Chapter 7 Yield and production costs of *Avena sativa* and Vicia faba in the upper Mezquital, Hidalgo

Capítulo 7 Rendimiento y costos de producción de *Avena sativa* y *Vicia faba* en el alto Mezquital, Hidalgo

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Abstract

Forage production is of great importance because it is a livestock input for the nutrition and feeding of the livestock sector. The objective of this project was to evaluate the effect of soil improvers on the yield of Avena sativa and Vicia faba to enhance agricultural productivity in alkaline soils in the upper Mezquital, Hidalgo; in order to ensure livestock feeding in this area. A completely randomized block experimental design was used. The use of organic amendments such as 150 kg ha-1 of manure supplied to the soil favored the biomass yield in oats (13,179 kg ha-1) and it should also be noted that the A-ES treatment reported a lower injection cost ($5,405) and a higher net profit ($11,057). 5), in the bean crop, the supply of organic amendments, minerals and phytohormones favors the yield in this forage, it should be noted that this treatment had a higher investment cost ($6,320) and lower net profit, both compared to the production system of this area. With the above, producers are invited to supply organic matter to the soil to increase the yield in forage productivity.

Oats, Biomass, Livestock input, Broad bean

Resumen

La produccion de forrajes son de gran importarcia debido a que es un insumo ganadero para la nutrición y alimentacion del sector pecuario. El objetivo del presente proyecto fue evaluar el efecto de mejoradores de suelo sobre el rendimiento de Avena sativa y Vicia faba para potencializar la productividad agrícola en suelos alcalinos en el alto mezquital, Hidalgo; con la finalidad de asegurar la alimentación ganadera en dicha zona. Se utilizo un diseño experimental de bloques completamente al azar. El uso de enmiendas organicas como son los 150 kg ha-1 de estiercol suministrados a el suelo favorecen el rendimiento de biomasa en avena (13,179 kg ha-1) asi mismo cabe señalar que el tratamiento A-ES reporta menor costo de inbercion ($5,405) y mayor ganancia neta ($11,057.5), en el cultivo de haba el suministro de enmiendas organicas, minerales y fitohormonas favorece el rendimiento en dicho forraje, cabe señalar que dicho tratamiento tuvo mayor costo de inversión ($6,320) y menor ganancia neta, abos comparados con el sistema deproducción de dicha zona. Con lo anterior se invita a los productores a suministrar materia organica a el suelo para incrementar el rendimiento en la productividad forrajera

Avena, Biomasa, Insumo ganadero, Haba

7 Introduction

Fodder is a crop that is used to feed the livestock sector. They can be consumed standing or deferred, depending on the needs of the production process, grass, feed, fodder, hay and silage. Forages are of great importance in livestock feeding due to their high dry matter production and low cost; there are highly adaptable forages that develop in different climatic conditions and low temperatures compared to forage crops such as maize, wheat or barley (Espinoza et al., 2018).

Legumes in animal feed represent an alternative due to their high content of protein, fibre and bioactive compounds. They can be used alone or in mixed crops with grasses. In some regions of the world, there has been a growing interest in the use of fava beans (Vicia faba). In Mexico, fava bean is the third most important grain legume crop in terms of production and is of social, economic and medicinal importance (Díaz and Escalante, 2019). In 2019, 11,500 ha were allocated for green bean cultivation and 19,800 ha for dry grain, with an average yield of 5.5 and 0.7 t-ha-1, respectively (Anonymous, 2019). These low yields are due to the susceptibility of the bean to biotic agents, long vegetative cycle, it is a crop sensitive to lodging, and the characteristics of bean size and colour are only locally accepted; i.e., most producers commonly plant native or traditional cultivars (Morales et al., 2002). Moreover, in traditional production systems, the same cultivar is used for both green pod and dry grain production. On the other hand, oats (Avena sativa) are of great importance in Mexico, as they are a key input for the production of balanced feed for livestock use, due to the fact that they are an easily managed crop and an alternative that generates high levels of biomass production per hectare with considerable nutritional values and high palatability (Figueroa and Morales, 2023).

