Design, construction and evaluation of wild pistachio sheller

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Abstract

The wild pistachio (Pistacia Atlantica Mutika) exists in 2.4 million hectares of Iranian forest. In spite of high nutritional and medical value of this fruit, its use and processing are still performed manually. The objectives of this research are to design, to construct and to evaluate the performance of a pistachio hulling machine. The pistachio of Kerman province was chosen as the case of study. The mechanism of shelling was chosen based on the applied pressure force of two cylinders, driving and driven. The effects of input variables including revolution of driving cylinder (three levels), the gap between two cylinders (four levels) and moisture content (four levels) on the performance of machine (shelling efficiency, percentage of intact kernel, percentage of imperfective broken nut, percentage of dust, and percentage of unshelled nut) were analyzed. The results showed that the shelling efficiency decreases with increasing the gap of two cylinders and moisture content of wild pistachio. The maximum intact kernel was obtained at moisture content of 6.61 wb %. The best performance was observed with the following conditions: the cylinders’ gap of 0.48 mm, rotational speed of the driving cylinder of 25.84 rpm and moisture content of 4.31% w.b.

Keywords: Wild pistachio, Design and construction, Evaluation, Sheller, Nut

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Development of a mechanism for measuring forces and aligning moment acting on the steering wheels of a four-wheel vehicle

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Abstract

In this paper, a low-cost dynamometer for rolling, steered wheels is described. The dynamometer was constructed to determine whether such an instrumented mechanism was practical. Four S-beam load cells, an Opto-counter and a potentiometer were used to obtain all moments, and forces using dynamic and kinematic analysis. Minimal simplifying assumptions considered for the required calculations. Overturning, aligning and rolling resistance moments besides vertical force are directly measured by the load cells. The Opto-counter detects wheel angular velocity and the potentiometer was used to measure the steering angle. The results showed that the mechanism was very well calibrated with a coefficient of determination of over 0.99 and can be used to define wheel dynamic behavior.

Keywords: Dynamometer, Wheel forces and moments, Load cell, Opto-counter, Potentiometer.

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Analysis of combine harvester sound pressure level in one-third octave band frequency

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Abstract

Workplace factors such as sound must have the minimum impact on the operators of combine harvester, so that they can guide and control many functions of the combine. In this study, some factors affecting the noise generated by two combine harvesters John Deere 1055 and Sampo 3065 were evaluated. Research factors were engine speed, gear ratios, type of operation and microphone distance. The results of this study indicated that sound pressure level decreased with increasing center frequencies. The sound pressure level of John Deere and Sampo combine at center frequency of 4000 Hz were 87.96 and 84.73 db, respectively. The results showed also that the maximum sound pressure of John Deere and Sampo combines were 116 db at frequency of 250 Hz and 111.1 db at frequency of 40 Hz, respectively.

Keywords: Combine harvester, Noise, Sound pressure level, Frequency analysis

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The feasibility of unmanned tractor guidance based on wireless video transmission

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Abstract

Automation of tractors due to their widespread use in different sectors e.g. agriculture, construction and industry have been seriously considered by researchers. In this study a tele-steering system for tractor was designed and constructed to controling and steering so the operator can control the tractor even far away from the stressful condition of tractor cab. A CCTV camera and an electric motor were used in order to view the path and to rotate the steering shaft accordingly. Bilateral communication between the control center outside the tractor and control unit on the tractor was provided by a Wireless Local Area Network (WLAN). To evaluate the effect of relevant parameters on system performance camera position, steering shaft rotational speed and tractor ground speed were selected as experimental factors in a completely randomized design. Root mean square of error (RMSE) of lateral deviations and frequency of out of range around the reference route (N_{out}) were used as criteria in variance analysis. The results for two different ground surfaces with three replications showed that the performance of system had less sensitivity on soil surface and had better stability because of deformable structure and condition of soil compare to asphalt. Steering speed alone had no effect on the accuracy of tractor guidance. This is because the accuracy of the system mainly depends on capability, skillfulness and mental concentration of the operator. The position of the camera installed in front of the tractor had higher accuracy than that of rear camera. Moreover, by increasing ground speed the RMSE of lateral deviations and N_{out} increased and this is in agreement with the results of previous research works.

