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ПОВЫШЕНИЕ ПРОДУКТИВНОСТИ ЛЮЦЕРНЫ НА МАРГИНАЛЬНЫХ ПЕСЧАНЫХ ПОЧВАХ

МАРГИНАЛДУУ КУМДУУ ТОПУРАКТАРДА БЕДЕНИН ТҮШҮМДҮҮЛҮГҮН ЖОГОРУЛАТУУ

ENHANCING ALFALFA PRODUCTION IN MARGINAL SANDY SOILS

Аннотация. Люцерна является одной из кормовых культур, широко культивируемой благодаря ее приспособляемости к различным почвам и условиям окружающей среды. Эта кормовая культура выращивается более чем в 80 странах, где производится более 210 миллионов тонн сена из люцерны. Почвы ОАЭ преимущественно песчаные и неплодородные и, следовательно, обладают плохими физическими, химическими свойствами и плодородием, что предполагает частое орошение и пополнение запасов питательных веществ в зависимости от потребностей урожая. Среди других кормов люцерну выращивают во многих хозяйствах. Устойчивая система сельскохозяйственного производства играет важную роль в создании вариантов, обеспечивающих устойчивость, путем разработки систем, которые являются экологически предпочтительными, более ресурсосберегающими и часто более рентабельными (Gupta RJ et al, 2009). Песчаным почвам пустынь присуще низкое плодородие, и из-за высокой дренажной способности происходят значительные потери питательных веществ и воды. Высокая температура, дефицит воды и соленость являются другими факторами, ограничивающими сельскохозяйственное производство в условиях пустыни (Suarez et al, 2010).

Засоление и засуха, два очень тесно связанных абиотических стрессора, негативно влияют на продуктивность сельскохозяйственных культур (Gamalero et al., 2020). Почти 20 % от общей площади орошаемых земель подверглись деградации из-за избыточного засоления почв (FAO, 2020). Для удовлетворения потребностей растущего населения в продовольствии, фуражех, энергии из биомассы, продуктах с добавленной стоимостью и занятости крайне важно развивать на этих маргинальных землях устойчивые сельскохозяйственные системы в стесненных условиях.

Ключевые слова: люцерна, устойчивое сельское хозяйство, фураж, зернобобовые корма, производство биомассы.

Абстракт. Беде ар кандай топурактарга жана айлана-чөйрөнүн шарттарына ылайыкташкандыгы үчүн кеңири өстүрүлгөн тоют өсүмдүктөрүнүн бири. Бул тоют өсүмдүгү 80ден ашуун өлкөдө өстүрүлөт, анда 210 миллион тоннадан ашык беде чөбү өндүрүлөт. БАЭнин топурактары негизинен кумдуу жана кунарсыз, ошондуктан физикалык, химиялык касиеттери жана түшүмдүүлүгү начар, бул түшүмдүн муктаждыгына жараша тез-тез сугарууну жана азык заттарын толуктоону талап кылат. Башка тоюттардын катарында беде көптөгөн чарбаларда өстүрүлөт. Туруктуу айыл чарба өндүрүш системасы экологиялык жактан артыкчылыктуу, ресурстарды үнөмдөөчү жана көбүнчө үнөмдүү болгон системаларды иштеп чыгуу аркылуу туруктуулукту камсыз кылган варианттарды түзүүдө маанилүү ролду ойнойт (Gupta RJ et al, 2009). Чөлдөрдүн кумдуу топурактары аз түшүмдүүлүккө ээ жана дренаждык кубаттуулугу жогору болгондуктан, азык заттар менен суунун олуттуу жоготуулары бар. Жогорку температура, суунун тартыштыгы жана туздуулук чөл шарттарында айыл чарба өндүрүшүн чектеген башка факторлор болуп саналат (Suarez et al, 2010).

