Design, Construction and Test of a Three-point Hitch Dynamometer

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Abstract

For measuring the draft forces exerted by implements into tractor, we use the dynamometers that are divided into pull type or three-point hitch type. For measuring the forces between the tractor and the mounted implements, three-point hitch dynamometers are used. In this research, an adjustable three-point hitch dynamometer with a draft capacity of 25 kN was designed and built which is made up from two frames that one of them placed inside the other. The force sensing elements were comprised of a loadcell that was installed between the frames. All mounted tillage implements were able to be tested by this measuring device excluding mounted implements which are powered by PTO and by using this dynamometer, the variations of implements draft force in the different tillage conditions consist of the various work depths and different forward speeds would be studied. After design and construction steps, dynamometer was calibrated, tested and evaluated. Field tests were done by using of four mounted tillage implements and obtained data were compared by obtained data from ASAE D497.5 standard formula. So with these data, the design of tines, their stems, equipment frames and the selection of the optimal size of the tillage equipments in regard of the soil type of the region and the power of the available tractors will be more scientific and reasonable.

Keywords: Three-point hitch, Draft measurement, Tillage, Dynamometer, Design & construction

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Evaluation and Comparison of Geostatistical Methods to Generating Digital Management Map of Cyanazine Variable Rate Cyanazine Application

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Abstract

In this study evaluation and comparison of various interpolation approaches for estimation un-sampled values of soil Organic Matter Content (OMC) and soil texture is presented. The main objective is to develop a precision method for generation of management maps for variable rate application of herbicide that eventuate to save herbicide application and to reduce adverse impact on the environment. For this purpose after sampling of 42 points on the test field and generation of local and global grid of sample points on a PC, various interpolation methods were applied to estimate soil OMC and texture on un-sampled points by Surfer software. Inverse distance to a power, Kriging, minimum curvature, weighed moving average and radial basis function were used as interpolators. To evaluate the mentioned methods, cross-validation approach and two statistical parameters MAE and MBE were used. The results showed that minimum curvature method with MAE equal to 1.31 has the minimum error than other methods. In this method MAE value for sand, silt and clay was equal to 1.6, 1.18 and 0.59, respectively. In comparison with other methods, this approach had the minimum error. It was demonstrated that minimum curvature method was the best approach to estimate grid point values at un-sampled points. Finally after selection of appropriate method and using considered manufacturer recommendations of herbicide application based on OMC and soil texture, a digital management map of Cyanazine variable rate application in a corn field was generated. Based on this map and considering the herbicide uniform application in the farm as 1.7, 2.9 and 4 Lha\(^{-1}\), herbicide application rate compared with 1.8 Lha\(^{-1}\), decreases 39% and increases 4 and 50% respectively. This means that if the entire field is sprayed with the uniform rate of 1.7 Lha\(^{-1}\), Compared with 1.8 Lha\(^{-1}\) which is obtained using management map, herbicide application will be saved 39 %. Similarly, if herbicide is applied 2.9 and 4 Lha\(^{-1}\) uniformly, compared to the amount 1.8 Lha\(^{-1}\), 4 and 50% of herbicide application will increase respectively.

Keywords: Digital map, Geostatistical methods, interpolation, Soil texture, Organic Matter Content (OMC), Pre-emergence herbicide

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Making Weed Management Maps by Artificial Neural Networks for Using in Precision Agriculture

