfni til að viðhalda hraustu rótarkerfi,
4. hæfni til endurnýjunar.

Þættir þessir eru hver öðrum háðir innbyrðis svo og því atriði, að plantan hafi nægilega mikið af grænum blöðum til þess að safna þeirri orku, sem nauðsynleg er plöntunni til vaxtar og viðgangs.

Vegna þess að plöntur þola mjög misjafnlega, að þær séu rændar hinum grænu blöðum, er nauðsynlegt að kanna efnaferli tiltekinna mikilvægra beitarplantna til þess að öðlast þekkingu á skynsamlegri nýtingu haglendis. En þekkingarskortur á þessum vettvangi torveldar mönnum að segja fyrir um framleiðslugetu beitilanda eða beitarþol.

Beit búpenings raskar eðlilegum vexti og viðgangi gróðurs. Minnkandi blaðflötur vegna beitar dregur úr getu plöntunnar til að framleiða næringu sem er nauðsynleg lífsstarfsemi og framleiðslu fræja eða forðanæringar til viðhalds plöntunni. Í fjölærum gróðri getur svo farið, að uppsöfnuð forðanæring eyðist tiltölulega fljótt, á meðan plantan er að ná sér eftir áhrif beitar. Slíkt dregur úr þroska og kann að seinka þeim líffræðilegu efnaferlum, er sinna viðhaldi gróðurs. Á þennan hátt getur beit haft áhrif á grósku og framleiðni plöntunnar. Plöntur, sem misst hafa blöð vegna beitar, breyta innri starfsemi í því skyni að endurnýja blöðin, sem búfé fjarlægði, en slík endurnýjun verður oftast á kostnað rótarkerfisins. Minnkandi rótarvöxtur og rótarstarfsemi dregur úr hæfni plöntunnar til að taka til sín vatn og næringarefni úr jarðvegi, og þar sem skortur er á slíkum næringarefnum, getur skert rótarkerfi valdið meiri skaða en skertur flötur grænna blaða.

Líkur plantna til að þola beit eru háðar hæfni þeirra til að framleiða fæðu með tillífun (photosynthesis) og til að afla vatns og næringarefna jarðvegs gegnum rótarkerfið. Heildarblaðflötur, er nýtur ljóss, er sá þáttur, sem mestu veldur um fæðuframleiðslu (tillífun), enda sá þáttur, sem beit hefur megináhrif á. Beit snemma vors, áður en plantan hefur öðlast lágmarksblaðflöt, getur auðveldlega tafið og minnkað fæðuframleiðsluna það, sem af er sumars, og þannig dregið úr beitarþoli og afrakstri hlutaðeigandi lands.

ÁHRIF KOLVETNAFORÐA Á ÞRIF PLANTNA

Sú fæða, sem blöð plantna framleiða, kann að verða nýtt samstundis til vaxtar og öndunar ellegar geymd til nýtingar síðar. Fjölærar plöntur geyma fæðuframleiðslu tillífunar aðallega sem kolvetni. Er slíkur kolvetnaforði geymdur í rótum og stönglum fjölærra beitarjurta, í stofnum og rótum trjáplantna og í fræjum einærra plantna. 1. mynd, bls ....., sýnir í grófum dráttum magn kolvetna eftir árstíðum í þeim geymsluhlutum plantnanna, sem einkum ræðir um í hinum tempruðu beltum jarðar. Þrjú atriði þessarar árstíðarkúrfu eru einkum athyglisverð:

1. Á þeim tíma, er plönturnar liggja í dvala, minnkar kolvetnaforði smám saman vegna stöðugrar öndunarstarfsemi.
2. Á byrjunarstigi gróðrartímabilsins minnkar kolvetnaforði misjafnlega ört eftir því, hve hraður byrjunarvöxtur er.
3. Þessi „vor-eyðsla" fer fram, þar til nægilegur blaðvöxtur hefur myndazt. Þegar slíku stigi er náð, fer plantan með tillífun að framleiða meiri fæðu en hún þarfnast sjálf til viðhalds og vaxtar, og kolvetnaforði fer að safnast í vaxandi mæli eftir því, sem plantan þroskast, unz hún að lokum leggst í dvala. Með komu vetrar hefst hringrásin að nýju.