Шор жана кургакчылык, бири-бири менен тыгыз байланышкан эки абиотикалык стресс, айыл чарба өндүрүмдүүлүгүнө терс таасирин тийгизет (Gamalero et al., 2020). Сугат жерлеринин жалпы аянтынын дээрлик 20% топурактын ашыкча тузданууусунан улам деградацияга учураган (FAO, 2020). Өсүп келе жаткан калктын азык-түлүккө, жемге, биомасса энергиясына, кошумча наркка жана жумушка болгон муктаждыктарын канааттандыруу үчүн бул маргиналдык жерлерде тар шарттарда туруктуу айыл чарба системаларын өнүктүрүү өтө маанилүү.

Негизги сөздөр: беде, туруктуу айыл чарба, тоют, дан-буурчак тоют, биомасса өндүрүү.

Abstract. Alfalfa is one of the forage crops widely cultivated due to its adaptability on different soil and environmental conditions. This forage crop is cultivated in more than 80 countries with over 210 million tons of alfalfa hay produced. The soils of the UAE are dominantly sandy and infertile and hence show poor physical, chemical and fertility properties, suggesting frequent irrigation and replenishment nutrients based on crop requirement. Among other forages alfalfa is grown in many farms. Sustainable agriculture production system plays an important role in creating the options that enable sustainability by developing systems that are environmentally preferable, more resource-efficient, and often more cost-effective (Gupta RJ et al, 2009). Desert sandy soils are low in inherent soil fertility and due to high drainage capacity there are significant losses of nutrients and water. High temperature, water scarcity and salinity are other constraints limiting agricultural production in desert environment (Suarez et al, 2010).

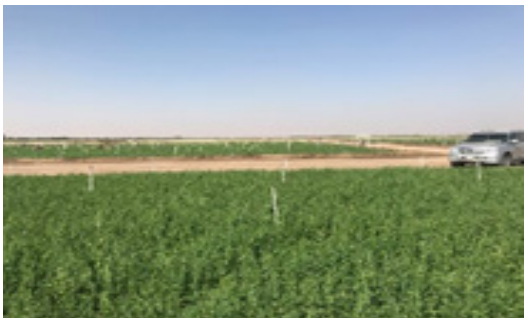
Salinity and drought, two very closely associated abiotic stressors, negatively affect crop productivity (Gamalero et al., 2020). Almost 20 % of the total irrigated land has been degraded due to excess soil salinity (FAO, 2020). To meet the food, fodder, biomass energy, value-added product and employment requirements of the expanding population, it is critical to developing sustainable agricultural systems under constricted conditions in these marginal lands.

Key words: Alfalfa, sustainable agriculture, fodder, legumineous forages, biomass production.

Introduction

Alfalfa *(Medicago sativa)* is a perennial forage legume crop. It is used for grazing, hay, and silage, as well as a green manure and cover crop. It is used less frequently as pasture. Alfalfa normally lives four to eight years depending upon the environment and potential of the variety. Once seedlings are established through small-seeds the plants can reach upto height of 2-3 feet with deep root system (+2 meters) with unrestricted good soil substratum. Alfalfa initially grows

slowly, after several months hard crowns are established that contain shoot buds enabling alfalfa to regrow many times after being grazed or harvested. It is a perennial crop grown as a forage, either for fresh produce or for hay.



Like other legumes, its root nodules contain bacteria, *Sinorhizobium meliloti*, with the ability to fix nitrogen, producing a high-protein feed regardless of available nitrogen in the soil. Its nitrogen-fixing ability (which increases soil nitrogen) and its use as an animal feed greatly improve agricultural efficiency. Alfalfa grows well on well-drained soils with a neutral pH of 6.5 – 7.5. Soils low in fertility should be fertilized with manure or a chemical fertilizer, but correction of pH is particularly important. Alfalfa is cut three to four times a year. Total yields are typically around eight tones per hectare in temperate environments, but yields have been recorded up to 20 t/ha.

