Effect of variety and humidity on the loss of maize crop after shelling in shelling and drying factories of maize (Zea mays) in Iraq

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Abstract

In order to know effect of the variety and the optimum humidity to reduce the percentage of loss in the yield of maize during the process of shelling the maize factories, this research was conducted during the autumn season of 2011 in Hawija district, west of Kirkuk governorate, using six entered varieties (CADIZ, DKC1120, DKC1188, DRACHMA, RONALDINO and RANT) were cultivated according to a randomized complete block design (RCBD) with three replications. The shelling was carried out at three levels of humidity (23-26%, 27-30% and 31-33%). The following characteristics were studied (number of rows in ear, number of grains per row, total yield kg/ du, outturn ratio of grain yield at the three moisture levels, and the percentage of loss of grain yield at the three moisture levels). The results indicated that there are significant differences between the varieties at a probability level of 1% for all the studied traits, and the results of the means test showed the superiority of the DRACHMA variety at the best rates for all the traits studied, as it gave a yield amounted to 3708.2 kg/ du, and it also gave the lowest percentage, it was 3.95% Low humidity 23-26%. The low humidity percentage also achieved the lowest rates of loss percentage during the shelling process for all varieties.

Keywords: maize, humidity, shelling.

1. Introduction

The maize crop (Zea mays. L) is one of the important cereal crops in many countries of the world, including Iraq, and it is globally ranked second after wheat in terms of cultivated area, and the first in terms of production, and the area planted with maize in the world in 2012 reached Approximately 182 million hectares were produced and 824 million tons were produced according to the statistics of the Food and Agriculture Organization of the United Nations [1], while maize is ranked third in the Arab world after wheat and barley in terms of cultivated area and second after wheat in terms of production. The area cultivated with maize in the Arab world reached (1535,460) hectares and produced approximately (7181,330) tons, i.e. a mean of (4,677) kg/ hectare, while the cultivated area in Iraq reached (199,500) hectares according to Central Statistical Organization, However, productivity per unit area is still low at 3.326 tons /hectare [2], in addition to the fact that the domestic rate of return is very low compared to the global production rate of 11.21 ton/ ha [3]. The demand for maize, rice and wheat does not need to be fully met by increasing production. Every year, a third of all food produced for human consumption, including up to 30% of grains, is lost or wasted, with enormous negative impacts on food availability and high environmental costs [4]. Substantial reduction in loss and waste Food, along with shifting to healthy and sustainable diets that are less dependent on animal protein, reduce the need for increased cereal production [5].

Indicated [6] that the increase in the moisture content led to an increase in the percentage of excessive grains and a decrease in the percentage of fine materials and the percentage of breakage and the percentage of cobs outflow, he mentioned that some necessary supplies must be provided that contribute to increasing the production of the corn crop from good shelling and storage operations to get rid of spoilage to the extent that is sufficient to accommodate all the produced ears or seeds, and process of harvesting the crop takes place in the humid atmosphere and in the prevailing method (manual harvesting), after which it is peeled and marketed to the maize factories for the purpose of shelling and drying, and this process leads to high humidity due to its exposure to rain and leaving it on the moist soil surface (when harvesting the autumn season) [7] stated that automatic shelling has a significant effect on grains such as breakage and other damages that appear during the storage period.
Although corn kernels reach physiological ripeness at 35% moisture [8], Corn plants grown for cereal production should be harvested when the grain moisture content does not exceed 28% [9]. When the moisture of the crop is over 28%, the beans become softer and can be squeezed very easily, this leads to more grain spoilage [10]. Mechanical damage to grains often results in the process of shelling, which is largely due to the high moisture content. Studies have shown that minimal grain damage during corn ear threshing is recorded at moisture contents between 20-22% [11]. Whereas, corn with higher moisture content is more susceptible to mechanical damage than machinery during shelling [10]. Claimed [8] that a gradual increase in mechanical damage to the grains (caused by the rotation of the threshing cylinder) with an increase in the moisture content of the harvest contributes to a decrease in the physiological ability of the grains and an increased incidence of fungi during grain storage.

Concluded [12] that the moisture and quality of the grain to be introduced artificially has a significant effect on the quantity of grains produced due to the high or low percentage of breakage according to the moisture content and quality of the variety entering the manufacturing stages. Concluded [13] that the loss is low at a moisture content of less than 35%. Afzalinia et al [14] reached that the grains provided for processing are affected a lot by their moisture content, and they stated that the reason for this is the decrease in the moisture content, which leads to an increase in the percentage of cracking and thus a decrease in the percentage of whole grains.

