Detection of pistachio Aflatoxin using Raman spectroscopy and artificial neural networks

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Abstract

Pistachio contamination to aflatoxin has been known as a serious problem for pistachio exportation. With regards to the increasing demand for Raman spectroscopy to detect and classify different materials and also the current experimental and technical problems for measuring toxin (such as being expensive and time-consuming), the main objective of this study was to detect aflatoxin contamination in pistachio by using Raman spectroscopy technique and artificial neural networks. Three sets of samples were prepared: non-contaminated (healthy) and contaminated samples with 20 and 100 ppb of the total aflatoxins (B1+B2+G1+G2). After spectral acquisition, considering to the results, spectral data were normalized and then principal components (PCs) were extracted to reduce the data dimensions. For classification of the samples spectra, an artificial neural network was used with a feed forward back propagation algorithm for 4 inputs and 3 neurons in hidden layer. Mean overall accuracy was achieved to be 98 percent; therefore, non-liner Raman spectra data modeling by ANN for samples classification was successful.

Keywords: Aflatoxin, ANN, PCA, Pistachio, Raman spectroscopy

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Field and laboratory investigation of USS3 ultrasonic sensors capability for non-contact measurement of pistachio canopy structure

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Abstract

Electronic canopy characterization to determine structural properties is an important issue in tree crop management. Ultrasonic and optical sensors are the most used sensors for this purpose. The objective of this work was to assess the performance of an ultrasonic sensor under laboratory and field conditions in order to provide reliable estimations of distance measurements to apple tree canopies. To achieve this purpose, a methodology has been designed to analyze sensor performance in relation to foliage distance and to the effects of interference with adjacent sensors when working simultaneously. Results showed that the average error in distance measurement using the ultrasonic sensor in laboratory conditions was 0.64 cm. However, the increase of variability in field conditions reduced the accuracy of this kind of sensors when estimating distances to canopies. The average error in such situations was 3.19 cm. When analyzing interferences of adjacent sensors 30 cm apart, the average error was ±14.65 cm. When adjacent sensors were placed apart by 60 cm, the average error became 6.73 cm. The ultrasonic sensor tested has been proven to be suitable to estimate distances to the canopy in pistachio garden conditions when sensors are 60 cm apart or more and can, therefore, be used in a system to estimate structural canopy parameters in precision horticulture.

Keywords: Ultrasonic sensor, Distance measurements, Ultrasonic interferences, Tree canopy

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A study of ultrasonic sensors to intelligent estimation of tree canopy volumes

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Abstract

Many research projects have been conducted about using ultrasonic sensors to estimate canopy volume. This study investigates using software applications such as artificial neural network (ANN) to improve the estimation of canopy volume by using ultrasonic sensors. A special experimental system was built. The system had three ultrasonic sensors mounted vertically on a wooden pole with an equal distance of 0.6 m. As the wooden pole moves with a constant speed, the ultrasonic sensors measure the thickness of tree canopy with sampling rate of 4 Hz. Experiments were conducted on 5 samples of Benjamin tree at three speed levels of 35, 45 and 55 cm s⁻¹ in three replications. The real volume of trees was measured manually with rectangular elements method. After a full passing of ultrasonic sensors, potential features such as canopy diameter, average width of tree canopy and height of the tree canopy were considered as the inputs to the ANN model and the manually volume as the output of the model. Optimal ANN model was selected based on mean square error and correlation coefficient. The results showed that 13-16-7-1 was the optimal neuron numbers in ANN topology for estimating canopy volume.

Keywords: Precision agriculture, Variable rate technology, Ultrasonic sensor, Artificial neural network, Tree canopy

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Comparison of microwave and ozonolysis effect as pretreatment on sugarcane bagasse enzymatic hydrolysis

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Abstract

Bioethanol production from agricultural residues is one of the promising methods. Pretreatment is the most important step in this type of bioethanol production. In this study, the saccharification percentage of sugarcane bagasse was investigated after two types of pretreatments including ozone steaming and microwave. Microwave pretreatment was studied with two factors of microwave radiation (170, 450, and 850 W) and microwave duration (2, 6, and 10 min). The ozonolysis (ozone steaming) pretreatment was surveyed with two factors of moisture content of bagasse (30, 40, and 50%) and ozonolysis time (1.5, 2.5, 3.5, and 4.5 hr). After hydrolysis, the Saccharification percentage of sugarcane bagasse increased to 57.2% and 67.06% with microwave and ozonolysis pretreatments, respectively; compare to 20.85% in non-ozonated bagasse. It can be concluded that the ozonolysis is the most effective pretreatment regarding to saccharification percentage of sugarcane bagasse.