Nutritional Values of Alfalfa

Alfalfa is rich in chlorophyll, carotene, protein, calcium and other minerals, vitamins in the B group, vitamin C, vitamin D, vitamin E, and vitamin K. The sun-dried hay of alfalfa has been found to be a source of vitamin D, containing 48 ng/g (1920 IU/kg) vitamin D_2 and 0.63 ng/g (25 IU/kg) vitamin D_3.

An overview of alfalfa field needs attention to intensify alfalfa production

Salinity tolerance

Alfalfa is moderately sensitive to soil salinity. It is frequently used in reclamation of saline and sodic soils to restore good soil structure. Yield decrease related to electrical conductivity is: 0 % at ECe 2.0 dS/m, 10% at 3.4, 25% at 5.4, 50% at 8.8, and 100% at ECe 15.5 dS/m.

Climate and Soils

Alfalfa is grown in a wide range of climates where average daily temperature during the growing period is above 5°C. The optimal temperature for growth is about 25°C and growth decreases sharply when temperatures are above 30°C and below 10°C. In warm climates, the production is higher under dry as compared to humid conditions.

Harvesting alfalfa

Harvest has to be timed to secure maximum amount of good seeds. It takes 5-6 weeks for the seeds to mature after pollination. Harvest can begin when three-quarters of the pods have changed color to brown or dark brown and before too much shedding begins. Because of uneven ripening, alfalfa is usually cut and allowed to dry in windrows before manual threshing or combining. Drying to about 14 percent moisture prepares the crop for combining.

When alfalfa is to be used as hay, it is usually cut and baled that is easy to store, transport and feed.

When used as feed for camels, alfalfa is often made into haylage by a process known as ensiling. Rather than being dried to make dry hay, the alfalfa is chopped finely and fermented in silos, trenches, or bags, where the oxygen supply can be limited to promote fermentation. The anaerobic fermentation of alfalfa allows it to retain high nutrient levels similar to those of fresh forage, and is also more palatable to dairy cattle than dry hay

Mitigation to improve alfalfa yield

- Select high yielding varieties with high levels of resistance to insects and diseases
- Soils should be healthy, deep enough to have adequate water-holding capacity.
- This great rooting depth gives alfalfa excellent drought tolerance.
- Integrated nutrient management
- Irrigation management to offset crop requirement based on ETc.

Field preparation

Alfalfa seeds can remain in soil for several years. Therefore, it is important to select fields where alfalfa has not been grown in the previous four years. On newly-claimed land, another crop such as wheat should be grown for at least two years before planting alfalfa. The soil should be fine and free of large clods and residues. This could be achieved by one deep ploughing and two-three harrowing followed by leveling to the desired tilth.

It is common practice to prepare soil well ahead of sowing of seed. Perennial weeds can be particularly competitive both during the seeding year and in subsequent years. Controlling weeds before seeding will help ensure a long-lasting, productive stand. Appropriate tillage practices are to be followed to prepare soil and eradicate weed. Primary tillage loosens the soil and helps control perennial weeds while disking controls weed regrowth, helps level the land, and breaks up large soil clods. The final tillage should be some type of smoothing operation.

Sowing

In temperate areas, alfalfa is sown in spring to obtain seed yields from the first growth in the same year. In more warmers areas, it can be sown in autumn to harvest seed the following year. The seed is normally drilled in rows on the seed-beds but seed can also be broadcast on moist fields. In UAE conditions 35-40 cm spacing between rows is considered as optimum. The optimal depth of sowing is 10-15 mm with a light but firm soil cover to promote seed-soil contact. Seed rates between 12-15 kg/ha are required, depending on spacing. A high proportion of hard seed (30-40%) can be present in seed lots. Therefore, seed treatment before sowing may be necessary.

Time of seeding - adequate soil moisture enhances seed germination and establishment. Do not seed unless good soil moisture is present. It should be noted that at emergence, alfalfa is extremely cold tolerant. At the second trifoliate leaf stage, seedlings become more susceptible to cold injury. A pre-plant herbicide is usually not needed, however, postemergence herbicides can be used if severe weed problem developed. Alfalfa needs at least 6 weeks growth after germination to survive the cold winter. *Minimizing competition from weeds is critical to ensure adequate development of alfalfa.* Failure to do so cuts seedling establishment and lowers yields particularly in no-till fields.