Keywords: Tractor automation, CCTV, WLAN, Unmanned guidance

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Evaluation of fluent software for simulation and construction of a variable rate sprinkler for an autonomous irrigation system

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Abstract

Water scarcity is today's world biggest challenge which requires different countries to manage their water resources in the most efficient way. Sprinkler irrigation increases water consumption efficiency due to more uniform distribution of water across the field. Precision farming is based on the site-specific use of inputs according to soil characteristics and plant needs. One of the main inputs for agricultural production is water. Thus, efficient use of water resources based on variable rate irrigation is considered to be a basic approach of precision irrigation. The main purpose of this study was to simulate and fabricate a variable flow sprinkler, applicable in solid set sprinkler irrigation system. The preliminary drawing of the proposed sprinkler, which equipped with a flow and pressure control plunger, was simulated using Fluent software. The actual sprinkler was then fabricated and evaluated in a field. The performance of the sprinkler was evaluated at three pressure levels, three plunger positions (at the points of the least and biggest sprinkler's cross section for water passage) and three diameters of outlet nozzle opening. Results showed that the plunger had the capability of varying outlet flow and pressure in the sprinkler and trends in flow and pressure variation as affected by the plunger position was very complicated. The Fluent model for conditions with fully open of the plunger and half opened was effectively efficient. However, as the plunger closed the water passage more than the half of cross section, the model did not show an acceptable efficiency.

Keywords: Irrigation, precision farming, simulation, variable flow sprinkler

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Developing an in-field yield monitoring system and predicting some nutritional quality properties of Alfalfa using shear and compressive energy

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Abstract

Precision Agriculture is continuously trying to address the sources and factors affecting the in-field variability and taking appropriate managerial decisions. One of the popular research focuses in the recent three decades has been on the development of new approaches to making yield variability maps. Advancement in development of sensors and the importance of quality factor in high value crops has motivated scientists to investigate real-time and nondestructive testing methods. This study tried to introduce and evaluate a new approach to concurrent yield mapping and to estimate some nutritional qualitative factors of alfalfa production. In this study, yield quantity was determined by measurement of added hay slice in every hay compression cycle by employing a new star wheel and integrating its output with positioning data from Global Positioning System. To predict some nutritional quality properties, measurement of specific shear energy applied on the cutting blade and compressive energy on plunger head of a hay baler in field conditions were also evaluated. The results of statistical analysis of yield quantity measurement data showed a very good correlation between the suggested approach and yield mass (r=0.96 and R²=0.92). The results of using specific shear energy for estimation of crude fiber and cumulative index RFV with regard to field conditions were rated as acceptable. Using specific compression energy was suitable only for estimating the dry matter. None of the suggested methods was able to estimate the hay crude protein. Further investigations at more extensive variations of quality indices and alfalfa varieties are suggested.

Keywords: Alfalfa, Nutritional quality indices, Precision agriculture, Quantitative yield

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Design, fabrication and pseudo field evaluation of a sugar beet crust breaker and weeding unit equipped with an infrared sensor

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Abstract

In conventional cultivation of sugar beet the weeding and crust breaking are mostly performed manually. The objectives of this research were to design, fabricate and evaluate a soil crust breaker and weeding implement equipped with a detecting sensor. Each unit consisted of a distance detecting sensor and a hydro-motor for driving the blades and pneumatic valves for moving the blades. The hydro-motor was activated by the sensors. To avoid damaging the plants, a command signal was sent to the pneumatic valves to move the blades up and down and pass safely. Three configurations of cutting blades were considered which could be mounted to the crust breaker. The field evaluation was conducted with two tractor forward speeds (0.4 and 1 km h⁻¹) and four plant-to-plant spacings within rows (20, 25, 30 and 40 cm) all with three different blade shapes. For field evaluation split plot experiments arranged in a completely randomized block design with three replications. The number of plants damaged (evaluated only for four-lobe blades) and size of broken crusts (evaluated for all blade shapes) for various treatments were recorded and compared. The results of analysis indicated that the higher the inter-row spacing the lower the injury to the plant. The highest and the least damage to the plants occurred for within-row plant spacings of 20 and 40 cm, respectively. The forward speed was also significantly affected the percent of plant damaged. The forward speed of 1 km h⁻¹ at 20 cm spacing had the most (59%) and the speed of 0.40 km h⁻¹ at 40 cm spacing had the least effect (3.3%) on the percent of plant damage. The two-lobe blade could result in the maximum surface area broken.

