The effect of urea fertilization method and moisture content at harvest time on mechanical properties of dried corn

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Abstract

Mechanical properties of grain are influenced by various factors including soil nutrients and grain moisture content at harvest time. In order to reduce mechanical losses, the design of different processing operations should be performed based on the knowledge of factors influencing the mechanical properties. The effects of urea fertilization methods and grain moisture content at harvest time on mechanical properties of dried corn were investigated in a field experiment as a strip split plot with four replications based on randomized complete block design at Khorram Abad Agricultural Research Station in 2010. The investigated factors were urea fertilization methods (urea foliar application and urea side-dress application), grain moisture content at harvest time (20, 30 and 40%) and four corn hybrids (NS 640, Konsur 580, Jeta 600 and control SC 704). The moisture content of dried grains due to different absorption property of the treatments was about 7±1 percent. The results showed that the interaction of fertilization methods and hybrid was significant (P < 0.05) for grain toughness. However, the grain moisture content at harvest time had significant effect on all studied traits except on grain firmness. The highest maximum fracture force, displacement at the maximum rupture force, energy consumption at maximum force point, specific deformation, rupture power and toughness were obtained at 20% grain’s moisture content. Also, the results showed that NS hybrid had the highest maximum rupture force (219 N), displacement at the maximum fracture force (0.37 mm), energy consumption at maximum force (42.51 mj), rupture power (3.89 . 10⁻³W) and toughness (0.33 mj mm⁻³).

Keywords: Maize, Grain moisture, Mechanical properties, Nitrogen, Rupture force

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Evaluation of walnut kernel quality (as degree of crushing) obtained under impact loading


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Abstract

In this research the quality of walnut kernels under impact loading were studied. Due to unavailability of specific varieties of walnut in Iran, the tests were carried out on the available genotypes. Three different genotypes from walnut orchards of Azarshar region were selected and were collected in 2009. A drop test device was designed and constructed to perform the experiments. The impact tests were performed considering five factors in a factorial experiment using completely randomized design with five replications. The factors were genotype, moisture content, geometrical mean diameter, load direction with three levels and the hammer drop height (five levels). The effect of these factors on kernel quality was examined. Walnut cracking assessments and kernel quality were evaluated by well-defined criteria. Generally, by increasing the moisture content, the percentage of broken kernels decreased while the number of unbroken kernels increased and the quality grade of the kernels improved. The percentage of broken kernels increased as hammer drop height increased. Soaking the walnuts in water for 3 hours, with transverse loading (in Y direction) and hammer drop height of 35cm were formed the best set of walnut cracking parameters for obtaining quality kernels.

Keywords: Evaluation, Walnut cracking, Impact, Kernel quality

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Investigating the mechanical properties and degradability of bioplastics made from wheat straw cellulose and date palm fiber

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Abstract

During the past two decades, the use of bioplastics as an alternative to regular plastics has received much attention in many different industries. The mechanical and degradable properties of bioplastic are important for their utilization. In this research cellulose of wheat straw and glycerol were mixed by different weight ratios and then reinforced by using date palm fibers. To prepare the bioplastic plates, the materials were poured in molds and pressed by means of a hydraulic press and simultaneously heating of the molds. The experiments were performed based on a 3×3 factorial design with three levels: 50\%, 60\% and 70\% of wheat cellulose and three types of reinforcement methods, namely: no-reinforcement, network reinforcement and parallel string reinforcement. The effect of the two factors on tensile strength, tensile strain, bending strength, modulus of elasticity and modulus of bending were investigated. The results indicated that the two factors and their interactions had significant effects on the mentioned properties of bioplastics (at \(\alpha=0.05\) level). The comparison of the means of the tests showed that the network reinforcement type with 50\% cellulose had the highest tensile and bending strengths with 1992.02 and 28.71 MPa, respectively. The maximum modulus of elasticity and modulus bending were 40.4 and 2.3 MPa, respectively for parallel string arrangement and 70\% of cellulose. The degradability tests of bioplastic using a fistulated sheep indicated that with increasing the percentage of cellulose, the degradability rate deceased. The maximum degradability rate, after 48 h holding in the sheep rumen, was 74\% that belonged to bioplastics with 50\% cellulose. The degradability data were well fitted to a mathematical model \((R^2=0.97)\).