Alfalfa Establishment

An alfalfa crop is usually planted for 2 or 3 years, with on average a cut each month. The secret for securing high yields and quality throughout its life cycle is to suceed in crop establishment.

This requires an optimum plowing of the soil and a sufficient number of alfalfa plants, well distributed per square metre (about 600 plants/m² at sprouting), thanks to good seeding.

Seeding depth

Following should be followed where appropriate:

- Seed should be covered with enough soil to provide moist conditions for germination while allowing the small shoot to reach the surface.
- Optimum seeding depths vary depending on soil types. Plant seed 1/4- to 1/2-inch deep on medium and heavy textured soils

and 1/2- to 1-inch deep on sandy soils.

• Shallower seedings may be used when moisture is adequate while deeper seedings should be used in drier soils. Please check the soil moisture depth before seeding.

• Careful irrigation is required to avoid soil crusting that prevents seeds emergence

Irrigation management

Crop water requirements are between 1000 and 1600 mm per growing period depending on climate and length of growing period. Water use by the crop in relation to its production is high when compared to other forage crops. Alfalfa has a deep rooting system extending up to 2 m in deep soils. Improper irrigation limits alfalfa yields more often than any other management factor.

Potential of using animal manure to improve soil health

One of the key factor to nourish soils and minimize weeds spread is to use appropriate manures at the time of field preparations. Chicken manure or mix of Chicken and Cow manure is best practice to establish 40-50 tones/Hac. Depending on soil fertility, alfalfa requires 55-65 kg/ha of phosphorus and 75-100 kg/ha of potassium, applied as basal dose at the time of planting. Alfalfa is capable of fixing atmospheric nitrogen which meets its requirements for high yields. However, a starter of approximately 40 kg/ha of nitrogen is beneficial for good early growth.

• Manure is a complete nutrient source, containing all the major nutrients

• It promotes biological activity in the soil and enhances the soil physical properties.

• *It should be noted that while manure may be beneficial to soil, applying manure on alfalfa fields can create problems. Manure can burn leaves, reducing yield and quality.*

• Nitrogen in manure can stimulate weeds growth. Alfalfa will use applied nitrogen but does not need it due to its ability to fix nitrogen. *Therefore, careful nitrogen management will be required based on soil and plant testing and the N applied in the form of Manure.*

• Spread manure immediately after removing a cutting so manure contacts the soil instead of the foliage. This reduces the risk of salt burn and minimizes palatability problems.

• Spread manure only when soils are firm to limit soil compaction and to avoid damaging crowns.

Weeds effect on alfalfa production

Weeds reduce alfalfa production during establishment by competing with and choking out young alfalfa seedlings. Weeds also invade established alfalfa fields and reduce forage quality and alfalfa yield. Effective weed control begins before seeding and continues throughout the life of the stand. The most important factor in weed management is to establish and maintain a vigorous alfalfa crop. Proper soil fertility and pH, seedbed preparation, varietal selection, and appropriate cutting schedules cannot be overemphasized to prevent weed encroachment. If using a herbicide, remember that application timing and rates vary. Once the initial infestation is controlled, follow-up monitoring and control is required to ensure that reinfestation does not occur.

Weed control recommendations

Weed control is important especially in seedling establishment stage. Several pre- and post-emergent herbicides can be used to control both grasses and broadleaf weeds and for more information, contact your local agricultural extension services.

Weeds can be controlled by mechanical removal or exhaustion. Removal by hoeing, digging out or repeat cultivation is an effective control for most annual and biennial weeds but less effective (as most gardeners know) for perennial weeds with underground rootstocks. It is possible to exhaust persistent perennial

weeds by repeated removal, but it is easy to allow a weed to recover if repeat cultivation is delayed for any reason (e.g. unsuitable weather). Other strategies like fallowing, or covering the ground with plastic mulch are usually essential to success. Deep ploughing will reduce perennial weeds.

