

---

# Alfalfa Establishment Guide - Afghanistan

---

Guy Ewald, June 2009

FAF Development



## Contents

Origin and overview .....	3
Soil, ph and salt .....	4
Fertility .....	4
Seeding Guidelines .....	5
Seeding depth.....	5
Soil to seed contact .....	6
Seeding rates .....	6
Inoculation of alfalfa seed.....	7
Seeding Method .....	7
Seedbed preparation.....	7
Planting.....	8
Management of New Seeding.....	10
Harvesting.....	10
Baling .....	10
Storage .....	11
Forage Market .....	12
Irrigation.....	13
Pests .....	14
Deliverables .....	14
Production Challenges.....	14
Conclusion and Recommendation.....	15
Forage Crop Expansion Plan Recommendation .....	15
Machinery and Equipment .....	16
Equipment Suppliers .....	16
List of needed forage crop equipment for P2K .....	19
Resources .....	28
Quick Links.....	29

## Origin and overview

The purpose of this alfalfa program was to create awareness among the farming community about the importance and development opportunities of alfalfa production, its contribution to increased livestock production, more use of improved seeds and demonstration of better agronomic practices.

Alfalfa is a purple flowering plant in the pea family that is now grown as an important forage crop all over the world. It is a cool season perennial legume living productively for three to 6 years depending on elevation, climate and water. Alfalfa grows to a height of up to 1 meter, and has a deep root system sometimes stretching to 4 meters in the ground; this makes it resilient to droughts.

The plant exhibits auto toxicity which means that it is difficult for alfalfa seed to grow in existing stands of alfalfa; therefore it is recommended that alfalfa fields be rotated with other crops like corn, wheat or vegetables.



The origination of alfalfa is from the mountainous regions of southwestern Asia. Ancient sites were found in northwestern Pakistan, in northern Afghanistan and Kashmir. Related forms and species are found as wild plants scattered over central Asia and into Siberia. By the 1st century B.C. it had spread to Greece and to China by the Silk Road and into southern Spain. By 100 A.D., alfalfa spread its roots into the New World with the Conquistadors.

Alfalfa is widely grown throughout the world as forage for livestock and is most often harvested as hay. It can also be made into silage, grazed, or fed as green chop. Alfalfa has the highest feeding value of all common hay crops and is the highest yielding forage plant when grown on soils where it is well-adapted.

Alfalfa is one of the most important legumes used in agriculture today. Its primary use is feed for cattle and sheep because of its high protein content and highly digestible fiber. It is used as a high quality component of forage mixtures and allows use of lower quality forages in rations. It is also important for soil enrichment and soil water holding capacity improvement.

## **Soil, ph and salt**

All soil textures of sand, loam, and clay can be used for alfalfa. Alfalfa must have good surface and internal drainage for optimum production. Long stand persistence alfalfa should be planted on soils that are well drained. Most of the soils in Afghanistan are well drained. The only time there may be a problem early in the spring when heavy rains and snow melt can create standing water conditions.

Soils acidity is a major deterrent to high yield alfalfa since it affects the utilization of other nutrients. Lime corrects soil acidity. Proper soil pH of 6.5 to 7.0 not only increases the availability of essential plant nutrients but promotes the growth of desirable microorganisms.

Alfalfa is moderately sensitive to salt levels in the soil and in irrigation water but is grown in the arid places of Afghanistan where salinity is an issue.

## **Fertility**

A key to establishing and maintaining highly productive alfalfa is adequate fertilization. Soils low in fertility should be fertilized with manure or commercial fertilizer to build soil nutrient levels before establishing alfalfa.

Phosphorus levels are especially critical during establishment. Phosphorus helps promote rapid root development and seedling establishment especially on soils low to medium in this nutrient.

The demand for potassium by young seedlings is relatively low. It becomes much more important for yield and persistence once stands are established. However, direct contact between fertilizer and seed should be avoided as it may inhibit germination.

