UNIVERSITI PUTRA MALAYSIA

FORAGE CORN YIELD AND NUTRITIVE QUALITY UNDER DIFFERENT PLANT DENSITIES AND TILLAGE SYSTEMS

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By

ALI BAGHDADI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the Degree of Master of Science

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Specially dedicated to:

My beloved wife Maryam

Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

FORAGE CORN YIELD AND NUTRITIVE QUALITY UNDER DIFFERENT PLANT DENSITIES AND TILLAGE SYSTEMS

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January 2012

Chairman : Assoc. Prof. Mohd Ridzwan A. Halim, PhD

Faculty : Agriculture

Plant density and tillage methods are two important factors affecting forage corn production. A field experiment was conducted in the summer of 2010 in northern Iran to evaluate the response of yield and yield components and nutritive quality of forage corn to various plant densities under different tillage methods. The experiment used a split-plot design with tillage as the main plot in three replications and plant density as the subplots within each tillage method. The plant densities were 90,000, 110,000 and 130,000 plants per hectare and the tillage methods were conventional tillage (CT), reduced tillage (RT), minimum tillage (MT) and no-tillage (NT).

The results of the study showed that plant density affected yield components, including forage dry matter (DM) yield, fresh forage yield, stem diameter, leaf

area index (LAI), crop growth rate (CGR), leaf to stem ratio and cob/whole plant ratio. At the high plant density (130,000 plants ha^{-1}), the forage yield (57.3 t ha^{-1}) was higher than the normal plant density used in the northern part of the country (110,000 plants ha^{-1}) by 16.75%. In terms of dry matter the highest yield was achieved for the highest plant density (16.5 t ha^{-1}) and the minimum was obtained for the lowest plant density (14.3 t ha^{-1}). Low plant density resulted in high stem diameter (1.93 cm). Lowest leaf to stem ratio (0.40) and cob/whole plant ratio (0.41) were obtained at high plant density as compared to low and usual plant density. Maximum LAI (4.59) and CGR (39.63 g m^{-2} day^{-1}) were recorded at the highest plant density

Increasing plant density reduced the nutritive quality of forage corn. The crude protein (CP) declined from 125 to 99 g kg^{-1} from the lowest to the highest plant density. Acid detergent fiber (ADF) increased from 156.9 to 197.5 g kg^{-1} from the lowest to the highest plant density. Dry matter digestibility (DMD) decreased from 689.9 to 655.0 g kg^{-1} from lowest to highest plant density.

Tillage methods had significant effects on dry matter (DM) yield, fresh forage yield, stem height and number of leaves of forage corn while the nutritive value of corn was not significantly affected. Conventional tillage resulted in dry matter yield of 17.1 t ha^{-1} which was not significantly different from the dry matter yield for reduced tillage (16.2 t ha^{-1}). However minimum tillage (14.6 t ha^{-1}) and no tillage (13.7 t ha^{-1}) showed significantly lower dry matter yield

than conventional tillage. Maximum CGR (35.5 g m^{-2} day^{-1}) and LAI (4.30) were recorded for conventional tillage method.

It is recommended that reduced tillage (two passes of rotary tiller) should be practised for planting corn in north of Iran as it benefits soil conservation without any reduction in yield compared to conventional tillage (mouldboard plow followed by two passes of rotary tiller). Plant density of 130,000 plants ha^{-1} result in the best potential for increased forage corn yield compared to lower plant densities. The slight reduction in nutritive quality at high plant density is compensated by the higher yield obtained.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