Hall [15] explained that the least harm occurs to corn seeds when their moisture content is between 24% - 30%, indicating that this percentage of moisture is suitable for carrying out the shelling process. Indicated [16] that the lowest percentage of shelling (the highest percentage of loss) is at the moisture content of 25%. Therefore, there is a positive relationship between the percentage loss and the percentage of the moisture content drop of the grains. Reported [17] that there was a significant effect of the moisture content of the ears of corn supplied to the manufacturing due to the mechanical damage that it faces during manufacturing, making it vulnerable to breakage and wear.

The grain yield of a plant depends on the size and efficiency of the photosynthesis system and on how long it lasts so it differs according to the nature of growth and genotype of the variety. Found [18] in his study to compare different ripening varieties that outnumber the late ripening varieties in the yield of a single plant. These results agreed with what they found [19,20].

Most comparison and evaluation studies have shown that the grain yield per unit area varies according to the different stages of growth, the components of the yield, the combination of genes possessed by the genotype, as well as the physiological processes that regulate the evolutionary stages of that type or genotype [21-23].

The aim of study: Due to the paucity of local studies, this study aims to determine the percentage of loss in the corn yield received by the maize factories when it is shelling on different moisture ratios and the extent of its impact on the percentage of final seed outturn of six varieties of different origin, in addition to estimating the yield and some of its components for these varieties.

2. Materials and methods

The experiment was conducted in Hawija district, where the seeds of six hybrids of yellow corn crop introduced into the country (CADIZ, DKC1120, DKC1188, DRACHMA, RONALDINIO and RANT) were planted in one of the fields in the fall season of 2011 using a complete random block design with three replications, each replicate contained six Experimental units with a width of 5 m. The experimental unit included five lines of plants, the distance between line and another is 75 cm. Ten plants were selected from the three middle lines to study the following characteristics (number of rows in ear, number of grains in a row and total yield in kg/du), in addition to calculating the percentage of grain outturn After shelling and the percentage of loss after shelling at three levels of humidity, the first level 23-26%, the second level 27-30% and the third level 31-33% through the following equations:

\[
\text{Grain outturn } \% = \left( \frac{\text{grain yield}}{\text{total yield}} \right) \times 100
\]

\[
\text{Loss ratio} \% = \left( \frac{\text{grain yield + cobs yield}}{\text{total yield}} \right) \times 100
\]

Samples were shelled in the Hawija factory for corn, using a conventional shelling machine, and an electric oven device (oven) was used to control the humidity and deliver it to the required level.

Agricultural operations were carried out to serve the crop, including irrigation, fertilization, hoeing and pest control, as needed and according to the recommendations in force.

The statistical analysis was conducted using the statistical analysis program (SAS) according to the experimental design method used in the experiment (RCBD) [24]. The mean of the varieties for the different traits was also tested in a less significant way (LSD) [25].

3. Results and discussion

The results of the analysis of variance appearing in Table (1) showed significant differences at a probability level of 1% between the six cultivars under study for all traits studied according to the F test, these results lead us to test means to determine the superior treatments.
The results of Table (2) indicated that the variety DRACHMA outperformed the highest mean for the number of rows in the ear which reached 15.27 rows/ear with a significant difference from all other varieties according to the results of the means test in a less significant way LSD, while the variety RONALDINIO recorded the lowest mean, which amounted to 12.9 rows per ear. This may be due to the nature of the genotype of each variety and the extent to which it is affected by environmental factors. This result is in agreement with [26].

For the number of grains per row, the variety DRACHMA is also distinguished in this characteristic according to the results of the means test shown in Table (2), achieving the highest rate of 40.40 grains/row, with a significant difference from all other varieties under study according to the results of the LSD test, while the variety RONALDINIO gave the lowest mean for the number of grains per row, which amounted to 31.03 grains, and from previous studies, found [26] significant differences between the varieties they studied for the number of grains per row.

In characteristic of total yield, the variety DRACHMA achieved the highest yield at a rate of 3708.2 kg/du, with a significant difference from all other varieties under study, while the variety RONALDINIO gave the lowest grain yield per unit area at a rate of 1974.4 kg/dunum. The superiority of this cultivar by the highest rates for the number of rows of ear and the number of rows of ear and this result is consistent with results of [19,20,26] , who obtained significant differences between genotypes which they studied for the yield per unit area.