Harvesting 2.2 tons of hay/jerb removes approximately 11kg/jerb of phosphorus ( $P_2O_5$ ), 22kg/jerb of calcium, and 50kg/jerb of potassium ( $K_2O$ ). Eventually these nutrients must be replenished with fertilizer application.

Alfalfa's root nodules have the ability to fix nitrogen, thereby producing a high-protein feed without adding nitrogen fertilizer to the soil. The nitrogen comes from the air which is 78 percent nitrogen. These nitrogen fixing abilities will increase soil nitrogen.

## **Seeding Guidelines**

Alfalfa can be seeded in spring or fall and does best on well-drained soils. The two primary seeding periods for alfalfa are late February to early May and August to mid-October. Optimum dates within these ranges vary, depending on location and altitude. Seeding too early in cold wet soils can result in poor germination and seedling loss due to fungal diseases resulting in weak stands. Seeding too late in the summer can cause seedlings to fail due to stress from high temperature and lack of moisture as well as weed competition.

## **Seeding depth**

Alfalfa seeds have a small supply of stored energy to support the developing seedling, so proper seeding depth is very important. Seeds placed too deep are not likely to emerge. Seeds placed on the surface at a shallow depth or in a loose or cloddy seedbed often do not have adequate soil to seed contact. Dry soil conditions following seeding usually result in death of the seedlings. Optimum seeding depth varies (.5 to 1 cm) with soil type, soil moisture, time of seeding, and firmness of seedbed.

A firm seedbed is essential for proper seed placement and for good soil to seed contact. Alfalfa seed should be covered with enough soil to provide

moist conditions for germination but not so deep that the shoot cannot reach the surface.

## Soil to seed contact

Alfalfa seeds need to absorb their own weight in water before germination starts. The absorbed water moves into the seed from the soil. Adequate soil

to seed contact ensures rapid water movement into the seed. Field situations of cloddy or loose soil do not promote good soil to seed contact, resulting in extended germination time and irregular emergence.



## Seeding rates

It is common for only a third of the sown seed to produce seedlings and only half of those to survive the first year. As a result, rates are given in ranges. The recommended rate for pure seeding rate of alfalfa is 3.5 to 7kg per Jerb.

It is critically important to properly calibrate your seeder!

## Inoculation of alfalfa seed

Alfalfa seed should be inoculated with the proper strains of nitrogen-fixing bacteria before seeding. Unfortunately inoculants are not available in Afghanistan at this time.

## Seeding Method

A crop of wheat can be used with a seeding of alfalfa. The wheat provides quicker ground cover than alfalfa seedlings alone and helps reduce wind/water erosion and weed invasion during alfalfa establishment. It also provides a usable crop for grain or green cutting.

## Seedbed preparation

Primary and secondary tillage (conventional tillage) in most cases is used to prepare the seedbed. The erosion potential of a field needs to be considered before choosing how the soil will be prepared. Primary tillage tools like the

moldboard plow, chisel plow, or a heavy disk bury much of the surface residue. This leaves the bare soil subject to runoff and erosion especially on sloping fields.

The purposes of tillage are to loosen the soil, eliminate existing vegetation, bury surface weed seeds, incorporate



fertilizer and provide a smooth surface for harvesting operations. Tillage increases soil moisture loss and soil erosion potential until the crop is established.

Conventional tillage is less desirable for planting in rocky soil or on steep slopes since rocks will be plowed up or excessive soil erosion can occur. Large clods or high residue seedbeds are usually too rough and/or uneven for uniform seed placement and are too coarse for good soil to seed contact. Excessive soil tillage results in fluffy or powdery seedbeds that dry quickly or increase the potential for poor seedling emergence due to surface crusting following irrigation. Small clods or soil granules can help prevent soil crusting.

The final seedbed must be smooth enough for easy machine operation since hay harvesting requires many trips over the field each year. After the final disking the field can be firmed and smoothed using a roller or other improvised methods (such as a tree trunk) if a roller is not available.