Keywords: Enzymatic hydrolysis, Microwave, Ozonolysis, Sugarcane bagasse

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An investigation into separation of impurity from saffron stigma using an electrostatic separator

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Abstract
In the present study, a laboratory electrostatic separator was constructed and its separation potential of white saffron impurities from stigma was investigated. The device was comprised of a nylon ribbon which moves in contact with a woolen brush and was charged by the triboelectric effect. The charged ribbon, then, moved over the material pan. Since the electrostatic behavior vary from various materials, their attraction to the ribbon differ. The separation tests were conducted at three levels of ribbon position (with 1.5, 2.5 and 3.5 cm from the material pan), three drum speeds (50, 60 and 70 rpm) and three working times (120, 18 and 240 seconds). The results showed that material absorption increased as working time increased and the ribbon distance decreased. Meanwhile, rising the speed from 50 to 60 rpm improved material absorption while, more increasing from 60 to 70 rpm reduced the absorption. A maximum impurity separation of 97% was observed with ribbon distance of 1.5 cm, ribbon speed of 60 rpm and working for 240 seconds. The minimum stigma losses were found to be about 2% when the ribbon distance and speed were 3.5 cm and 70 rpm, respectively, and the separator worked for 120 seconds.

Keywords: Electrostatic, Saffron, Separation

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Introducing a strategy for selection of plowing systems using hybrid SWOT-AHP method (Khodabandeh, Zanjan)

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Abstract

For improvement or change in a plowing system, it is crucial that all important parameters to be taken in account. Recommendation of a tillage system should receive supports from research data as well as from skilled farmers in order to find a resolution to problems of that system. In this study, strengths, weaknesses, opportunities and threats (SWOT) of different tillage systems for wheat cultivation in the Khodabandeh region (Zanjan province, Iran) were identified and ranked using Analytic Hierarchy Process (AHP). Based on the viewpoints of skilled farmers, the main threats in tillage systems, which include small farm lands in the region, lack of qualitative research on new tillage systems and lack of government support, affected the system selection (32 percent), relative strengths (26 percent), opportunities (22 percent), and weakness (20 percent). Because of these threats, farmers keep using conventional tillage method (with the value of 47 percent) in spite of their awareness about the benefits of conservation tillage and no-tillage methods. In this situation, the recommended measures are; making new policies for the land integration, performing qualitative research specially on new machinery, clarifying the government's policies on exporting and importing agricultural products and on the amount of guaranteed prices of products before starting the growing season. By these activities the threats can be replaced by opportunities and strengths.

Keywords: Opportunities, Strengths, Tillage, Threats, Weaknesses

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Field performance of the disk harrow, power harrow and rotary tiller at different soil moisture contents on a clay loam soil in Mazandaran

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Abstract

About 60% of the mechanical energy consumed in mechanized agriculture is used for tillage operations and seedbed preparation. On the other hand, unsuitable tillage system resulted in soil degradation, affecting soil physical properties and destroying soil structure. The objective of this research was to compare the effects of three types of secondary tillage machines on soil physical properties and their field performances. An experiment was conducted in a wheat farm in Jouybar area of Mazandaran as split plots based on randomized complete block design with three replications. The main independent variable (plot) was soil moisture with three levels (23.6-25, 22.2-23.6 and 20.8-22.2 percent based on dry weight) and the subplot was three types of machine (two-disk perpendicular passing harrow, Power harrow and Rotary tiller). The measured parameters included: clod mean weight diameter, soil bulk density, specific fuel consumption, machine efficiency and machine capacity. The effects of treatments and their interactions on the specific fuel consumption, machine efficiency and machine capacity and also the effects of treatments on bulk density were significant (P<0.01). The bulk density decreased 15.3%, the specific fuel consumption increased 11.8%, whereas the machine efficiency and machine capacity increased and decreased with the decrease in soil moisture, respectively. The maximum value of the bulk density and machine efficiency were obtained by the use of rotary tiller and the maximum value of the specific fuel consumption and machine capacity were obtained by the use of power harrow. A criterion was defined for selecting machine type and moisture content for optimum condition. The results suggested power harrow working at soil moisture condition of 24.3% (based on dry weight).