Keywords: Crust breaker, Sugar beet cultivation, Cultivator, Ultra violet sensor.

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Evaluation and comparison of three types of pistachio hullers used in Kerman province

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Abstract

The objective of this study was to evaluate different pistachio hullers and determine the proper harvest time of pistachio nuts for hulling. Three pistachio hulling machines (Helical drum, Helical-blade drum, Rubber drum) at three harvest times and 15 days interval were evaluated. The hulling efficiency, percentage of damaged nuts, faulty hulled nuts and unhulled nuts were measured at each time interval. A factorial experiment was carried out using a randomized complete block design with three replicates. Data were compared using analyses of variance and employing Duncan's multiple range tests. The results showed that the interaction effect of hulling machine type and harvesting time on the hulling efficiency and nut damage in the outlet of hull and nut was significant at the five percent level (p<0.05) and on the faulty hulled and non-hulled nuts was also significant at the one percent level (P<0.01). The rubber drum machine had the most hulling efficiency (90.81%) at the end of harvest season. This machine also produced the least percentage of damaged nuts in the outlet of hull and nut at all three harvest times. The least percentage of damage in the outlet of hull (0.47%) and nut (0.23%) was observed for the rubber drum machine at the middle of harvest time. The helical drum machine produced the most damage for hull (3.86%) and nut (2.75%) at the beginning of harvest season. The least percentage of non-hulled nuts (2.5%) was obtained from the helical-blade drum machine at the end of harvest season.

Keywords: Damaged nuts, Hulling machines, Hull efficiency, Harvest time, Pistachio

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Analysis of factors affecting the management of overall energy efficiency of tractor-implement by real-time performance monitoring

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Abstract

Overall energy efficiency (OEE) is an important indicator of energy consumption in tillage operations. Tillage energy was studied objectivity to accurately measure the OEE of MF399-4WD tractor. The tractor was equipped with different types of sensors to measure and calibrate the required data including: fuel consumption, actual forward speed, wheel speed and slippage, engine speed, draft and drawbar power. The data were recorded with frequency of 1000 Hz and transmitted by employing a suitable wireless technology in the range of up to 1.5 km to the user's personal computer and is stored in Excel format. The hardware and the software program, which was written in C# language, simultaneously monitor the changes in functional parameters and the monitoring can be done even from far away and via the Internet. The split factorial experiment with three factors including ballast, selected gear ratio and two wheel drive configurations (two and four wheel drive) was employed to perform analysis of variance (ANOVA), POST ANOVA AND PATH ANALYSIS. The results show that the performance of remote monitoring devices installation was very accurate and high-quality. Furthermore, statistical analysis showed that three parameters including slippage, fuel consumption and tractor Power Equivalent (PEQ) were the most effective parameters on overall energy efficiency of tractors – tillage. The variance analysis showed that the effect of gear ratio and drive configuration on the OEE were also significant at the one percent level. However, ballasting had no significant effect on the OEE.

Keywords: Fuel consumption, Overall energy efficiency, Monitoring, Sensor, Wireless,
Bio-oil production from fast pyrolysis of corn wastes and eucalyptus wood in a fluidized bed reactor


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Abstract

Fast pyrolysis is an attractive technology for biomass conversion, from which bio-oil is the preferred product with a great potential for use in industry and transport. Corn wastes (cob and stover) and eucalyptus wood are widely being produced throughout the world. In this study, fast pyrolysis of these two materials were examined under the temperature of 500 °C, career gas flow rate of 660 l h⁻¹; particle size of 1-2 mm; 80 and 110 g h⁻¹ of feed rate. The experiments were carried out in a continuous fluidized bed reactor. Pyrolysis vapor was condensed in 3 cooling traps (15, 0 and -40 °C) plus an electrostatic one. Eucalyptus wood was pyrolysed to 12.4, 61.4, and 26.2 percent of bio-char, bio-oil and gas, respectively while these figures were as 20.15, 49.9, and 29.95 for corn wastes. In all experiments, the bio-oil obtained from electrostatic trap was a dark brown and highly viscose liquid.