Soil firmness can be judged by walking across the seedbed. On properly firmed soil, a man's footprint should be about .5cm deep. If the seedbed is too soft the seed will be planted too deep and if the seedbed is too hard or cloddy the seed may not make good soil contact which will hurt germination.

## Planting

The most common seeding method in Afghanistan is hand broadcast seeding. Hand broadcast seeding involves spreading the seed on the soil surface by hand. Broadcast seeding is difficult to spread evenly and thereby getting an even stand.

The various methods of hand seeding currently employed in Afghanistan are:

- 1.** Spreading the seed on dry soil followed by irrigation
- 2.** Irrigating the land followed by seeding
- 3.** Seeding in standing water

All of these methods appear to be effective, but were not confirmed.

Other broadcast seeding methods include mechanical hand (spinner) seeders that are not available in Afghanistan. These seeders are included in the recommended equipment list.

Demonstrations of the hand seeders can be seen using the following internet links:

<http://www.youtube.com/watch?v=P4xqrZsMjNc>

[http://www.youtube.com/watch?v=AHgEAEA1H8o&feature=channel\\_page](http://www.youtube.com/watch?v=AHgEAEA1H8o&feature=channel_page)

<http://www.youtube.com/watch?v=TiXxpP7n8j8>

An alternative seeding method utilizes a grain drill. Grain drills with boxes for small seeds and seed tubes extending to ground level can accurately meter the seed, but controlling the depth of seeding can be difficult. A considerable amount of seed may be covered too deeply, especially if the furrow openers are set too deeply and the seed is dropped before or near the openers. The seed that falls beneath soil thrown up by the openers are usually covered with too much soil for the seedlings to emerge. If the seed furrow is too deep, the seed falling in the furrow may be too deep for emergence, especially if additional soil is washed into the furrow by irrigation. Higher seeding rates should be used to compensate for these losses.

Drills with press-wheels (not available in Afghanistan) generally provide excellent results if a uniform shallow depth can be maintained. They also work better than culti-packer seeders when some crop residue remains on the soil surface. Drills without press-wheels should be followed with a culti-packer/roller to ensure adequate soil to seed contact. In some areas producers lightly harrow rather than culti-pack/roll. Harrowing does not provide the desired soil to seed contact that a culti-packer does.

The best way, but not yet available in Afghanistan, is culti-packer seeding. The culti-packer seeders consist of two sets of grooved rollers with seed-metering boxes mounted between them. The first set of rollers firms the soil into shallow corrugations behind which the seed is dropped. The second set of rollers splits the ridges of the corrugations covering the seed and firming the soil around it. These seeders have been a common method for seeding alfalfa on tilled seedbeds for many years in the west because they have proper seeding depth and good soil to seed contact.

## **Management of New Seeding**

Alfalfa planted at the proper depth with optimum moisture and temperature, will begin emerging in less than one week. Seed planted deeper than 1cm will emerge more slowly and seed planted deeper than 2.5cm may never emerge.

If proper planting methods are used and weather conditions are optimum, 75 to 90 plants per square meter should be visible within 30 days. Alfalfa stands thin rapidly during the first year and more slowly in subsequent years, the number of stems per plant tend to increase as neighboring plants die.

Optimizing growth of new alfalfa seedlings by minimizing weed, maintaining optimum soil fertility and using best harvest management will pay dividends over the life of the alfalfa stand.

## **Harvesting**

Generally alfalfa in Afghanistan is cut 3 to 5 times a year. However, in the south, they may harvest up to 10 times per year. Yields vary with region, weather, water available and the crop's maturity stage when cut. Cuttings alfalfa when it is more mature improves yield but reduce nutritional content. Alfalfa is the most important high quality forage for livestock because of its high protein, vitamins, energy, and digestibility.

Ideally, the first cutting should be taken at the bud stage and the subsequent cuttings just as the field is beginning to flower or one tenth bloom because carbohydrates are at their highest.

## **Baling**

Alfalfa that is to be used as winter feed should be baled. Loose haystacks or twisted bundles can be used but bales are easier to transport and store. It is very important that the hay be dry before baling. Wet bales will mold. If the hay molds, it will have less feed value and livestock are less likely to eat it.