Keywords: Energy, Soil physical properties, Secondary tillage machinery, Soil moisture, Specific fuel consumption

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Recognition of paddy, brown rice and white rice cultivars based on textural features of images and artificial neural network

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Abstract

Identification of rice cultivars is very important in modern agriculture. Texture properties could be used to identify of rice cultivars among of the various factors. The digital images processing can be used as a new approach to extract texture features. The objective of this research was to identify rice cultivars using of texture features with using image processing and back propagation artificial neural networks. To identify rice cultivars, five rice cultivars Fajr, Shiroodi, Neda, Tarom mahalli and Khazar were selected. Finally, 108 textural features were extracted from rice images using gray level co-occurrence matrix. Then cultivar identification was carried out using Back Propagation Artificial Neural Network. After evaluation of the network with one hidden layer using texture features, the highest classification accuracy for paddy cultivars, brown rice and white rice were obtained 92.2%, 97.8% and 98.9%, respectively. After evaluation of the network with two hidden layers, the average accuracy for classification of paddy cultivars was obtained to be 96.67%, for brown rice it was 97.78% and for white rice the classification accuracy was 98.88%. The highest mean classification accuracy acquired for paddy cultivars with 45 features was achieved to be 98.9%, for brown rice cultivars with 11 selected features it was 93.3% and it was 96.7% with 18 selected features for rice cultivars.

Keywords: Rice, Image processing, Artificial neural networks, Textural features

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Designing of computer vision algorithm to detect sweet pepper for robotic harvesting under natural light

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Abstract

In recent years, automation in agricultural field has attracted more attention of researchers and greenhouse producers. The main reasons are to reduce the cost including labor cost and to reduce the hard working conditions in greenhouse. In present research, a vision system of harvesting robot was developed for recognition of green sweet pepper on plant under natural light. The major challenge of this study was noticeable color similarity between sweet pepper and plant leaves. To overcome this challenge, a new texture index based on edge density approximation (EDA) has been defined and utilized in combination with color indices such as Hue, Saturation and excessive green index (EGI). Fifty images were captured from fifty sweet pepper plants to evaluate the algorithm. The algorithm could recognize 92 out of 107 (i.e., the detection accuracy of 86%) sweet peppers located within the workspace of robot. The error of system in recognition of background, mostly leaves, as a green sweet pepper, decreased 92.98% by using the new defined texture index in comparison with color analysis. This showed the importance of integration of texture with color features when used for recognizing sweet peppers. The main reasons of errors, besides color similarity, were waxy and rough surface of sweet pepper that cause higher reflectance and non-uniform lighting on surface, respectively.

Keywords: Automatic harvesting, Computer vision, Image processing, Robot, Texture index

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Orange recognition on tree using image processing method based on lighting density pattern

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Abstract

Within the last few years, a new tendency has been created towards robotic harvesting of oranges and some of citrus fruits. The first step in robotic harvesting is accurate recognition and positioning of fruits. Detection through image processing by color cameras and computer is currently the most common method. Obviously, a harvesting robot faces with natural conditions and, therefore, detection must be done in various light conditions and environments. In this study, it was attempted to provide a suitable algorithm for recognizing the orange fruits on tree. In order to evaluate the proposed algorithm, 500 images were taken in different conditions of canopy, lighting and the distance to the tree. The algorithm included sub-routines for optimization, segmentation, size filtering, separation of fruits based on lighting density method and coordinates determination. In this study, MLP neural network (with 3 hidden layers) was used for segmentation that was found to be successful with an accuracy of 88.2% in correct detection. As there exist a high percentage of the clustered oranges in images, any algorithm aiming to detect oranges on the trees successfully should offer a solution to separate these oranges first. A new method based on the light and shade density method was applied and evaluated in this research. Finally, the accuracies for differentiation and recognition were obtained to be 89.5% and 88.2%, respectively.