Keywords: Renewable energy, Biomass, Fast pyrolysis, Feed rate

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Effect of bio ethanol and diesel blend on small diesel engine vibration

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Abstract

The use of Bio-ethanol as an alternative diesel engine fuel is rapidly increasing. Bio-ethanol is mixed with diesel fuel at different ratios and used in CI and SI engines. Since vibrations have direct effects on users and engine components, for this reason analysis of vibration resulting from combustion in CI engines is very important. In this study, evaluation of vibration was performed for both diesel and ethanol blends. Commercial diesel fuel (D100), E2 (2% ethanol and 98% diesel fuel), E5, E10, E15 and E20 were used in a two-wheel MITSUBISHI tractor. The engine was tested in 1200, 1600, 2000 and 2400 rpm for all fuel blends, and also the effect of load was investigated for D100 and E10. Results showed that vibration is significantly affected by fuel blend. It was observed that E10 had the lowest vibration while E20 had the highest value. It was also observed that vibration increased as engine speed increased for all fuel blends. It was found that both axial and lateral vibrations affected significantly by load. The lateral vibrations decreased continuously with load rise, but the axial vibrations increased initially but started to follow a reverse trend.

Keywords: Bio ethanol, Diesel engine, Two-wheel tractor, Vibration

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Demarcation and estimation of agricultural lands using ETM+ imagery data
(Case study: Astan Ghods Razavi great farm)

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Abstract

Application of satellite imagery and remote sensing techniques in agriculture and other natural resources has been approved by many studies. In this study two ETM+ imagery data for May and September 2012 of Astan Ghods Razavi Great Farm were acquired to identify the boundaries of lands cultivated with different crops coverage and to create crops maps of that farm. To classify the images, the supervised classification methods including Maximum Likelihood and artificial neural network were used. In order to compare the results of two applied classification methods, the same training and testing samples were used. To evaluate the accuracy of classification results, the produced map was compared with the ground control points extracted by GPS and local observations. Kappa coefficient and overall accuracy were estimated to be 82% and 85%, respectively by maximum likelihood method and these outputs were estimated to be 84% and 87%, respectively by neural network approach. The difference of cultivated area estimated by maximum likelihood and by neural network methods with actual measured area was 16.8% and 14.2%, respectively. The results of this study showed that satellite imagery has high capabilities to classify and estimate agricultural and cultivated areas. These data can be useful for strategic management to develop mechanization and cultivation plans.

Keywords: Maximum likelihood, Remote sensing, ETM+, Neural network classification, Agricultural crops

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Monitoring of conservation tillage and tillage intensity by ground and satellite imagery

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Abstract

Local information about tillage intensity and ground residue coverage is useful for policies in agricultural extension, tillage implement design and upgrading management methods. The current methods for assessing crop residue coverage and tillage intensity such as residue weighing methods, line-transect and photo comparison methods are tedious and time-consuming. The present study was devoted to investigate accurate methods for monitoring residue management and tillage practices. The satellite imagery technique was used as a rapid and spatially explicit method for delineating crop residue coverage and as an estimator of conservation tillage adoption and intensity. The potential of multispectral high-spatial resolution WorldView-2 local data was evaluated using the total of eleven satellite spectral indices and Linear Spectral Unmixing Analysis (LSUA). The total of ninety locations was selected for this study and for each location the residue coverage was measured by the image processing method and recorded as ground control. The output of indices and LSUA method were individually correlated to the control and the relevant $R^2$ was calculated. Results indicated that crop residue cover was related to IPVI, RVI1, RVI2 and GNDVI spectral indices and satisfactory correlations were established (0.74 - 0.81). The crop residue coverage estimated from the LSUA approach was found to be correlated with the ground residue data (0.75). Two effective indices named as Infrared Percentage Vegetation Index (IPVI) and Ratio Vegetation Index (RVI) with maximum $R^2$ were considered for classification of tillage intensity. Results indicated that the classification accuracy with IPVI and RVI indices in different conditions varied from 78-100 percent and therefore in good agreement with ground measurement, observations and field records.