When using farm equipment rather than hand harvesting, a sickle cutter cuts

the alfalfa and arranges the hay in windrows. After the alfalfa has dried, a tractor pulling a baler collects the hay and compresses it into bales. The bales can be loaded and stacked by hand and loaded into a trailer for transport to winter storage or the market for sale.



The baler that is proposed for Afghanistan can be viewed in the following internet link:

<http://www.youtube.com/watch?v= KVH7gbtL14>

In the Kabul area the most common method of sale is it is sold wet, meaning that it is cut and sold the same day. The wet hay is taken by horse cart or bike into the nearest city and sold into the Hay Market (bazaar).

## Storage

The purpose of hay storage is to maintain the desired quality of the crop. An effective hay storage structure must resist the forces of nature; wind loads that tend to blow the building over, or remove the roof, and snow loads. Storage should provide weather tightness, convenience of access and hay handling, and the proper type of base to prevent spoilage of hay at the floor.

When designing a proper storage structure, the following factors should be considered:

- Site selection
- Base material and site preparation
- Roads and access

- Drainage and snow control
- Building design for weather protection
- Ventilation and condensation control

## Forage Market

In general, alfalfa is delivered to markets/villages by bicycle, horse cart and/or truck. The hay market is a very basic operation. It typically includes a scale and a small space for storage. The farmer/hay seller brings in the crop. The crop is then weighed and the farmer/hay seller is paid.

During the summer, the hay is cut in the morning and transported directly to the market. The hay is brought and sold wet during the summer and in the

winter it is bought and sold dry. This practice is common in larger villages and cities. In Kabul, May "in price" (the amount the farmer/seller receives) was about 15afs/kilo and the "out price" (the hay market sale price) was about 20afs/kilo.

The extension team agreed this is the

same as the P2K area with the exception that more hay is dried for winter use or for winter sale. In all cases the demand far exceeds the supply.



## Irrigation

A good strategy for alfalfa irrigation is to begin the growing season with a soil profile which is holding as much water as possible. A full profile at the beginning of the growing season will allow the crop to take full advantage of available water and put on rapid early season growth. This should be done when soil and water

temperatures are not likely to be so high as to stress the crop and limit production. In most cases, alfalfa produces anywhere from 40 to 50% of its total yield for the year during the first harvest. It is important to get the crop off

to a good start which will have a great effect on the annual yield.



**Amount of water to apply:** On average, irrigated alfalfa will use approximately 12 to 15cm of water for every ton of hay produced. A well fertilized and healthy alfalfa crop may use as much as 24cm of water from the soil in addition to water supplied by irrigation and rainfall before the first cutting.

**Length of time for flood irrigation:** Length of flooding time and irrigation water temperature can have an effect on the growth and survival of alfalfa. It is common when flood irrigating that some parts of the field be under water for an extended period of time during and after irrigation. Alfalfa stand longevity can be shortened considerably by prolonged flooding. Alfalfa is very sensitive to excess soil water. In addition, air temperature and temperature of the irrigation water can affect alfalfa stand longevity. Farmers should avoid prolonged flooding of irrigated alfalfa.

## Pests

Afghan alfalfa does not report high pressures of pests. Some pests such as alfalfa weevils, aphids, armyworms, and the potato leafhopper could reduce alfalfa yields particularly with the second cutting when weather is warmest.

## Deliverables

The following deliverables have been accomplished:

1. Forage crop market assessment
2. Prepared list of needed forage crop equipment
3. Developed alfalfa production training materials
4. Provided trainings to farm store staff and farmers in modern forage crop production methods
5. Designed informational pieces for distribution in P2k area
6. Report including main conclusions and recommendations
7. Provided P2K management with plan for enlargement of forage crop production in P2K area

Photos and powerpoint presentation were delivered to the P2K office in Kabul, Afghanistan.