Keywords: Orange harvesting, Image processing, Separation, Harvesting robot, Machine vision, Regional maxima

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Pattern recognition of near-infrared spectroscopy for non-destructive discrimination of oranges based on taste index

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Abstract

In recent years, application of near-infrared spectroscopy (NIR) as a non-destructive technique combined with chemometric methods has been widely noticed for quality assessment of food and agricultural products. In chemometric methods, quality analyses are important issues which could be related to pattern recognition. In this research, the feasibility of pattern recognition methods combined with reflectance NIR spectroscopy for non-destructive discrimination of oranges based on their tastes was investigated. To this end, both unsupervised and supervised pattern recognition techniques, hierarchical cluster analysis (HCA) and soft independent modeling of class analogies (SIMCA) were used for assessing the feasibility of variety discrimination and classification (according to their taste), respectively, based on the spectral information of 930-1650nm range. Qualitative analyses indicated that NIR spectra of orange varieties were correctly clustered using unsupervised pattern recognition of HCA. It was also concluded that supervised pattern recognition of SIMCA for NIR spectra of oranges provided excellent results of variety classification based on BrimA index at 5% significance level (classification accuracy of 98.57%). Moreover, wavelengths of 1047.5nm, 1502nm, and 1475nm contributed more than other wavelengths in discriminating two classes. Samples having the same BrimA index were also correctly classified with the high classification accuracy (95.45%) at 5% significance level. The discrimination power of wavelengths of 1475nm, 1583nm, and 1436.75nm were more than those for other wavelengths to achieve this classification. Therefore, reflectance NIR spectroscopy combined with pattern recognition methods can be utilized for determination of other attributes related to taste.

Keywords: Classification, Near-infrared spectroscopy, Non-destructive, Pattern recognition, Taste

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Design, construction and performance evaluation of a metal oxide semiconductor (MOS) based machine olfaction (Electronic nose) for monitoring of banana ripeness

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Abstract

Aroma is one of the most important sensory properties of fruits and is particularly sensitive to the changes in fruit compounds. Gases involved in aroma of fruits are produced from the metabolic activities during ripening, harvest, post-harvest and storage stages. Therefore, the emitted aroma of fruits changes during the shelf-life period. The electronic nose (machine olfaction) would simulate the human sense of smell to identify and realize the complex aromas by using an array of chemical sensors. In this research, a low cost electronic nose based on six metal oxide semiconductor (MOS) sensors were designed, developed and implemented and its ability for monitoring changes in aroma fingerprint during ripening of banana was studied. The main components are used in the e-nose system include sampling system, an array of gas sensors, data acquisition system and an appropriate pattern recognition algorithm. Linear Discriminant Analysis (LDA) technique was used for classification of the extracted features of e-nose signals. Based on the results, the classification accuracy of 97.3% was obtained. Results showed the high ability of e-nose for distinguishing between the stages of ripening. It is concluded that the system can be considered as a nondestructive tool for quality control during banana shelf-life.

Keywords: Linear discriminant analysis, Ripeness, Machine olfaction, Banana, Metal oxide semiconductor

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The effects of drop height and padding surface on bruising of exportable apple

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Abstract
Unfortunately despite the great ranking of Iran for apple production around the world, the export potential is not suitable. It seems that one of the major causes of poor quality for Iranian apple varieties is bruising damage of this product. Therefore, in this study, some factors affecting the apple bruising were addressed. For this purpose, factorial experiment in a completely randomized design with 72 treatments, including variety factor in three levels (Golden Delicious, Red Delicious and Granny Smith), type of padding surface in four levels (Cardboard on plastic, wood, Rubber on steel and apple) and the drop height in six levels (5, 15, 25, 35, 45 and 55 cm) with four replications were considered. Moreover, the maximum allowable drop heights of apples along with bruising volume estimation models were studied. Analysis of variance (ANOVA) showed that bruising area and volume were significantly affected by all experimental parameters at the 1% level. The comparison test revealed that Granny Smith has tougher tissues and is less prone to vulnerability. Based on the results of this study, the maximum allowable drop heights for the Red Delicious, Golden Delicious and Granny Smith varieties were found to be 12, 15 and 20 cm, respectively. In addition, the effect of apple variety on the dependent parameters was significant. Based on the findings of this study, the bruising due to the impact of apple and apple was lower for the moving apples compared with the stationary apples.