Keywords: Conservation tillage, Line-transect method, Multispectral, Linear spectral unmixing analysis, Satellite imagery, Spectral indices

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Evaluation of an experimental model for flat-fan nozzles drift in wind tunnel by image processing

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Abstract

Each year, millions of liters of toxic liquid, are used to combat with pests and plant diseases in farms. The wide spread use of chemical pesticides causes great environmental hazards. Particles drift is one of the main problems in spraying which results in the contamination of farm lands, humans and animals. Management of particle size is regarded as the main factor in drift control. In this study, the effect of some parameters on the size of deposited particles on non-target areas was studied using statistical method. The effects of nozzle type (orifice size), spraying pressure, spraying boom height and wind speed as effective factors on drift were examined. A horizontal wind tunnel with working section of 0.47 m wide, 0.75 m height and 5.5 m long was used for testing. Experiment was performed in the form of factorial split-plot based on randomized complete block design with two replications. Droplets were measured in the treatment combinations of the type of flat-fan nozzle with three orifice area (11003-0.87 mm², 11004-1.18 mm² and 11006-1.8 mm²), spraying pressure (150, 275 and 400 kpa), wind speed (1, 2 and 3 m s⁻¹) and the boom height of (0.35, 0.55 and 0.75 m). Water-sensitive papers were used at intervals of 0.8, 1.6 and 2.4 m from the tip of nozzles for detecting droplets size. The factors of pressure, speed and height had positive effects on the droplet size at the desired distance, but the effect of nozzle size on droplet size was negative. In the regression model the coefficients of speed was higher than the others.

Keywords: Particle size, Drift, Wind tunnel, Volume median diameter, Empirical model

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Yield estimation of sugar beet based on plant canopy using machine vision methods

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Abstract

Crop yield estimation is one of the most important parameters for information and resources management in precision agriculture. This information is employed for optimizing the field inputs for successive cultivations. In the present study, the feasibility of sugar beet yield estimation by means of machine vision was studied. For the field experiments stripped images were taken during the growth season with one month intervals. The image of horizontal view of plants canopy was prepared at the end of each month. At the end of growth season, beet roots were harvested and the correlation between the sugar beet canopy in each month of growth period and corresponding weight of the roots were investigated. Results showed that there was a strong correlation between the beet yield and green surface area of autumn cultivated sugar beets. The highest coefficient of determination was 0.85 at three months before harvest. In order to assess the accuracy of the final model, the second year of study was performed with the same methodology. The results depicted a strong relationship between the actual and estimated beet weights with $R^2=0.94$. The model estimated beet yield with about 9 percent relative error. It is concluded that this method has appropriate potential for estimation of sugar beet yield based on band imaging prior to harvest.

Keywords: Image processing, Canopy, Beet, Band imaging, Yield monitoring

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Comparison of four different methods for agricultural positioning using GPS and IMU


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Abstract

In this research, four different positioning methods were compared in order to evaluate their accuracy, using a remotely controlled robot on a specific route. These methods included: using a single GPS module, combining the data from three GPS modules, using an Inertial Measurement Unit (IMU), and GPS/IMU data fusion. The comparison of these four methods showed that GPS/IMU data fusion along with a Kalman filter was the most precise method, having a root mean square error of 23.4cm. Integrating the data acquired simultaneously from three GPS modules with fixed and equally spaced position and far enough from each other, had a root mean square error of 31.3cm was the second most precise method. Also analysis of the IMU data showed that due to cumulative errors, it was not a suitable method using a single IMU for positioning.

Keywords: Global positioning systems, Inertial measurement, Data fusion, Kalman filter

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Evaluation of watermelon ripeness by analyzing sounds generated from imposed impact

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Abstract

One of the nondestructive methods for assessing the internal quality of some fruits is the processing and analyzing the sound signals generated by an impact on the fruit. In this regard determining the location and the suitable impact levels for a certain fruit is required. In this study, the selected Crimson sweet variety of watermelon was used for the acoustic tests by imposing the impact force on samples. Acoustic tests were conducted using two independent variables including impact location (two sides of the symmetrical line of watermelon and the opposite of the stem end) and impact levels (12.09, 15.08 and 17.11 kg mm s⁻¹) on the generated sound signals, to evaluate the stiffness of the fruit. The relation between the acoustic signals and the texture of both peel and flesh was examined using puncture test. The results showed that the variation of location and levels of impact on the obtained values of acoustic tests were significant.