Keywords: Date palm fiber, Bioplastic, Reinforcement, Mechanical properties, Wheat straw

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The effect of moisture content and temperature on the specific heat capacity of nut and kernel of two Iranian pistachio varieties

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Abstract

Pistachio has a special ranking among Iranian agricultural products. Iran is known as the largest producer and exporter of pistachio in the world. Agricultural products are imposed under different thermal treatments during storage and processing. Designing all these processes requires thermal parameters of the products such as specific heat capacity. Regarding the importance of pistachio processing as an exportable product, in this study the specific heat capacity of nut and kernel of two varieties of Iranian pistachio (Kalle-Ghochi and Badami) were investigated at four levels of moisture content (initial moisture content (5%), 15%, 25% and 40% w.b.) and three levels of temperature (40, 50 and 60°C). In both varieties, the differences between the data were significant at the 1% of probability; however, the effect of moisture content was greater than that of temperature. The results indicated that the specific heat capacity of both nuts and kernels increase logarithmically with increase of moisture content and also increase linearly with increase of temperature. This parameter has altered for nut and kernel of Kalle-Ghochi and Badami varieties within the range of 1.039-2.936 kJ kg⁻¹ K⁻¹, 1.236-3.320 kJ kg⁻¹ K⁻¹, 0.887-2.773 kJ kg⁻¹ K⁻¹ and 0.811-2.914 kJ kg⁻¹ K⁻¹, respectively. Moreover, for any given level of temperature, the specific heat capacity of kernels was higher than that of nuts. Finally, regression models with high R² values were developed to predict the specific heat capacity of pistachio varieties as a function of moisture content and temperature.

Keywords: Colorimeter, Equilibrium temperature, Heat capacity, Pistachio

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Effect of potassium permanganate Nano-zeolite and storage time on physicochemical properties of kiwifruit (Hayward)

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Abstract

In this research, kiwifruits (Hayward) were selected in two mass ranges (large and small). They were placed in one-liter glass bottles in the vicinity of the polyethylene sachets containing potassium permanganate nano-zeolite (0, 0.2, 0.4 and 0.8 g) and were stored in a germinator (5°C temperature and 30% relative humidity). Then, the physicochemical properties of the fruits (soluble solid content, pH, moisture content and fruit firmness) and potassium permanganate nano-zeolite color (L, Hue angle, Chroma and ΔE) were measured after 0, 2, 4 and 6 weeks of storage. The factorial treatment structure based on completely randomized block design was used for analyzing the obtained data. The results of analysis showed that potassium permanganate nano-zeolite had a significant effect on the measured physicochemical properties, except for the moisture content (P<0.01). Also results showed that potassium permanganate nano-zeolite increased the fruits storage time in a way that pH of 3.58 and 3.71, firmness of 10.84 N & 5.7 N and SSC of 14.78 Brix & 15.36 Brix were measured from samples with and without nano-zeolite, respectively after 6 weeks of storage. The results of the variables correlation test showed that there was a significant relationship between kiwifruits firmness (maturity index) and color characteristics of potassium permanganate nano-zeolite (smart agent). The best coefficient of determination ($R^2= 0.98$) and correlation coefficient (0.83) were observed between fruit firmness and total color difference ($\Delta E$).

Keywords: Polyethylene, Storage, Color, Firmness, Soluble solid content

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Design, implementation and evaluation of a potato yield monitoring system

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Abstract

In this paper the design, implementation, and evaluation of an experimental-scale potato yield monitoring system is presented. The main objective of this research was to develop a method for accurate mapping of potato yield. At the first stage an instantaneous yield monitoring system was mounted on a potato harvesting machine. This system consisted of a weighing tray, two load cells, a shaft rpm encoder, a PLC controller and a mobile computer. The PLC controller, which was able to communicate with the mobile computing unit through the control applications developed in Visual Basic and Win-Proladder, was capable of encoding the load cells and other sensors and making decisions by analyzing the obtained records. Laboratory tests were conducted on a potato harvesting machine to evaluate the performance of the system. The independent variables were: forward speed, tray angle, and the thickness of shock absorber plate. To analyze and compare the results of the laboratory data, Duncan's test with confidence level of 95% was used. In order to investigate the interactions of various factors the factorial experiment with completely randomized design was used. In examining the interactions of tray angle, forward speed and performance-related shock absorber on the system performance, the highest performance (with 2.81% error) only was found to be at the tray angle of 37 degrees, forward speed of 2 km h⁻¹ and without shock absorber.