This crop has the following advantages: low production costs, adaptability to different climatic zones, annual production, high biomass yields, excellent protein value and digestibility. This type of forage generates positive expectations that open the way to solving the production difficulties of cattle and sheep feed in arid regions (Campuzano et al., 2020). In addition, the objective of this project was to evaluate the effect of soil improvers on the yield of Avena sativa and Vicia faba to enhance agricultural productivity in alkaline soils.

7.1 Methodology

The present experiment was carried out in the upper Mezquital area, where an experimental plot was taken as the study area in the ejido El Mezquital, located in the municipality of Santiago de Anaya, Hidalgo at an altitude of 1951 metres above sea level; at a latitude of 20.373056 and a longitude of -99.021111. The experiment was established using a completely randomised block experimental design with the following treatments.

Table 7 Treatments established in the field

No.	Abbreviation	Description	Dosage
1	A-ES-MIN	Oats, manure and minerals.	135 kg/ha de ES, 2.5 kg/ha Diat, 11.300 kg/ha microelementos.
2	A-ES-MIN-FITO	Oats, manure, minerals and phytohormones.	135 kg/ha de ES, 2.5 kg/ha Diat, 11.300 kg/ha microelementos.
3	A-ES	Oats with manure.	150 kg/ha.
4	T-A	Vein test.	0
5	H-ES-MIN	Faba bean, manure and minerals	135 kg/ha de ES, 2.5 kg/ha Diat, 11.300 kg/ha microelementos
6	H-ES-MIN-FITO	Faba bean, manure, minerals and phytohormones.	135 kg/ha de ES, 2.5 kg/ha Diat, 11.300 kg/ha microelementos.
7	H-ES	Faba bean, manure	150 kg/ha.
8	T- H	Fava bean witness	0

Where: A is Avena sativa, H is Vicia faba, ES refers to manure, MIN is mineral, FITO refers to Fitohormones and T refers to the control.

Fodder oats (Chihuahua variety) were established at a sowing density of 100 kg ha-1. Faba bean with large ball seed at a sowing density of 60,000 thousand seeds ha-1. Green forage sampling of both forages was carried out using the CIMMYT yield determination manual (Verhulst et al., 2012). With the support of the field logbook, activities and production costs during the growing season were recorded. Data were processed with the RStudio software, version 4.2.3 by Tukey's method with 95% probability.

7.2 Results and discussion

The oat forage yields presented in Figure 1 show a significant difference (Tukey, $p \leq 0.05$); treatment A-ES obtained 1,302 kg ha^{-1} more than A-ES-MIN-FITO, which benefits the producer's economy by generating higher yields and lower production costs. The lowest yield was obtained by A-T (Control), which refers to the traditional production system. Arias et al., 2021, made high investments in economic and human capital to report an average forage yield of 14,105 kg ha^{-1}, which is in the range of production obtained in the A-ES treatment. On the other hand, Rojas and Vega in 1996 state that the application of cattle manure, poultry manure and swine manure raise the dry mass of oats (Avena sativa) and maize (*Zea mays*) to the same levels as a basic fertilization. Figure 7 presents the forage yield of Vicia faba, where significant differences are reported (Tukey, $p \leq 0.05$) between both forages, where it is denoted that the treatment with high yield is H-ES-MIN-FITO with 509 kg ha-1 more than the control which refers to a low yield according to Baizán, Vicente et al., 2018 reports a yield higher than 1475 kg ha^{-1} in the same crop