Keywords: Impact levels, Impact location, Acoustic properties, Watermelon

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Study of changes in rheological properties of potato tissue during storage using the creep test

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Abstract

The changes in viscoelastic properties of potatoes (Tubuls Agria) stored at 4 °C for 4 months were modeled and evaluated by using the creep-recovery test. Cylindrical specimens with 15 mm in diameter and 35 mm long were used. The samples were allowed to deform gradually under the constant stress (110 kPa) for about 30 min. After removing the load, the sample recovery was registered. Deformation of the specimens with time were measured and recorded. Strain-time curve was plotted for loading and recovery process. Four-element (Burgers) mechanical model adequately described the creep response of the potato tissue. The coefficients of instantaneous elasticity, elastic and viscous coefficients of the retarded elastic part, Newtonian viscous flow and retardation time were determined, as they can be used to study the effect of storage conditions on the quality of the stored potatoes. These values were decreased significantly ($P < 0.05$) as the storage time increased.

Keywords: Creep test, Viscoelastic properties, Retardation time, Potato, Burger model.

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Evaluating the mechanical properties of tomato based on electrical conductivity

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Abstract

Evaluation of mechanical and electrical properties of agricultural products plays an important role in equipment design and optimizing post-harvest operations. Among the crops, tomato and its products are the major processing industries in the world and its economic importance is increasing. Considering the importance of the quality and various post harvesting uses of tomato, the evaluation of mechanical properties including rupture force and deformation and the work done to establish the rupture of two tomato cultivars (Petoearly CH and Newton) were studied under penetration test based on the electrical conductivity. These properties were measured at three levels of 1, 3 and 5 days after harvesting. The evaluated mechanical properties of both cultivars were decreased by increasing the storage time. Interaction of cultivar and time were significant at the 1% level, for all mechanical parameters except the deformation failure in both cultivars. The electrical conductivity of both cultivars was decreased by increasing the storage time. Interaction of cultivar and time on the electrical conductivity of both cultivars were significant at the 1% level. Significant relationships were found at the 1% level between electrical conductivity and mechanical properties except for deformation of Petoearly CH cultivar. Among the mechanical parameters, rupture forces and rupture works of both cultivars were highly correlated with the electrical conductivity.

Keywords: Mechanical properties, Tomato, Electrical conductivity

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Quality analysis of pear fruit of shah miveh variety using nondestructive ultrasonic technique

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Abstract

Development of ultrasound technique has not been progressing for evaluating the internal quality of fruits as fast as that of processed foods. In this research for quality assessment of pear fruit (Shah Miveh variety) an ultrasonic measurement system was constructed to transmit and receive the ultrasonic waves. The apparatus included a pulser-receiver, a pair of 75 kHz ultrasonic transducers with exponential horn, and a computer system for data acquisition and analysis. Several mechanical and chemical properties, including firmness, TSS, acidity, elastic modulus, pH and total dry matter for destructive quality assessment were measured. Velocity and attenuation of ultrasonic waves for nondestructive tests were also measured. The fruit quality levels for the experiment were: unripe, ripe and overripe. The results of tests showed that firmness was the best parameter for measuring fruit quality, as it decreased significantly with ripeness. The effect of ripeness on the velocity and attenuation of ultrasonic waves was also significant. Investigation showed a positive linear relationship between fruit firmness and wave velocity ($R^2=0.81$). Furthermore, the relationship between fruit firmness and attenuation was exponential and wave attenuation decreased with increasing fruit firmness ($R^2=0.895$). The relationship between ultrasonic properties and fruit modulus of elasticity showed that the wave velocity increased and attenuation decreased with increasing elasticity. It can be concluded that the ultrasonic instrument equipped with exponential horns can effectively be utilized for pear quality assessment based on measurement of wave velocity and attenuation.

Keywords: Quality assessment, Non destructive test, Ultrasonic, Firmness, Pear fruit
Field evaluation of cereal combine harvesters processing losses on JD-955 and JD-1165 combines equipped with grain loss monitor

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Abstract

Grain loss monitors are installed on combine harvester and make it possible to measure grain loss on different parts of the combine. The instrument permits the operator to adjust a proper ground speed to keep grain loss within an acceptable range. In this study a loss monitoring system was implemented to measure grain losses continuously on straw walker and sieves. Two grain loss monitors (KEE and TeeJet) were installed behind the straw walker and the sieves of JD-955 and JD-1165 combine harvesters. Harvesting performance parameters such as combine total and processing losses were then measured. To evaluate the precision and accuracy of the instruments, the measured and monitored losses were compared and investigated. The results of a two-year research showed that the average processing loss of the combine harvesters with 10-12\% grain moisture content and 750 rpm drum speed was 0.82\% which is within the acceptable range recommended by ASAE Standard No. S343.3. Furthermore, there was no significant difference between the measured and monitored values of processing loss.