Keywords: Crop yield monitor, Tray weighing, Load cell, Encoder, PLC controller

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Estimation of apple volume and its shape indentation using image processing technique and neural network

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Abstract

Physical properties of agricultural products such as volume are the most important parameters influencing grading and packaging systems. They should be measured accurately as they are considered for any good system design. Image processing and neural network techniques are both non-destructive and useful methods which are recently used for such purpose. In this study, the images of apples were captured from a constant distance and then were processed in MATLAB software and the edges of apple images were extracted. The interior area of apple image was divided into some thin trapezoidal elements perpendicular to longitudinal axis. Total volume of apple was estimated by the summation of incremental volumes of these elements revolved around the apple’s longitudinal axis. The picture of half cut apple was also captured in order to obtain the apple shape’s indentation volume, which was subtracted from the previously estimated total volume of apple. The real volume of apples was measured using water displacement method and the relation between the real volume and estimated volume was obtained. The t-test and Bland-Altman indicated that the difference between the real volume and the estimated volume was not significantly different (p>0.05) i.e. the mean difference was 1.52 cm³ and the accuracy of measurement was 92%. Utilizing neural network with input variables of dimension and mass has increased the accuracy up to 97% and the difference between the mean of volumes decreased to 0.7 cm³.

Keywords: Apple, Image processing, Neural network, Volume

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Design, development and evaluation of a pneumatic seeder for automatic planting of seeds in cellular trays

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Abstract

For planting fine seeds in cellular trays, an automatic pneumatic seeder was designed, constructed and evaluated. CATIA software was used to design and analysis the system parts of the seeder. Different parts of the seeder, including vibrating seed hopper, vacuum boom, seed picking nozzles, seed tube, pneumatic system and electronic control unit for automation of the seeder, were designed and constructed. The area of nozzle orifice was used to calculate the required pressure of nozzle tip. The seeder was evaluated using two sizes of trays. Experiments were performed with five replications and the error of planting the seeds in the 105 and 390-cellular trays were 1.9 and 0.46 percent, respectively. The time of planting for 105 and 390 cellular trays reduced from 20 min (for manual seeding) to 35 s and from 90 min to 160 s, respectively.

Keywords: Pneumatic system, Automatic seeding, AVR controller, Vibrating seed hopper

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Design, implementation and evaluation of a torque transducer with ability of real-time torque monitoring

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Abstract

Torque, speed, and power as mechanical variables are associated with the functional performance of any rotating machinery. The real-time performance and the efficiency of a machine can be determined with on-line measurement of these parameters. In this investigation a rotary torque meter (transducer) was constructed from strain gauge sensors for measuring the torque of rotating shafts. The system converts the torque of rotating shaft into voltage signals, based on the principle of strain gauge resistance. The signals are then amplified and converted into digital signals. These digital signals are sent to a RF receiver circuit for displaying and storage. Results of static calibration and a series of dynamic tests confirmed a satisfactory operation of the designed apparatus in various conditions. Also, the torque measuring range, resolution and the accuracy were from 3 to 700 N m, 3 N m and 1%, respectively.