Figure 7 Dry biomass yield of Avena Sativa

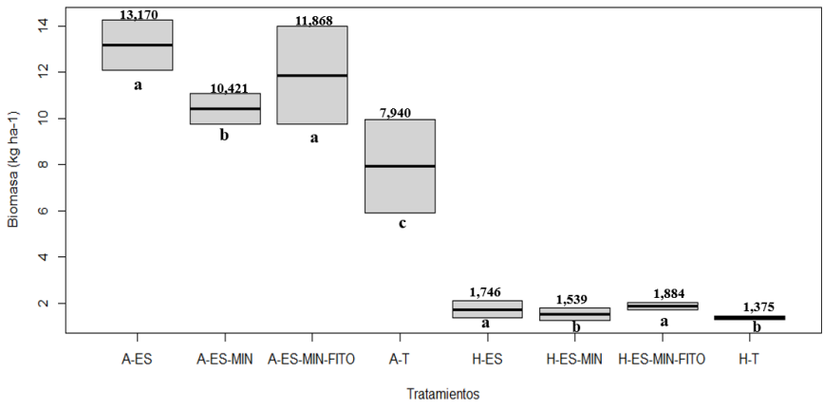
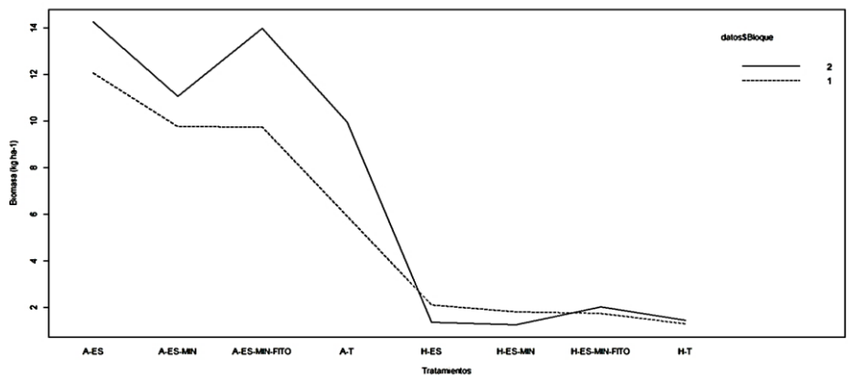


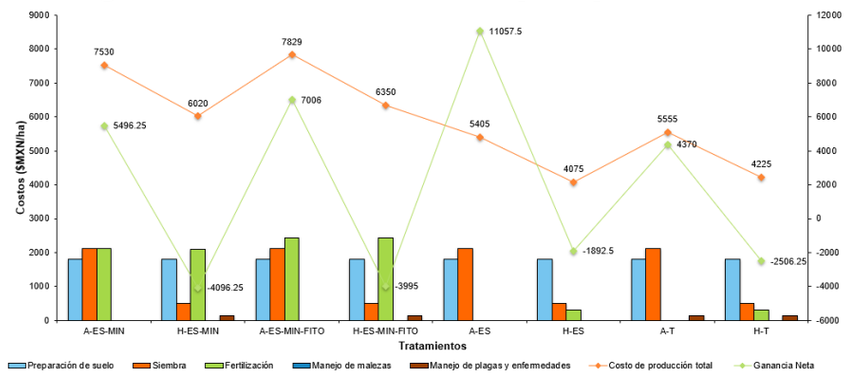
Figure 7.1 shows the oat and broad bean biomass yield (kg ha-1) per block. The comparison of the two yield blocks shows minimal variation in the A-ES-MIN-FITO and H-ES-MIN treatments. The homogeneous treatments were A-ES, AS-ES-MIN, A-T, H-ES-MIN-FITO, H-ES-MIN, H-T, which increases the reliability of the results obtained.

Figure 7.1 Dry biomass yield of forage oats per block



The most heterogeneous treatment was A-ES-MIN-FITO and is reported with the highest cost of production (Figure 7.2). In the oat crop, A-ES reported the highest yield and net gain with a cost of production $ 2,424 less than A-ES-MIN-FITO. The A-ES-MIN treatment was 20.8% less in yield and 31.9% less in profit compared to A-ES.

Figure 7.2 Production costs and net profit per treatment



In the broad bean crop, the treatment with the highest economic investment was H-ES-MIN-FITO, being the treatment with the highest yield kg ha-1 due to the high synthesis of the hormones generated in the plant, developing high growth and cell division and prolonging an appropriate plant growth (Ligero and Lluch, 1986). Of the crops evaluated, the greatest investment was reflected in the A-ES-MIN and H-ES-MIN-FITO treatments. It should be noted that the minerals used were for the purpose of neutralizing the pH of the study area.

7.3 Conclusions

For higher forage yields in oats, fertilization of previously composted manure (A-ES) is suggested, which is economically feasible, in addition to mitigating the use of synthetic fertilisers and promoting the recycling of organic residues. It is important to note that the broad bean crop is adaptable to highly alkaline soils, so it will be more feasible and profitable for the farmer to cover his food demands with this legume. The results make it possible to meet the demands of family production and growth with equity and sustainable development. growth with equity and sustainable development, based on the study area.

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