**Keyword:** Combine harvester, Grain loss, Harvesting, Monitor, Wheat

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Modeling of yield estimation for the main crops in Iran based on mechanization index

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Abstract

Agricultural mechanization is a method for transiting from traditional agriculture towards industrial and sustainable one. Due to the limitation of natural resources and increasing population we need to have economical production of agricultural crops. For reaching this destination; agricultural mechanization has a remarkable role. So it is necessary to have an extensive view for mechanization, because with the help of mechanization the agricultural inputs such as seeds, fertilizer and even water and soil can effectively be managed for an economical and sustainable production. This study has been carried out in many provinces of Iran. The data of agricultural tractors and cereal combine harvesters were firstly gathered by means of questionnaire. The tractors were categorized in four power levels of less than 45, 45 to 80, 80 to 110, and more than 110 hp. In addition, it was also carried out for cereal combine harvesters; it was in three power levels, i.e. between 100 to 110, 110 to 155 and 155 to 210 horse-power in 3 ages, i.e. less than 13, between 13 to 20, and more than 20 years. Information regarding to cultivation areas, production volume, and yield of main crops gathered from statistics of Ministry of Jihad-e-Agriculture. Then agriculture mechanization level index (hp ha⁻¹) in each province was calculated. Four main crops including irrigated and rain-fed wheat and irrigated and rain-fed barley, which met the required criteria to be used in the model, were statistically analyzed. Correlation analysis was carried out in order to get an effective model between yield of the four main crops in Iran and agriculture mechanization level index. Pearson correlation index showed that there is a direct and significant correlation between these variables. Subsequently, outliers were identified in order to get a model with necessary efficiency to predict the yield through mechanization level index, by scatter diagram and estimating regression lines in 1% probability level. The effective model was estimated with acceptable coefficient of determination 0.851, after removing outliers.

Keywords: Agricultural mechanization, Horsepower, Mechanization Index, Yield, Model Regression.

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Effect of tillage systems with corn residue on grain yield of rapeseed in Moghan region

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Abstract

This study carried out to evaluate the effect of different tillage systems on rapeseed yield (hayola 401) planted in corn residues. This experiment was done in Moghan region with clay soils during 2009-2012. Different seedbed preparation methods include MT: moldboard + disk tillage (conventional tillage was included), SCT: Stem Crusher + chisel + disk tandem harrow, STT: Stem Crusher + double-disc, CT: chisel + disk tillage and DD: two heavy disks. The experiment was conducted in a randomized complete block design with four replications. The results showed that soil bulk density in the 0-10 cm layer was not significant in different tillage treatments, but it was significantly higher than the conventional tillage in 10-20 cm depth. However, penetration resistance in 10-30 cm under DD was significantly higher than other treatments, but it was not significant in 0-10 cm layer among all tillage treatments. Thus, Comparison of the soil bulk density, penetration resistance, and plant establishment showed that the reduced tillage in canola seedbed preparation was effective. Besides, the surveys indicated that there was a significant different between MWD after primary and secondary tillage. The mean diameter weighted under SCT and DD, were 1.19 and 1.24 cm, respectively had the best status. The highest value and the worst status of this parameter observed for MT which was 1.92 cm. The highest rate of grain yield obtained by application of treatment SCT, and it was 2563.8 kg ha\textsuperscript{-1}. The SCT treatment can be recommended as an effective canola bed preparation due to its significant saving in time and cost after corn harvesting.

Keywords: Reduce tillage, Soil resistance, Corn residue, Canola yield

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Prediction of combine economic life based on repair and maintenance costs model


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Abstract

Farm machinery managers often need to make complex economic decisions on machinery replacement. Repair and maintenance costs can have significant impacts on this economic decision. The farm manager must be able to predict farm machinery repair and maintenance costs. This study aimed to identify a regression model that can adequately represent the repair and maintenance costs in terms of machine age in cumulative hours of use. The regression model has the ability to predict the repair and maintenance costs for longer time periods. Therefore, it can be used for the estimation of the economic life. The study was conducted using field data collected from 11 John-Deer 955 combine harvesters used in several western provinces of Iran. It was found that power model has a better performance for the prediction of combine repair and maintenance costs. The results showed that the optimum replacement age of John-Deer 955 combine was 54300 cumulative hours.