## Production Challenges

The limiting factors in alfalfa production are as follows:

- Small land area under forage cultivation which limits equipment use
- Cultivation of alfalfa is at a low level due to the use of traditional practices
- Low to medium level of knowledge on alfalfa production and management
- Low soil fertility and poor irrigation practices
- Low rainfall and draught conditions
- Limited use of fertilizer, commercial or animal

- Cost of quality or improved seed
- Competition with food crops for humans
- Difficult to extend the cultivated land due to lack of water/irrigation

## Conclusion and Recommendation

In the 5 years that I have been consulting on Afghan agriculture, there has been an extreme shortage of livestock feed. This is the 1<sup>st</sup> project that is addressing this extreme feed shortage. This should have been an initial step years ago. This lack of feed will continue to dampen development of the livestock market if it is not changed.

There is a potential for additional acres of alfalfa production. It is critical to maximize the capability of this land. This project and the recommended expansions are linchpins to the success of further livestock development.

Even though security concerns restricted my access to the P2K area, we were still able to successfully conduct the training of the trainers.

## Forage Crop Expansion Plan Recommendation

Unfortunately, due to unsecure conditions, I was not allowed to travel into P2K to get a first-hand look. With a potential of 6,000 acres of alfalfa coming on line, it is recommended that the following 3 areas be further developed:

1. Build the farm stores knowledge base and the capacity to buy, store and sell dry alfalfa into the winter months.
2. Establish a demonstration farms using demonstration equipment. Instruct farmers on the proper use of the equipment to maximize yield. This should be done with a consultant with the appropriate expertise to provide hands-on training after the equipment is on-site.
3. Establish a feedlot and alfalfa feeding demonstration within the local areas.

## Demonstration farm/feedlot objectives

The recommended objectives of the establishment of a demonstration farm and feedlot are as follows:

- Understand and improve the alfalfa production and feedlot systems in P2K area
- Test and introduce new alfalfa and feedlot methods
- Research the feasibility of the establishment of commercial forage and livestock production units
- Develop concept of better utilization of forages in livestock feeding
- To increase the production per unit (feed/livestock) per area on the existing cultivated lands.
- Familiarize farmers with the production potential of Alfalfa in feedlots

## Machinery and Equipment

Photos and videos of current methods of cutting, raking and baling hay can be viewed at:

<http://www.flickr.com/photos/fafdevelopment/sets/72157619880954903/>

## Equipment Suppliers

### Helal Group

---

Kabul, Afghanistan

Website: [www.helalseeds.com](http://www.helalseeds.com)

Email: [info@helaseeds.com](mailto:info@helaseeds.com)

Online catalog:

#### *Balers*

[http://www.alibaba.com/catalogs/12801/Balers.html?traceLog=vertical\\_category&readCookie=Y&needStatistic=Y](http://www.alibaba.com/catalogs/12801/Balers.html?traceLog=vertical_category&readCookie=Y&needStatistic=Y)

#### *Harvesters*

[http://www.alibaba.com/catalogs/12803/Harvesters.html?traceLog=vertical\\_category&readCookie=Y&needStatistic=Y](http://www.alibaba.com/catalogs/12803/Harvesters.html?traceLog=vertical_category&readCookie=Y&needStatistic=Y)

## John Deere

---

Website: [http://www.deere.com/en\\_US/deerecom/usa\\_canada.html](http://www.deere.com/en_US/deerecom/usa_canada.html)

Online catalog:

### *Hay and Forage Equipment*

[http://www.deere.com/en\\_US/ProductCatalog/FR/category/FR\\_HAY.html](http://www.deere.com/en_US/ProductCatalog/FR/category/FR_HAY.html)

Dealer:

AG Power Enterprises, Inc.