Það er í byrjun gróanda á vorin, sem plöntur eru sérstaklega viðkvæmar fyrir áhrifum beitar og í þeim mun meira mæli sem beitarálag er meira. Ef fyrstu blöðin eru fjarlægð á þessu vaxtarstigi, seinkar það orkusköpun tillífunar og veldur frekari tæmingu á orkuforða plöntunnar. Sé miklu beitarálagi við haldið allt vorið, getur svo farið, að plantan nái ekki að safna orkuforða að nýju og verði þannig illa undir vetur búin. Slíkt eykur líkur á vetrarkali, einkum meðal ungra plantna, og dregur í öllum tilvikum úr framleiðslugetu sumarið, sem á eftir fer. Snemmtekin vorbeit kann einnig að hafa áhrif á tilfærslu kolvetna innan plöntunnar, svo að orka, sem venjulega stuðlar að vexti rótarkerfisins, fer í að endurnýja laufblöðin, sem búsmalinn fjarlægði. Þetta dregur úr rótarvexti og um leið úr getu plöntunnar til að taka til sín vatn og næringarefni. Rýrt rótarkerfi á því tímabili, þegar eðlilegur vaxtarhraði er að jafnaði mikill, getur auk ofannefndra áhrifa einnig valdið því, að óæskilegar beitarjurtir nái undirtökum í gróðrarfélaginu. Séu slíkar óæskilegar plöntur ekki bitnar að vorinu, eykur það samkeppnisaðstöðu þeirra miðað við þær plöntur, sem eru mikið bitnar. Er hætt við, að áhrif slíkra breytinga gæti allt sumarið og dragi þannig hlutfallslega úr framleiðslumagni æskilegra beitarplantna. Er til lengdar lætur, rýrir slík meðferð beitargæði landsins með hlutfallslegri aukningu óæskilegra beitarplantna. Breytingar til hins betra eða afturbati eftir beitarskemmdir, eins og að ofan er rakið, geta reynzt mjög hægfara, einkum á norðurslóðum, þar sem gróðrartímabil er stutt, veðrátta svöl og jarðvegur tiltölulega snauður að næringarefnum. Lítið er vitað um árstíðabundnar vaxtarbreytingar og kolvetnamagn í stönglum og blöðum íslenzkra beitarplantna annars vegar og í rótarkerfi hins vegar. Og sýnu minna er vitað um áhrif beitar á ýmsum tímum árs á þessi atriði né hve langan tíma það tekur tiltekna plöntu að ná sér eftir misjafnlega mikla beit á mismunandi tímum gróðrartímabilsins. Eins og stendur, verðum við að leiða getum að þessum atriðum á grundvelli erlendra rannsókna. Framtíðarrannsóknir hér á landi ættu að leita svara við þessum spurningum sem þáttar í þeirri viðleitni að stöðva hnignun íslenzkra beitilanda.

ÁHRIF ÓTÍMABÆRRAR VOTBEITAR Á BEITARÞOL OG ÞRIF BÚFJÁR

Niðurstöður íslenzkra rannsókna hafa sýnt, að ótímabær vorbeit á úthaga og túnum getur dregið úr afrakstri beitarplantna. Þannig benda bráðabirgðaniðurstöður beitartilrauna í Sölvholti og Kelduhverfi til þess, að mikil beit snemma á gróðrartíma geti dregið mjög úr vexti plantna og afrakstri haglendisins. Þó að almennt (kvalítatift) samspil árstíðabundinnar framleiðslu beitarplantna og beitarþols úthaga sé í flestum atriðum vel þekkt, liggja fyrir takmörkuð töluleg (kvantítatíf) gögn um það, hve mikill nýgræðingur skuli vera kominn að vori, áður en búpeningi er hleypt á landið. Skynsamleg beitarmeðferð skapar hámarksmagn kolvetnaforða í plöntunni og mikinn blaðvöxt, áður en beitt er. Að hinu leytinu ber að gæta þess að fara ekki yfir skaðlegt *lágmark* í þessum efnum. Með því að bíða með vorbeit, þar til plönturnar hafa byggt upp uppurna kolvetnissjóði, má tryggja meiri og jafnari fóðurframleiðslu það, sem eftir er sumars. Á þann hátt má auka beitarþol og afrakstur búpenings á hverja flatareiningu beitilands.

Auk framangreindra atriða má minna á, að þrif beitarpenings eru oft léleg, þegar beit er hafin of snemma að vori. Í 1. töflu eru færðar niðurstöður frá Írlandi, þar sem afrakstur búpenings var mældur sem fall af þeirri tímasetningu, þegar vorbeit hófst. Þessar niðurstöður sýna, að daglegur vaxtarauki beitarpenings getur aukizt mjög verulega með lítilli frestun beitar. Að hinu leytinu er fóðurgildi beitarplantna mest í byrjun gróanda. Og sé beit frestað um of, getur af því hlotizt minnkandi daglegur vaxtarauki búsmalans. Því er æskilegt að kanna með tiltækum ráðum ástand gróðurs á vorin og leita þess vaxtarstigs, þar sem þrif beitarpenings verða sem bezt, án þess að helztu beitarplöntur bíði verulegan hnekki. En þó að hinar írsku niðurstöður gildi í grundvallaratriðum fyrir íslenzk beitilönd, verða þær ekki yfirfærðar í bókstaflegum skilningi, með því að íslenzkur úthagi er að jafnaði miklu ófrjórri. Enn fremur er það breytilegt frá ári til árs, hvenær hæfilegt er að hefja vorbeit, vegna ólíks veðurfars og staðhátta. Þess vegna ætti að meta vandlega, eftir atvikum með aðstoð efnagreininga, vaxtarstig og vaxtarhraða tiltekinna beitarplantna og hleypa búpeningi á landið með hliðsjón af slíku mati.

SAMANTEKT

Hérlendis, þar sem sumur eru stutt og vetur langir, er sérstaklega mikilvægt, að hver einstaklingur í haga skili sem mestum afurðum. Sé vorbeit hafin of snemma, leiðir það til minnkandi plöntuframleiðslu, sem svo kemur fram í minnkandi þyngdaraukningu búfjár og minni heildarframleiðslu á hverja flatareiningu beitilands.

Séu haglendi beitt snemma vors ár eftir ár, breytist samsetning gróðurlenda í þá veru, að lélegar beitarplöntur ná smám saman mestri útbreiðslu. Getur þannig dregið mjög verulega úr afrakstri gróðurlenda bæði í bráð og lengd sé beit hafin of snemma á gróðrartímabilinu.

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