HASIL DAN KUALITI PEMAKANAN JAGUNG FORAJ DITANAM DENGAN KEPADATAN TANAMAN DAN SISTEM PEMBAJAKAN YANG BERLAINAN

oleh

ALI BAGHDADI

Januari 2012

Pengerusi: Prof. Madya. Mohd Ridzwan A. Halim, PhD

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Kepadatan tanaman dan kaedah pembajakan tanah adalah dua faktor penting yang mempengaruhi pengeluaran jagung foraj. Satu percubaan lapangan telah dilakukan pada musim panas tahun 2010 di utara Iran untuk menilai respons hasil dan komponen hasil serta kualiti pemakanan jagung foraj terhadap kepadatan tanaman dan cara pembajakan tanah yang berbeza. Percubaan menggunakan reka bentuk petak belahan dengan pembajakan tanah sebagai petak utama dalam tiga replikasi dan kepadatan tanaman sebagai anak petak dalam setiap pembajakan tanah. Perlakuan kepadatan tanaman adalah 90,000, 110,000 dan 130,000 tanaman per hektar dan kaedah pemprosesan yang berbeza termasuk pembajakan konvensional (CT), pembajakan berkurang (RT), pembajakan minimum (MT) dan tanpa pembajakan tanah (NT). Keputusan kajian menunjukkan bahawa

kepadatan tanaman berpengaruh terhadap komponen hasil, termasuk hasil bahan kering (DM), hasil hijauan segar, diameter batang, indeks keluasan daun (LAI), kadar pertumbuhan tanaman (CGR), nisbah daun batang dan nisbah tongkol ke seluruh tanaman. Pada kepadatan tanaman tinggi (130,000 ha^{-1}), hasil hijauan segar (57.3 t ha^{-1}) lebih tinggi daripada yang diperolehi dengan kepadatan tanaman yang biasa digunakan di utara negara (110,000 ha) sebanyak 16.75%. Hasil bahan kering tertinggi dicapai pada kepadatan tanaman yang tinggi (16.5 t ha^{-1}) dan minimum yang diperolehi untuk kepadatan tanaman yang rendah (14.3 t ha^{-1}). Kepadatan tanaman rendah mencatat diameter batang tertinggi (1.93 cm). Nisbah daun/batang (0.40) dan nisbah tongkol ke seluruh tanaman (0.41) yang terendah diperolehi pada kepadatan tanaman tinggi berbanding dengan kepadatan tanaman rendah dan normal.

Peningkatan kepadatan tanaman mengurangkan kualiti pemakanan jagung foraj. Protein kasar menurun dari 125 ke 99 g kg^{-1} dari kepadatan terendah ke kepadatan tanaman tertinggi. Serat detergen asid (ADF) meningkat dari 156.9 ke 197.5 g kg^{-1} dari kepadatan tanaman terendah ke kepadatan tanaman tertinggi. Nilai cerna bahan kering (DMD) berkurangan daripada 689.9 ke 655.0 g kg^{-1} dari kepadatan tanaman terendah ke tertinggi.

Kaedah pembajakan tanah mempunyai pengaruh yang signifikan terhadap hasil bahan kering (DM), hasil hijauan segar, ketinggian pokok dan bilangan daun jagung foraj manakala kualiti pemakanan jagung tidak dipengaruhi. Pembajakan konvensional mencatat pengeluaran bahan kering 17.1 t ha^{-1}

yang tidak berbeza daripada pengeluaran bahan kering dengan pembajakan berkurang (16.2 t ha^{-1}). Namun hasil pembajakan minimal (14.6 t ha^{-1}) dan tanpa pembajakan (13.7 t ha^{-1}) menunjukkan pengeluaran bahan kering lebih rendah daripada pembajakan konvensional. Nilai CGR maksimum (35.5 g m^{-2} $hari^{-1}$) dan LAI (4.30) tercatat untuk pembajakan konvensional.

Disarankan bahawa pembajakan berkurang (dua lintasan bajak putar) harus digunakan untuk menanam jagung di utara Iran kerana manfaat pemuliharaan tanah tanpa penurunan hasil dibandingkan dengan pembajakan tanah konvensional (bajak sepak diikuti oleh dua lintasan bajak putar). Kepadatan tanaman 130,000 ha^{-1} memberikan potensi terbaik untuk meningkatkan hasil jagung makanan ternakan berbanding dengan kepadatan rendah. Sedikit penurunan dalam kualiti pemakanan pada kepadatan tinggi tanaman diimbangkan dengan hasil yang lebih tinggi diperolehi.

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I certify that a Thesis Examination Committee has met on 26 January 2012 to conduct the final examination of Ali Baghdadi on his thesis entitled "Forage Corn Yield and Nutritive Quality under Different Plant Densities and Tillage Systems" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institutions.

ALI BAGHDADI

Date: 26 January 2012

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