Modeling physical damage and percentage of threshed pods of chickpea in a finger type thresher using artificial neural networks

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A four layers feed forward artificial neural network (ANN) model having four input neurons, two output neurons and two hidden layers was developed to predict the percentage of physical damage, PPD, and percentage of threshed pods, PTP, of chickpea in a finger type thresher. The learning of ANN was accomplished by a backpropagation algorithm. The training and testing data were obtained by studing the effects of impact velocity (at 6.3, 9.5, and 12 m/s), kernels moisture content (at 7, 12, and 18%), pod size (large, mediu, and small), and variety (Bivanij, Kaka, and Jam) on PPD and PTP in a finger type threhser.

The number of patterns used in the ANN modeling was 81, which were randomly divided into 61 and 20 data sets for the training and testing the neural network, respectively. Different networks were made and the optimum values of network parameters were obtained by trial and error. A two hidden layers ANN with 5 nodes in the first and 3 ones in the second hidden layer and 30,000 learning runs was optimum. A good agreement between the measured and the predicted values was obtained. The selected neural network model, predicted the output parameters with maximum RMS Errors and T value of 0.047 and 0.977, respectively.

The results of the tests showed that the mean value of PPD at a velocity of 6.3 m/s was about 0.0%, which increased exponentially to 7.0% at a velocity of 12 m/s. With increasing the impact velocity from 6.3 to 12 m/s at 7% moisture content, the mean value of PPD increased from 0.1% to 16.3%. The maximum and minimum PTP were related to velocities of 12 m/s and 6.3 m/s, respectively which were equal to 85% and 42%, respectively. Moreover, the results show that moisture content had a significant effect on PTP and PPD. With decreasing the moisture content from 18% to 7%, the mean PPD increased from 0.2% to 6.7% and for PTP increased from 43% to 80%. Pod size had an increasing significant effect on PPD, but it was not significant on PTP. No statistically significant difference (P=0.01) was observed in PPD and PTP among varieties.