For the characteristic of outturn grains as a percentage of the total yield, the variety DRACHMA has the highest rates of this characteristic at the three humidity levels under study, with a significant difference from the other varieties, as its means reached 74.1%, 62.1% and 48.6% at humidity levels 23-26%, 27-30% and 31-33%, respectively. While the CADIZ variety gave the lowest rates for the outturn characteristic of the grains, they were 66.8%, 51.1% and 40.2% at humidity levels 23-26%, 27-30% and 31-33% respectively.

For the percentage loss in the yield noticed that there are significant differences between the varieties according to the results of the means test using the LSD method shown in Table (2), which confirmed the results of the analysis of variance and the test of variables with the F test shown in Table (1), as it is noticed that the cultivar DRACHMA is superior at the humidity ratio 23 – 26, while the variety RONALDINIO exceeded the rates of humidity 27-30% and 31-33% with the lowest rates of loss, which amounted to 3.95%, 8.28% and 18.91% respectively, while the CADIZ variety gave the highest loss rate among all the varieties, and at the three humidity levels, rates were 7.77%, 15.21% and 33.64%, respectively. As for the percentages of loss in the yield during the process of shelling within each of the six varieties under study, it appeared from Table (2) that there are significant differences between their means according to the results of the test using the LSD method according to the difference in the percentage of humidity that was shelled, and it is generally noticed that the process of shelling is superior
to the percentage of Low humidity 23-26% with the lowest of loss rates in the yield and for all varieties under study, while the process of shelling at high humidity 31-33% recorded the highest rates for the percentage of loss in the yield and for all the varieties under study, and these results are consistent with the findings [6]. In that the low humidity gave shelled grains well and reduced the loss in yield, while it was not in agreement with [14] who found different results.

It is concluded from the foregoing that the studied varieties had a high degree of heterogeneity and for all the traits, during which the DRACHMA variety was superior in the yield characteristics and its components and the outturn ratio of the grain yield. Also, the difference in the moisture content during the shelling process was found to have a significant effect on the percentage of loss in the corn yield. Based on the foregoing, it may be recommended to pay attention to the DRACHMA variety as an adapted variety with good quantitative characteristics for the purpose of evaluating it under different conditions and approving it. We also recommend emphasizing the reduction of the humidity of the corn yield to low levels in order to reduce the percentage of loss in yield during the process of shelling. We also recommend conducting studies more in-depth suffix for the purpose of minimizing the losses in the yield of this strategic crop.

Table (2) means of varieties for the traits under study.

| Varieties Traits | CADIZ | DKC1120 | DKC1188 | DRACHMA | RONALDINO | RANT | LSD for traits |
|------------------|-------|---------|---------|---------|-----------|------|----------------|
| Number of rows per ear | 14.11b | 14.63b | 14.33b | 15.27a | 12.9c | 14.61b | 1.73 |
| The number of grains per row | 35.73c | 37.57b | 37.12bc | 40.40a | 31.03d | 37.81b | 1.73 |
| Total yield (kg/ du) | 2845.3d | 3292.4b | 3211.6c | 3708.2a | 1974.4e | 3208.9c | 75.2 |
| Grain outturn at 23-26% moisture | 66.8d | 71.6b | 70.8b | 74.1a | 71.8b | 68.9c | 1.8892 |
| Grain outturn at 27-30% moisture | 51.1e | 58.2b | 55.9c | 62.1a | 61.1a | 54.1d | 1.035 |
| Grain outturn at 31-33% moisture | 40.2e | 44.8c | 45.0c | 48.6a | 46.9b | 42.4d | 1.2603 |
| The percentage of loss at humidity 23-26 | c7.77a | c4.86c | c5.93b | c3.95e | c4.32d | c6.24b | 0.346 |
| The percentage of loss at humidity 27-30 | b15.21a | b10.61b | b11.42b | b10.04b | b8.28c | b13.91a | 1.56 |
| The percentage of loss at humidity 31-33 | a33.64a | a22.69c | a23.74bc | a19.66d | a18.91d | a25.38b | 1.98 |

LSD for loss ratio | 2.57 | 1.58 | 1.6 | 2.05 | 0.94 | 2.73 |

-The numbers followed by the same letter are not different from each other.
- The pre-letters indicate the differences between the loss ratios within each class.
- The post-letters indicate the differences between the varieties within each characteristic.

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