Keywords: Module, Radio frequency, Strain gauges, Torque

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Design, construction and evaluation of a row crop thinning machine

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Abstract

Equipment availability is necessary in the development of Agriculture mechanization. Crop thinning is one of the most important stages in row crop production which is laborious and costly. The objective of this project is design and construction of a row crop thinning machine. Four main system units are plant sensors, ground sensors, control and thinning platforms. In this machine the unwanted plants on the rows are randomly removed by employing a pneumatically system. A blade on a vertical arm with pendulum motion removes the plant from the rows. The machine control system consists of an arm and a blade which is activated by a double acting cylinder and equipped with a relay and a timer. The pneumatic cylinder is controlled via a solenoid valve. Laboratory tests were conducted to validate the machine performance. Some other preliminary tests also were performed for optimization of parameters such as cinematic index and cutting length of blades. The laboratory tests (totally 9 tests) were performed with a constant forward speed and three levels of plant density, using artificial plants. The data were analyzed using SPSS software. The results show that satisfactory performance of the machine is achieved when the plant density is moderate i.e. the thinning performance reduces with higher plant distance in the row. The other effective variable on machine performance is the adjustment of sensor sensitivity, which is used to distinguish between week and strong plants. In general the machine performance is sensitive to plant shape and morphology, plant distribution pattern in the field, growing stage of the plants, time of thinning and the effectiveness of previous weeding operations.

Keywords: Thinning, Pneumatic system, Electrical control, Row crop

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Development and evaluation of a gas flamer with the ability of targeted-discrete flaming in locating and eradicating weeds

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Abstract

Farmers are now more interested in application of weed control methods and tools with less environmental side effects. Flame weeding using propane gas is an approach with almost no any chemical residue on the soil and plant surfaces or underground water. In this research, a flame weeding machine with the ability of uniform and also discrete flaming was developed and evaluated in laboratory and field scales. In this apparatus, machine vision technology successfully discriminates between soil and weeds (plants grown in between the corn rows are considered as weeds) under natural illumination. In the laboratory tests, the effect of three forward speeds (0.5, 0.7 and 0.9 m s\(^{-1}\)) on flaming leading or lagging was investigated. The feasibility of using this technology for site-specific weed control of a corn field in comparison with conventional continuous flaming was investigated. The field trials were conducted with both continuous and discrete flaming approaches. The system performance and weed response to flaming treatments were evaluated by measuring the fuel consumption, counting the number of and weighting the survived and dead weeds one and three days after each flaming treatment. The results of laboratory tests showed that the effect of forward speed on system accuracy was significant and the system performance was more accurate at forward speeds of 0.5 and 0.7 m s\(^{-1}\) than 0.9 m s\(^{-1}\). According to the field experiments, continuous and discrete flaming methods exhibited similar results in eradication of weeds (both number and weight-based), while the fuel consumption of the discrete flaming was lower than the continuous one. The results also showed that discrete flaming by employing machine vision technology could be an efficient substitute for continuous flaming due to its lower fuel consumption and potential reduction of air pollution as well as other benefits of flame weeding.

Keywords: Flame weeding, Weeds, Machine vision, Precision agriculture

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Investigation of kinetics and energy consumption of thin layer drying of corn

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Abstract

In this study thin layer drying of corn in a convective dryer was investigated at air temperatures of 50, 60 and 70°C and air flow rates of 1, 1.4 and 1.8 kg min\(^{-1}\). Experiments were performed in Completely Randomized Design (CRD). The effect of air temperature and flow rate on drying time, drying rate, effective diffusivity coefficient and activation energy were studied. Results showed that the effects of temperature and flow rate on drying process were significant. Increasing the air temperature from 50 to 70°C, caused 31.7 percent decrease in drying time and change of air flow rate from 1 to 1.8 kg min\(^{-1}\) reduced drying time 27 percent in average. The effective diffusivity coefficient and activation energy varied from 3.47258 ×10\(^{-11}\) to 7.34352×10\(^{-11}\) m\(^2\) s\(^{-1}\), and 13.761 to 16.193 kJ mol\(^{-1}\), respectively depending on the drying treatments. The Logarithmic model was found to be in a better agreement with experimental data compared with other models. The minimum value of specific energy requirement (3.61 kWh kg\(^{-1}\)) was obtained at a drying air temperature of 50°C and air flow rate of 1 kg min\(^{-1}\), whereas the corresponding parameters for the maximum value (5.34 kWh kg\(^{-1}\)) were determined as 70°C and air flow rate 1.8 kg min\(^{-1}\).