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Abstract

With the rise of new powerful statistical techniques and neural networks models, the development of predictive species distribution models has rapidly increased in ecology. In this research, a learning vector quantization (LVQ) and multi layer perceptron (MLP) neural network models have been employed to predict, classify and map the spatial distribution of \textit{A. repens} L. density. This method was evaluated based on data of weed density counted at 550 points of a fallow field located in Faculty of Agriculture, Shahrood University of Technology, Semnan, Iran, in 2010. Some statistical tests, such as comparisons of the means, variance, statistical distribution as well as coefficient of determination in linear regression were used between the observed point sample data and the estimated weed seedling density surfaces by two neural networks to evaluate the performance of the pattern recognition method. Results showed that in the training and test phases non significant different was observed between average, variance, statistical distribution in the observed and the estimated weed density by using LVQ neural network. While this comparisions was significant except statistical distribution by using MLP neural network. In addition, results indicated that trained LVQ neural network has a high capability in predicting weed density with recognition error less than 0.64 percent at unsampled points. While, MLP neural network recognition error was less than 14.6 percent at unsampled points. The maps showed that, patchy weed distribution offers large potential for using site-specific weed control on this field.

Keywords: Classification, Neural network, Site-specific management, Spatial distribution

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Evaluation of Image Processing Technique for Measuring of Nitrogen and Yield in Paddy Rice and Comparing it with Standard Methods

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Abstract

In order to use new and low cost methods in precision agriculture, nitrogen should be supplied for plants on time and precisely. For determining the required nitrogen of paddy rice in the clustering stage, a series of experiments were conducted using three different methods of: image processing, kjeldahl and chlorophyll meter set (SPAD-502), in a randomized complete block design with three replications during 2010 at Rice Research Center of Tonekabon, Iran. Four experimental treatments were different level of fertilizer (Urea with 46% nitrogen). In the clustering stage, some images from rice plants were taken vertically by a digital camera and were analyzed using image processing technique. Simultaneously the chlorophyll index of plants was measured by SPAD-502 chlorophyll meter set and the percentage amount of nitrogen was measured using of the so called kjeldahl laboratory method. The results showed that the three methods of determining nitrogen of rice plant were highly correlated. Moreover, the correlation among the three methods and crop yield were almost the same. In general, the method of image processing could have a high potential for nitrogen management in the field, while this method was low-cost, faster and also nondestructive in comparison to the other methods.

Keywords: Nitrogen, Paddy Rice, Kjeldahl, Chlorophyll meter SPAD-502

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Investigation on the Field Performance of Four Weeding Methods for Peanut

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Abstract

In this research, field performance of four weeding methods for peanut crop was investigated in Kiashahr located at Guilan province. The weeding methods were included weeding by two types of motorized weeders (power tiller operated cultivator and power tiller operated rotovator at three forward speeds of 1.0, 1.5 and 2.0 km/h), weeding by hand-driven wheeled cultivator and hand weeding by trench hoe. A randomized complete block design with three replications was used for the experiment. Weeding index, crop yield, field capacity, energy consumption and the economical index of benefit-cost ratio were measured and determined. Results showed that the highest weeding efficiencies of 98.61 and 97.37% were obtained in hand weeding for the first and second weeding stages, respectively. In all the mechanical treatments, the weeding efficiency of the second stage was greater than that of the first stage. The highest value of field capacity in the first stage (0.1263 km/h) and second stage (0.1287 ha/h) was recorded for power tiller operated rotovator at travel speed of 2.0 km/h. with amount of field efficiency was achieved in weeding with tiller rotovator at forward speed of 2 km/h (0.1263 and 0.1287 ha/h for first and second stages of weeding operation respectively). Among the methods, the lowest value of energy consumption with the average of 307.8 Mj/ha was registered for hand-driven wheeled cultivator. Results also indicated that power tiller operated rotovator at forward speed of 1.0 km/h had the highest benefit-cost ratio of 2.06 compared to other treatments. Thus, weeding by power tiller operated rotovator at forward speed of 1.0 km/h is advisable for peanut cultivation in the region.