Keywords: Apple, Bruising, Height of drop, Padding surface
Performance evaluation of a solar dryer with finny, perforated absorber plate collector equipped with an air temperature control system for dill drying

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Abstract

Dill is one of the most important plants in the world because of its medicinal properties and it is widely used as a vegetable in the most parts of Iran. In the present study a new solar dryer with finny, perforated absorber plate collector was utilized to dry fresh dill. The dryer was comprised of a solar collector, a product container, a fan and a drying air temperature controller. The temperature controller was used as a control system to regulate the drying air temperature. Thermal performance of the dryer with finny, perforated solar collector was compared with that of a simple flat plate solar collector at different airflow rates. The effect of drying air temperature at three levels (45, 55 and 65 °C), the product size at three lengths (3, 5 and 7 cm) and two different modes of drying (mixed and indirect) on the dryer performance was investigated. The results showed that the finny, perforated absorber plate solar collector could improve the thermal efficiency about 11% in comparison with the flat plate collector and the highest thermal efficiency was achieved at the maximum airflow rate. Meanwhile, increasing the air temperature and decreasing the product size caused a significant reduction in energy consumption. Solar fraction reduced by increasing the air temperature. Finally a maximum dryer efficiency of 70% was observed at air temperature of 65 °C, product size of 3 cm with mixed mode drying.

Keywords: Dill, Finny perforated collector, Solar dryer

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Comparison of two methods of purple top turnip drying based on energy consumption and quality parameters

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Abstract
Drying is one of the oldest methods to preserve agricultural products and hence expanding the food market. By drying, the agricultural products can be stored and transferred to the market throughout the year. One of the most important and nutritious vegetables is turnip which can be used by drying in out of season. In this research, the hot air and vacuum drying methods of turnip were compared. The effect of independent factors including temperature and vacuum, on dependent factors such as the shrinkage, rehydration and rate of electric energy consumption on final products of turnip were investigated. A randomized completely design for hot air dryer and a factorial experiment based on completely randomized design for drying under vacuum condition were used. Results showed that the temperature and vacuum have affected the shrinkage, rehydration and electricity consumption. Shrinkage parameter is more depend on the final humidity of product and the energy consumption of the devices depends on time. The best quality of dried turnip was achieved from hot air drying device with final humidity of 14±1%, shrinkage of 39.98%, rehydration of 4.45 and consumed electricity of 32.36 kWh kg⁻¹ of DM in 60°C. For the vacuum drying device the best quality of produce achieved with shrinkage of 38.12%, rehydration of 4.87 and consumed electricity of 30.58 kWh kg⁻¹ of DM in vacuum condition of 10 kPa in 60°C. Comparison of results showed that the vacuum dryer is more appropriate than the hot air dryers for drying turnip with better quality and lower power consumption.

Keywords: Rehydration, Shrinkage, Vacuum dryer, Turnip

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Energy analysis and kinetics of mint leaves dehydration using vibro-fluidized bed heat pump dryer

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Abstract

Fluidized bed dryers have not yet been used for drying products such as mint leaves. This could be due to high porosity and low mechanical resistance resulting in poor quality of fluidization. Applying vibration has been recommended to overcome problems such as channeling and defluidization, and hence improving the fluidization quality. In this research, a laboratory scale vibro-fluidized bed heat pump dryer was designed and constructed for drying mint leaves. The experiments were conducted at vibration frequency of 80 Hz and amplitude of 3 mm. The velocity and temperature of the inlet air was controlled by an automatic control system. Experiments were carried out at 40, 50 and 60 °C, and two methods: heat pump drying (HPD) and non-heat pump drying (NHPD). The results revealed that drying process primarily occurred in the falling rate period. Effective moisture diffusivity of the samples increased with increase in drying air temperature and varied from \(4.26656 \times 10^{-11}\) to \(2.95872 \times 10^{-10}\) m\(^2\) s\(^{-1}\) for the HPD method, and \(3.71918 \times 10^{-11}\) to \(1.29196 \times 10^{-10}\) m\(^2\) s\(^{-1}\) for the NHPD method and was within the reported range of \(10^{-9}\) to \(10^{-11}\) m\(^2\) s\(^{-1}\) for drying of food materials. The activation energy was determined to be 84 kJ mol\(^{-1}\) for the HPD and 54.34 kJ mol\(^{-1}\) for the NHPD, both have very good agreement with the results of other investigators. The coefficient of performance and specific moisture evaporation rate showed the acceptable performance of the heat pump system. Moreover, the energy consumption of the dryer for the NHPD method was more than the HPD method.