Keywords: Drying, Modeling, Thin layer, Energy consumption

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Comparison of rice direct seeding methods (mechanical and manual) with transplanting method

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Abstract

The main method of rice planting in Iran is transplanting. Due to poor mechanization of rice production, this method is laborious and costly. The other method is direct seeding in wet lands which is performed in the one third of rice cultivation area of the world. The most important problem in this method is high labor requirement of weed control. In order to compare the different rice planting methods (direct drilling, transplanting, and seed broadcasting) a manually operated rice direct seeder (drum seeder) was designed and fabricated. The research was conducted using a randomized complete block design with three treatments and three replications. Required draft force, field efficiency, effective field capacity, yield, and yield components were measured and the treatments were compared economically. Results showed that there were significant differences among the treatments from the view point of rice yield at the confidence level of 95\% i.e. the transplanting method had the maximum yield. A higher rice yield was obtained from the direct seeder compared to the manual broadcasting method but, the difference between these two methods for crop yield was not significant even at the confidence level of the 95\%. The coefficient of variation of seed distribution with direct seeding was more than 20\%. The labor and time requirements per hectare reduced to 7 and 20 times, respectively when comparing the newly designed direct seeder with the transplanting method. The direct seeding method had the highest benefit to cost ratio in spite of its lower yield. Therefore, this method could be recommended in the rice growing regions.

Keywords: Manually operated seeder, Paddy, Direct seeding

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Prioritization of strategic agricultural crops in Alborz province using the Fuzzy Delphi method and the Analytical Hierarchy Process (AHP)

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Abstract

Alborz province with an area of about 5121.7 km² has about 0.31% of the total area of the country. The total arable area of the province is about 48954 hectares. Water, land and capital are the most important factors for agricultural production. By understanding the subjective beliefs, decision-making criteria and economic incentives of local farmers, the priority of crops can be achieved with the maximum profitability of farmers and the least damage to the resources (water and land). The combination of Fuzzy Delphi techniques and methods of integrating analytical hierarchy process (AHP) can be an appropriate approach for achieving this goal. By employing the above combination of Fuzzy and AHP techniques, the priorities of the strategic agricultural crops in Alborz province achieved as wheat, barley, corn silage, alfalfa, cotton and canola, with final priority weighting factors of 0.496, 0.403, 0.354, 0.320, 0.183, and 0.090, respectively. By comparing the decision criteria it has been determined that the farmers prefer the amount of cultivation area, net income, production costs and livestock needs with the relative importance factors of 0.487, 0.410, 0.346 and 0.188, respectively. Among all prioritization criteria, the cultivated area had the highest priority. Water shortage, labor costs, lack of financial support, and governmental purchase allowance for wheat, were the main reasons for shifting the cultivated area towards wheat cultivation with total area of 14350 hectares.

Keywords: Alborz province, Fuzzy Delphi method, Analytical hierarchy process (AHP), Strategic agricultural products

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Brief Report

Evaluation and modeling of camel thorn (*Alhagi maurorum*) weed cutting by water jet

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Abstract

Due to the importance of weed control and the limitations of mechanical methods in some places, in this research the water jet cutting for weed control was investigated. The cutting tests were performed on camel thorn weed in Shahid Bahonar university of Kerman. The water jet pressure of 90 bars was achieved with the aid of a suitable pump. The cutting time was studied in a completely randomized factorial design experiment (CRD) with five replications. Factors of experiments are: stem diameter in 2 levels (smaller and larger than 5 mm), distance of spraying jet from weeds in 3 levels (10, 20 and 30 cm) and two types of plant holders: blade and plate. The results showed that stem diameter and jet distance from the weed stem had significant effects on cutting time (at the 1%). The mean comparison of parameters showed that with increase of stem diameter the cutting time increased and any increase in jet distance from the weeds decreased the cutting time linearly with $R^2=0.96$ and $R^2=0.99$ for small and large diameter weeds, respectively. The minimum cutting time was measured at 30 cm of the jet from small diameter of stems. A multivariate linear regression model was also proposed for cutting weed parameters. It can be concluded that due to the flexibility of water jet cutting for restricted places, hydrodynamic control of weeds is proposed as a complementary method and sometimes a competing substitute method.

Keywords: Cutting, Hydrodynamic, Regression model

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