The Stale Seedbed technique

The "stale seedbed technique" can work well to reduce competition from annual weeds whose seeds will remain in the soil after clearance. This method involves preparing a seedbed then delaying sowing to allow a flush of weed seed germination from the surface layers. This flush of weeds is then killed, by spraying or surface cultivation/ hoeing, before sowing your seed mixture onto the cleaned "stale" seedbed - the surface of which now has a reduced weed seed burden. Timing and weather conditions are important for success.

- Most alfalfa stands are left in production for several years. The absence of tillage during the life of the stand naturally favors invasion by perennial weeds.
- Thorough tillage helps uproot existing annual weeds and sets back established perennial weeds.
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Diseases and Insect pests

Alfalfa mosaic virus, Anthracnose, Bacterial wilt, Fusarium wilt and Rhizoctonia stem rot are some of the common diseases of alfalfa. Lygus bug, alfalfa plant bug, alfalfa weevil and pea aphids are the common insect pests on alfalfa. For chemical control, consult with the agricultural extension services in your area. Chemical control measures should take into account the need to protect pollinators like honeybees and avoiding insecticide sprays at the time of flowering.

Drying and Storage

Seed must be dried immediately after combining. The temperature of the drying air should not exceed 38°C. If the initial moisture content is above 20%, the air temperature should be lower than 30°C and progressively increased as the seed loses moisture. Dried seeds can be cleaned with air/screen cleaner followed by a gravity separator. For longer periods of storage, moisture content should be reduced to below 8%.

Constraints and viable options to improve alfalfa production

Alfalfa plant exhibits auto-toxicity which means it is difficult for alfalfa seed to grow in existing stands of alfalfa. Therefore, alfalfa fields are recommended to be rotated with other species (other potential crops, like maize, sorghum, pearl millet, grasses etc.) before reseeding. Low seed rates used, usually a seeding rate of 13 – 20 kg/hectare is recommended, with differences based upon region, soil type, and seeding method. Harvesting the alfalfa by mowing the entire crop area destroys the soil biology, but this can be avoided by mowing in strips so that part of the growth remains. Wet soils create conditions suitable for diseases that may kill seedlings, reduce forage yield, and kill established plants. High pH of soil disturb the nutritional disturbance due to precipitation of phosphorous and micronutrients. Insufficient inoculum in soil reduces nodulation and nitrogen fixation. Another limitation to crop growth is poor drainage, soil with hard pan within potential rooting zone (1 m) of alfalfa. Poor soil drainage also reduces the movement of soil oxygen to roots while uneven soil leads to low spots where water stands and create patchy waterlogging. The weeds if not controlled before seeding, these weeds may re-establish faster than the new alfalfa seedlings and reduce stand density.

Conclusion Summary

In the current scenario, agricultural research is required to focus on the identification and utilization of alfalfa varieties for sustainable agriculture in marginal lands such as saline and sodic soils. Research efforts must be intensified to understand the morphological, physicochemical, genetic and biochemical properties of the local species that render their successful growth in saline-rich areas under diverse climate conditions (Busby et al., 2017). Such studies will enable the large-scale cultivation of appropriate alfalfa varieties in non-fertile saline soils, which is yet to be achieved.

Adaptation: Mild/ Cool season
Planting time: Spring, Autumn
Rotation: Four years
Salinity threshold: 4.0 dS/m
Pollination behavior: Cross-pollinating, Insects
Isolation: 100 m
Soil pH: 6.5-7.5
Row spacing: 35-50 cm
Plant spacing: Broadcasting or drilling
Seeding depth: Not more than10-15 mm
Seed rate: 12-15 kg/ha
Fertilizers (per ha): N 40 kg, P 55-65 kg, K 75-100 kg
Harvesting: Pods change in color to brown or dark brown
Seed yield: 200-300 kg/ha

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