Keywords: Activation energy, Coefficient of performance, Effective moisture diffusivity, Fluidized bed drying, Pharmaceutical plants

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Comparison of applied forces on selective joints and muscles of drivers during clutching of MF285 and MF399 tractors

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Abstract
In this research, the imposed forces on three muscles including: Gastrocnemius muscle, Trapezius muscle and Quadratus lumboirum of the tractor drivers during clutching have been studied. The sample included 30 persons and the research was conducted on two domestic tractors including: MF285 and MF399 models. The clutching forces for these tractors were measured as 340 N and 290 N, respectively. The difference between drivers' knee angle of the two tractors was proved significant at the one percent level. The decrease of pain threshold after 30 seconds and 60 seconds clutching and 60 seconds rest after clutching in MF285 tractor in all three muscles were more than that of MF399 tractor. The impact of clutching on the average decrease of pain threshold, among all the drivers, and for all time intervals, during and after clutching in the Quadratus lumboirum muscle for both tractors was more than the other two muscles. In order to reduce the imposed force of clutching for MF285 tractor, some modifications is suggested. In this regard the force transfer joint between the pedal and the disc in the mechanism of clutching can be replaced with one made of cast iron.

Keywords: Algometer, Ergonomic, Muscle, Operator, Tractor

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Design and performance assessment of a semi-active suspension model of tractor cabin

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Abstract
Cumulative effect of transmitted vibrations to the tractor driver not only leads to driver health problems, but also reduces the driver working efficiency. Tractor suspension system is one of the methods which is employed to lower the level of transmitted vibrations to the driver. In this study the design and performance assessment of a semi-active suspension model of tractor cabin was considered. Tractor full vibration model was developed first, and subsequently a semi-active ON-OFF damper model was designed. The examination of the model indicated that doubling the piston area and the volume of hydraulic accumulator air chamber, led to 39% increase and 31% reduction of the resonance frequency of transmitted vibrations to the driver, respectively. On the other hand doubling the piston area and the primary air pressure of the accumulator, affected the RMS of transmitted vibration to the driver by 77 cm s^{-2} reduction and 66 cm s^{-2} increase, respectively. Moreover, the numerical comparison of the model outputs with and without activation of semi-active cabin suspension, while the model was stimulated with the same input function, led to 43% improvement in RMS acceleration of the transmitted vibrations to the tractor seat. Therefore, the designed semi-active suspension model of cabin was able to attenuate the level of transmitted vibrations to the tractor driver.

Keywords: Agricultural tractor, Modeling, Semi-active suspension, Tractor cabin

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Effects of drum speed and feed rate on damaged wheat grain during threshing operation

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Abstract

In this research the effects of drum speed and feed rate on the amount of wheat grain damages during threshing operation were investigated. A local flail type threshing machine for threshing wheat at three different drum speeds (11, 20 and 36.7 m s⁻¹) and at three different feed rates (0.013, 0.025 and 0.05 kg s⁻¹) was used. Increasing drum peripheral speed from 11 to 20 m s⁻¹ has been resulted in increasing visible and invisible damages from 0.01% to 1.95% and from 2.13% to 16.5%, respectively. Increasing drum peripheral speed up to 36.7 m/s the visible and invisible damages observed as 24.3% and 36.85%, respectively. On the other hand, increasing the machine feed rate from 0.013 to 0.025 kg s⁻¹ and then to 0.05 kg s⁻¹, the percent of broken seeds were decreased by 21.17% and 31.8%, respectively. The germination test showed that the both type of germinations (visible and propositional) decreased with increasing drum speed and increased with increasing feed rate. The electrical conductivity of the threshed seeds had a direct relationship with increasing the drum speed and decreasing the feed rate. The Slids10 and Sohag10 varieties were the toughest and the most weakened varieties, respectively in this investigation.

Keywords: Wheat grain, Threshing, Mechanical damage, Grain quality and germination test
Investigation of compost fertilizer granulation parameters using response surface methodology

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Abstract

Nowadays compost fertilizers are suitable alternative to chemical fertilizers, due to the threats for human health and agriculture products. The most important problems for applying the compost fertilizer in the farm are: transportation (high volume), high moisture content, spreading problem, impurity such as dust and storage. To solve the problems mentioned, pressing process such as converting the compost to pellets and granules are suggested. In this research the effects of some granulation parameters on the percent of useful granules in a laboratory scale rotating drum was evaluated. The percentage of useful granules decreased by increasing the granulation time and increased by increasing the percentage of drum filling. The optimal conditions for granules production was achieved at drum rotational speed of 40.38 rpm, granulation time of 15 min, drum filling of 10% and molasses percentage of 40.97. According to these conditions, the response for useful granule was estimated as 81.6% with R² of 0.924.