Keywords: Peanut, Weeding machine, Weeding efficiency, Field capacity
Effect of Moisture Content on Mechanical Properties and Terminal Velocity of Berberis

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Abstract

The study of mechanical properties of Berberis not only is useful for design and optimization of transportation, processing and packaging equipment but also can prevent mechanical injuries and losses. In this study force, deformation, energy and toughness were measured at different moisture content levels including 70-76, 45-50, 25-30 and 7-10 percent (w.b.). The decrease of moisture content caused increasing rupture force from 1.387 to 2.679 N, decreasing shape deformation from 3.387 to 2.413 mm, increasing toughness from 4.297 to 8.220 J/cm³ and decreasing rupture energy from 0.921 to 0.661 mJ. Effects of loading speed, force orientation and their interaction were investigated on just fresh Berberis fruit. It was indicated that only force orientation was effective on all investigated properties except toughness. The moisture content was identified as an effective parameter on terminal velocity. It decreased from 9 to 4.5 m/s with decrease of moisture content from 76 to 7 percent (w.b.).

Keywords: Berberis, Mechanical properties, Moisture content, Terminal velocity

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Comparison of the Effects of No Tillage, Minimum Tillage and Conventional Tillage on Dry Land Wheat Yield in Pebbly Field in Tropical Region

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Abstract

The current study was conducted to compare different tillage methods on wheat yield in pebbly dry land areas done within three years (2006-2008) in north Khuzestan (Baghmalek city) in randomized block design with five treatments and four replications. The experimental treatments were: (1)chisel plow +seed-drill, (2)Semi plow(mold board plow with remove mold board)+seed-drill, (3)no-till-drill, (4)sweep plow +seed-drill and (5)conventional method(mold board plow+ broadcasting seed and fertilizer+ sweep plow). These treatments included minimum tillage (treatments 1, 2 and 4), no tillage (treatment 3) and conventional tillage (treatment 5). Complex variance analyses of three years data showed that there was no significant difference between tillage methods and interaction of tillage methods with year in soil moisture content in different plant growth stages (stem, flowering, and filling seeds stages) but years were different in this factor. Variance analyses of data showed that there was no significant difference between different tillage methods in percent of organic materials in different soil depths in the end of the project. However, no difference in tillage methods in the amount of organic material has been analyzed based on the pebbly conditions. The complex variance analyses of data also showed that tillage methods had significant effect on grain yield and other agronomical factors, except plant height and harvest index. According to the results any devices cause to back more gravel and cobblestone into sub soil layer provide more grain yield. Therefore, mold board plow resulted in maximum yield in three experimental years which were different in amount and distribution of rainfall, and also in third year the amount of rainfall was considerably low. The grain yield averages of three years were 1333, 1558, 1190, 1080 and 1787 Kg.ha⁻¹ for chisel plow, semi plow, no-till-drill, sweep plow and mold board plow respectively.

Keywords: Dry land, Tillage method, Pebbly, Wheat

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Investigation of Energy Use Efficiency for Dry Wheat Production Using Data Envelopment Analysis (DEA) Approach; Case Study: Silakhor Plain

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Abstract

In this research energy efficiency for dry wheat production in three levels including 0.1 up to 2, 2.1 up to 5 and over 5.1 hectares for the farming year 2008-2009 in Silakhor plain located in Borujerd and Dorud divisions of Lorestan province was studied using data envelopment analysis (DEA) technique. The results showed that the input energy for seed, fertilizer and pesticides had the highest levels of energy consumption and the share of that in each studied level were 63.63, 56 and 54.07 percent respectively. The results of data envelopment analysis showed that the average of energy efficiency levels were 82, 78 and 68 percent, respectively. First level, that consumes more input energy than other two studied levels, had highest energy efficiency, because in this level output yield were more than other levels. Technical efficiency of inefficiency units in CRS model in three levels is 79%, 77% and 66% respectively. This issue indicates that 21, 23 and 34 of total energy input could be saved with upgrade efficiency in these units. All wrong using and also all share of total saved energy in three levels related to grain, fertilizer and pesticides and then fuel consumption.

Keywords: Data Envelopment Analysis, Different Levels of Planting, Dry Wheat, Energy Efficiency

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