Keywords: Combine, Economic life, Repair and maintenance cost

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Abstract

In order to restrain the potential of wind energy, the first step is to determine the wind energy potential. In this study the wind data was used from the three-hour frequency recording of 10-year period (2002-2011). To predict the occurrence probability of each wind speed, the two-parameter Weibull function was used. The goodness of fit test by Chi-Square test showed that the wind speed distribution is not represented by the typical two-parameter Weibull function for all the months. Weibull probability density function has a good fit for eleven months, but for the 9th month of the year (September), it is not fitted. Thus, four-parameter Weibull probability function has been developed to analyze the wind speed frequency distribution in that region for the mentioned months. The electrical energy consumption of agricultural water wells in the region was also calculated for the desired periods of the year. Energy demand and energy supply were matched. Data analysis was performed using SPSS 18.0.0, MATLAB 7.13.0.564 and WIDOGRAPHER 3.0.2. The results show that in Broujerd, to exploit the wind energy at all times of the year, it is necessary to have at least 39 turbines of 2300 kW with 99 meters tower. If the desired turbines are used, there will be extra energy and also, agriculture will be continued towards sustainable development.

Keywords: Sustainable development, Weibull distribution function, Wind direction, Wind energy, Wind speed.
Brief Report

Technical and economic evaluation of rice harvesting methods in Shirvan-Chrdavol region

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Abstract

Rice is a main food for Iranian people and has an important role in providing food security. Regarding the population growth, increase of rice production and reduction of losses have special importance in prevention of rice import. Rice losses in the harvest stage are the highest through the whole production period of this crop and hence the reduction of these losses is necessary. Provision of this purpose depends on on-time harvesting and separation of grains from chaff with the least grain losses, and choosing a suitable harvesting method. The choice of harvesting method depends on various factors in each region; thus, different harvest methods in each region must be compared while conducted in the same conditions. In order to recommend the best harvest method in Shivan-Chardavol region, three harvesting methods (manually, rice-specific combine harvester and conventional cereals combine harvester) were considered as three experimental treatments and four different parts of this region considered as experimental blocks. The experimental design was randomized complete block design. This study was carried out on Anbarboo variety and the measured factors were: effective farm capacity, percent of total losses, percent of harvesting losses, number of workers and harvesting cost. The results of this study indicated that the total difference of factors was significant at the 1% error level among all treatments. The effective farm capacity in harvesting by cereals combine harvester was more than other treatments. The lowest percent of loss was observed for harvesting by rice-specific combine harvester (2.32%) and the highest percent of loss was obtained for cereals combine harvester (3.816%). The manual harvesting method had the highest harvesting cost and the lowest cost was found to be associated with the rice specific combine harvester. Therefore, from the results of this study, the use of this combine harvester is recommended for rice harvesting in this region.

Keywords: Rice harvesting, combine harvester, losses, costs

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Brief Report

Prediction of soil fragmentation during tillage operation using adaptive neuro fuzzy inference system (ANFIS)

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Abstract

Suitable soil structure is important for crop growth. One of the main characteristics of soil structure is the size of soil aggregates. There are several ways of showing the stability of soil aggregates, among which the determination of the median weight diameter of soil aggregates is the most common method. In this paper, a method based on adaptive neuro fuzzy inference system (ANFIS) was used to describe the soil fragmentation for seedbed preparation with combination of primary and secondary tillage implements including subsoiler, moldboard plow and disk harrow. Adaptive neuro fuzzy inference system (ANFIS) is a suitable approach to solving non-linear problems. ANFIS is a combination of fuzzy inference system (FIS) and an artificial neural network (ANN) method and it uses the ability of both models. In this study, the model inputs include “soil moisture content”, “tractor forward speed” and “working depth”. The performance of the model was evaluated using the statistical parameters of root mean square error (RMSE), percentage of relative error (ε), mean absolute error (MAE) and the coefficient of determination (R²). These parameters were determined as 0.135, 3.6%, 0.122 and 0.981, respectively. For the evaluation of the ANFIS model, the predicted data using this model were compared to the data of artificial neural network model. The simulation results by ANFIS model showed to be closer to the actual data compared with those made by the artificial neural network model.

Keywords: Tillage, Soil fragmentation, Median weight diameter (MWD), Adaptive neuro fuzzy inference system, Artificial neural network.

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