Belle Plaine, Hollandale, Owatonna, and Waseaca, MN

Contact: Jacob M. Veldman

1 (507) 889-4221 [Hollandale Office]

1 (507) 383-2185 [Mobile]

Freight Forwarder Contact: Blake Bina 1 (800) 726-2996

Private Exporter Contact: Don Dressen 1 (507) 760-4004

Dealer:

JB Tractors LLC (US Company Name)

16634 County Rd 156 NW

Brandon, MN 56315

Contact: Bas Nijland

Cell Phone: 1 (320) 760-9334

1 (320) 876-2406 [Workshop]

1 (320) 876-2264 [Office]

Website: [www.jbtractors.com](http://www.jbtractors.com)

Email: [info@jbtractors.com](mailto:info@jbtractors.com)

Dealer:

Kofo Tractor Centre (European company name)

Nijverheidsweg 18

7671 Da Vriezenveen (OV)

Nederland

Phone: + 31-(0)546-564926

Website: [www.kofo.nl](http://www.kofo.nl)

Email: [kofo@kofo.nl](mailto:kofo@kofo.nl)

Contact: S. Nijland

Cell Phone: + 31-(0)653-428-664

## Orient Irrigation Service

---

Dubai, UAE 00971-4- 2972700

Email: [orient@orientirrigation.ae](mailto:orient@orientirrigation.ae)

## Brillion Farm Equipment

---

Website: [www.brillionfarmeq.com](http://www.brillionfarmeq.com)

## Krone

---

Website: <http://www.krone-northamerica.com/>

## New Holland

---

Website:

[http://www.newholland.com/h4/products/products\\_series.asp?Reg=N&RL=ENNA&NavID=000001277003&line=000001864511](http://www.newholland.com/h4/products/products_series.asp?Reg=N&RL=ENNA&NavID=000001277003&line=000001864511)

## Kuhn

---

Website: <http://www.kuhnnorthamerica.com/>

## Vermeer

---

Website: <http://www.vermeerag.com/>

## New Idea

---

Website: <http://www.newidea.agcocorp.com/>

Contact: Gary Budach 1 (507) 465-3237

## Class

---

Website: [http://www.claas.com/countries/generator/cl-pw/en/home\\_feature,lang=en\\_US.html](http://www.claas.com/countries/generator/cl-pw/en/home_feature,lang=en_US.html)

## List of needed forage crop equipment for P2K

The following equipment is recommended for improving alfalfa production in Afghanistan:

1. Hand seeders – The extension team was very interested in the hand-seeders because they inexpensive and easy to use. The farm stores could have several on hand to rent to the farmers on the daily basis. The quality of the seeding will be better because these hand seeders will spread the seed more evenly than by hand.
2. Drills - These would useful for developing larger areas of land.

3. Brillion seeder - The Brillion seeder is one of the best on the world market. If more funds become available, acquisition of this seeder should be considered.
4. 3 pt hitch mower - These will improve harvesting capabilities.
5. Walk behind mowers - These will improve harvesting capabilities.
6. Balers - These are an important part of the alfalfa project. Balers will enable the farmers to greatly improve storage capabilities.



Figure 1 : Hand-seeder

This inexpensive hand seeder can be purchased at a cost between \$10 and \$15 per unit. This product is made in China.



Figure 2: Hand-seeder

This is a moderately priced hand-seeder that can be purchased at a cost of \$25 to \$40.



**Figure 3: Drill**

This drill can be sourced from China or Pakistan to fit on a 40 horse power tractor. The cost of this type of drill is \$1,000 to \$1,500. One drill has been purchased and is in transit. We did not have the opportunity to field test this equipment. The extension team was trained on the drills at the state farm for overall use and calibration.



**Figure 4: Brillion Seeder**

This Brillion seeder is made in the USA. The acquisition cost including delivery to Kabul is approximately \$15,000.



**Figure 5: Hitch mower**

This 3 point hitch mower can be attached to a 40horse power tractor at a cost of \$800 to \$1000 each. Four of these have been ordered.



**Figure 6: Sickle-mower**

This is a “walk-behind” sickle mower. It is a 5 horse power machine that can be purchased for \$1000 to \$1200. It would take approximately 6 weeks for delivery.