Keywords: Granulation, Compost fertilizer, Response-surface method

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Mapping alfalfa yield using an energy monitoring system on a rectangular hay baler

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Abstract
The most advanced part of precision agriculture technology is yield monitoring of grain and non-grain crops. In this study, the horizontal pressing force of baling plunger and the angular position of the plunger connecting rod were simultaneously measured by installing a load cell and a shaft encoder on the connecting rod and plunger flywheel of a small rectangular baler, respectively. The signals of these sensors were processed in an electronic board and the output data were recorded on a portable computer for monitoring and further analysis. Before baling the harvested alfalfa from the test field, random samples were collected and weighted to obtain a referenced measure of the yield variation along the entire field. Comparing the yield data with the pressing energy and angular position data indicated a good correlation between the throughput rate of the baler and the horizontal force imparted on the baler plunger. The estimated crop yield variations were geo-referenced by using a GPS receiver. By combining the output data of the installed sensors and the positioning data, the yield map of the test field was prepared.

Keywords: Alfalfa, Hay baler, Energy monitoring system, Yield map

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Investigation of energy indices and energy consumption optimization for peach production—case study: Saman region in Chaharmahal va Bakhtiari province

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Abstract
As one of the most important conditions in sustainable agriculture, optimization of energy consumption in agriculture is necessary in order to reduce the production cost and saving non renewable resources as well as reduction of air pollutants. In this regard, this study was conducted in Saman region, Chaharmahal va Bakhtiari province. A linear programming based on Data Envelopment Analysis (DEA) was used for optimization of energy consumption in peach production in order to increase the technical efficiency. By performing a linear regression analysis, some inputs including animal fertilizer, pesticide, human labor and machinery had no significant influence on product yield, while some other inputs including fuel, electricity, water and chemical fertilizer showed a significant effect on the product yield. Therefore, the latter inputs and the product yield were considered as the inputs and output, respectively. Selecting the BCC model (efficiency to variable scale model of input nature) and using DEA Solver software, efficient and inefficient farmers were determined. The efficient farmers had the technical efficiency of unit (one) and the inefficient farmers had this value within 0.47-0.94. Also, the technical efficiency of inefficient farmers was computed as 0.74. This means that using 74% of the inputs and keeping the current yield, the inefficient farmers can approach to the efficiency limit. Total technical efficiency of all farmers was found to be 0.82. Based on the results, the maximum value of inefficiency belonged to electricity energy with 65.32%.

Keywords: Technical efficiency, Peach, Saman region

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Effect of farm size on energy consumption and input costs of peanut production in Guilan province of Iran

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Abstract
In this study, the energy and economic analysis of peanut production in Guilan province of Iran was studied. Data were collected from questionnaires of 75 farmers. The data were collected from three farm size categories namely: 0.1–0.5 ha, 0.5-1 ha and larger than 1 ha. The results revealed that 19407.36 MJ ha\(^{-1}\) energy input was totally consumed. The highest share of energy consumption belonged to diesel fuel (50.05%) followed by chemical fertilizers (19.14%). The mean difference of energy inputs including machinery, diesel fuel and electricity among different sizes of farms was significant at the 5% level. The average energy efficiency in different farm size categories including less than 0.5 ha, 0.5-1 ha and more than 1 ha were 3.67, 4.02 and 4.12, respectively. The energy productivity of these sizes was calculated as 0.155, 0.169 and 0.174 kg MJ\(^{-1}\), respectively. The Cobb-Douglas model results showed that the effects of inputs including human labor, machinery, chemical fertilizers and electricity on the yield were positive, while the effect of inputs including seed, diesel fuel and chemicals on peanut yield were negative. The benefit-cost ratio was calculated as 1.82. Farmers with a farm larger than 1 ha used the least amount of energy and input costs.

Keywords: Guilan province, Peanut, Cost analysis, Energy efficiency, Farm size

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