**Figure 7: Two wheel tractor**

The above picture is of a two wheel tractor that was demonstrated for us. Nine of these tractors have been ordered.



**Figure 8: Baler**

This baler is made in China and sells for approximately \$5,000. Four of these bailers have been ordered. When this machinery arrives, a consultant should return to ensure proper set up and training.

## Resources

Carpenter, J., Knight, J., & Johnson, W. S. (n.d.). *Integrated Pest Management of Insect Pests in Alfalfa Hay*. Retrieved May 2009, from University of Nevada Cooperative Extension: <http://www.unce.unr.edu/publications/files/ag/other/fs9811.pdf>

*Crop Profile for Alfalfa and Other Hay Production in South Dakota*. (n.d.). Retrieved May 2009, from National Site for the USDA Regional IPM Centers Information System: <http://www.ipmcenters.org/cropprofiles/docs/SDalfalfa.pdf>

Duffy, M., & Smith, D. (2008, December). *Estimated Costs of Crop Production in Iowa - 2009*. Retrieved May 2009, from Iowa State University, University Extension: <http://www.extension.iastate.edu/AGDm/crops/html/a1-20.html>

Meyer, D., & Helm, J. (1994, November). *Alfalfa Management of North Dakota*. Retrieved May 2009, from North Dakota University: <http://www.ag.ndsu.edu/pubs/plantsci/hay/r571-1.htm>

Minnesota Department of Agriculture; Compiled by Lundgren, Jonathan G.; Bartels, David W. (2009). *Minnesota Plant Pest Survey*. Retrieved May 2009, from Minnesota Department of Agriculture: <http://www.mda.state.mn.us/plants/growing/alfalfa.htm>

Oklahoma State University. (n.d.). *Alfalfa in Oklahoma*. Retrieved May 2009, from Oklahoma State University: <http://alfalfa.okstate.edu/pub/alfalfa-production/guide1.pdf>

Purdue University. (n.d.). *Forage Information*. Retrieved May 2009, from Purdue University, Agronomy Extension: <http://www.agry.purdue.edu/ext/forages/index.html>

Texas Agricultural Extension Service; Zerle L. Carpenter, Director. (n.d.). *Texas Alfalfa Production*. Retrieved May 2009, from Forages of Texas: <http://foragesoftexas.tamu.edu/pdf/alfalfa.pdf>

University of California Agriculture and Natural Resources. (n.d.). *Statewide Integrated Pest Management Program*. Retrieved May 2009, from UC IPM Online: <http://www.ipm.ucdavis.edu/PMG/selectnewpest.alfalfa-hay.html>

University of Wisconsin Extension. (n.d.). *University of Wisconsin Forage Research and Extension*. Retrieved May 2009, from University of Wisconsin - Extension: <http://www.uwex.edu/ces/forage/articles.htm>

Wilson, H. R., & Eisley, J. (n.d.). *Insect Pest Management on Alfalfa*. Retrieved May 2009, from Ohio State University: <http://ohioline.osu.edu/ent-fact/0031.html>

## Quick Links

<http://www.oznet.ksu.edu/library/crpsl2/C683.pdf>

<http://foragesofttexas.tamu.edu/pdf/alfalfa.pdf>

<http://www.extension.iastate.edu/AGDm/crops/html/a1-20.html>

<http://www.mda.state.mn.us/plants/growing/alfalfa.htm>

<http://www.ag.ndsu.edu/pubs/plantsci/hay/r571-1.htm>

<http://www.agry.purdue.edu/ext/forages/index.html>

<http://www.uwex.edu/ces/forage/articles.htm>

<http://alfalfa.okstate.edu/pub/alfalfa-production/guide1.pdf>

<http://www.ipmcenters.org/cropprofiles/docs/SDalfalfa.pdf>

<http://ohioline.osu.edu/ent-fact/0031.html>

<http://www.ipm.ucdavis.edu/PMG/selectnewpest.alfalfa-hay.html>

<http://www.unce.unr.edu/publications/files/ag/other/fs9811.pdf>