THE EFFECTS OF SEED PRIMING, PLANTING DATE AND DENSITY ON THE SILAGE YIELD OF CORN (ZE A MAYS L.) IN SUMMER DELAYED SOWING

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Abstract: To determine the effects of seed priming, date and density of planting on the silage yield of corn (Ks.c 704 cultivar) in summer delayed planting, an experiment was carried out as a split-split plot in a randomized complete block design with four replications in 2015 and 2016. Treatments were examined including two planting dates (July 27 and August 13) as main plots, two planting densities (7 and 9 plants per m²) as sub plots and four levels of seed priming (without priming, distilled water, 0.5% KNO₃ and 10% PEG(8000)) as sub-sub plots. The results showed maximum of the speed and percentage of seedling emergence at the first year. The number of days decreased from planting date until 8- and 12-leaf stages in seed priming by the distilled water method. The silage yield decreased (26.69%) with the late planting (13 August), but the speed of seedling emergence increased. The planting density (9 plants/m²) yielded the highest percentage of lignin, speed of seedling emergence, plant height and silage yield. The highest ratio of the ear fresh weight to the total silage weight was obtained by the late planting date (13 August) and seed priming with the PEG method. The maximum value of the silage yield (45,566.41 kg/ha) was produced by the early planting date (27 July) and higher planting density (9 plants/m²). Thus, to increase seedling emergence speed and to obtain maximum silage yield, early planting date (27 July), higher planting density (9 plants/m²) and seed priming by the distilled water method are recommended.

Key words: plant density, seed priming, corn silage yield, sowing date.

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Introduction

Corn is the most important plant among cereal crops after wheat and rice. Corn cultivation has been increased because of increasing animal husbandry industry in the last several years in Iran (Fathi, 2005). Corn is one of the most suitable crop plants to produce green manure and silage due to high starch in seed and yield of this plant (Khodabandeh, 2000). Corn silage herb will be provided under general conditions easily until energy and herb sustainable quality are obtained (Curran and Posch, 2000). Germination and seedling emergence speed is one of the most important and effective factors to attain maximum yield for most crop plants (Subedy and Ma, 2005). The seed priming treatment can increase the ability and speed of seed germination (Farooq et al., 2006). The seed priming treatment will lower the time between dates until seedling emergence. Because of that, the seeds germinate equally, which will improve the quantity and quality of the yield of the plant (Basra et al., 2004). Murungu et al. (2003) have found that seed priming treatment increased seedling emergence percentage and seedling growth of corn as compared with the witness treatment (without priming). The most common methods for seed priming are hydro-priming and osmo-priming. Regarding the osmo-priming method, seeds will be settled into solutions with low osmotic potential, which include chemical materials such as poly-ethylene glycol (PEG), menthol and chemical fertilizers like urea (Ashraf and Foolad, 2001). Seeds will be also soaked into water and will be dried before completing seed germination within the hydro-priming method. Determination of the suitable planting date for crop plants is important to use the potential of the variety, soil and climate of each region (Estakhr and Dehpour, 2010). Sadeghi and Bahrani (2002) have examined the effect of three planting dates (24 April, 4 and 14 May) on silage corn and the maximum silage yield was obtained (13388 kg/ha) on 24 April. The maximum yield for every plant can be influenced by determining the suitable plant density regarding the climate conditions and variety properties (Nourmohammadi et al., 2001). Viddicombe and Thelen (2002) have reported that high planting density (90,000 plants/ha) increased grain yield as compared with low planting density (560,000 plants/ha). The most appropriate plant density to achieve maximum yield (79,040 plant/ha) was also suggested by Bean and Gerik (2000). Therefore, this research was conducted to find out the effect of pre-sowing seed treatment (seed priming), date and density of planting on the corn silage yield of S.C704 variety in the summer delayed sowing.

Materials and methods

This experiment was carried out as a split-split plot design in a randomized complete block design with four replications in the Agricultural Research Center of
Qarakheyl - Qaemshahr, Mazandaran province during the two agronomic years (2015 and 2016). The soil of the test site had a clay loamy texture with acidity of 7.1, organic matter of 1.8% and electrical conductivity of 0.26 dS/m. Meteorological data for two years are shown in Table 1. Planting date has been chosen as a main plot at two levels (27 July and 13 August) and planting density has been selected as a sub-plot at two levels (7 and 9 plants per m²). Seed priming has been also preferred as a sub-sub plot at four levels: control (without priming), distilled water, 0.5% potassium nitrate (KNO₃)₂⁻ and 10% polyethylene glycol (PEG₈₀₀₀). The experimental field was divided into 4 blocks equal to the number of replications of each treatment combination. Each block was divided into 2 main plots, which were divided further into 2 sub-plots. Each sub-plot was then divided into 4 sub-sub plots. Thus, there were 16 sub-sub plots in each block, which was repeated 4 times. The main plot, sub-plot and sub-sub plot treatments were arranged completely randomly.

Table 1. Meteorological data for two years.

| Variable           | Minimum temp. (°C) | Maximum temp. (°C) | Evaporation (mm) | Precipitation (mm) |
|--------------------|--------------------|--------------------|------------------|--------------------|
| Year               | 2015               | 2016               | 2015             | 2016               | 2015             | 2016               |
| May                | 14.6               | 14                 | 21.8             | 24                 | 82.0             | 75                 | 25.3              | 32                 |
| June               | 20.1               | 19                 | 28.5             | 30                 | 159.8            | 110                | 1.5               | 28                 |
| July               | 22.6               | 22                 | 31.1             | 34                 | 171.5            | 128                | 48.1              | 9.2                |
| August             | 23.9               | 25                 | 32.2             | 34                 | 170.2            | 156                | 31.2              | 12.2               |
| September          | 19.9               | 18                 | 27.8             | 28                 | 100.7            | 121                | 98.6              | 48                 |
| October            | 15.7               | 15                 | 25.2             | 18                 | 78.4             | 85                 | 143.2             | 82                 |
| November           | 8.4                | 14                 | 15.7             | 16                 | 42.4             | 82                 | 144.9             | 95                 |

The plot size was 4.5*6 m². In the row, seven plants were cultivated at each plot and the distance between each row was 75 cm. As for seed priming, the selected seeds were combined with provided solution of earlier mentioned materials, during 24 hours. After that, settled seeds were dried under natural conditions and then were cultivated in plots. Regarding the soil test, the amount of chemical fertilizers was added to the soil and other agronomic operations such as care and harvesting operations were done. The measured traits within this research included: phonological traits such as the number of days from the planting date until 8 leaves and the number of days from the planting date until 12 leaves, speed and percentage of seedling emergence and percentage of lignin, plant height, silage yield, yield components such as plant fresh weight, silage yield per surface unit, the ratio of the leaf fresh weight to total silage weight, the ratio of the stem fresh weight to total silage weight and the ratio of the ear fresh weight to total silage weight. To determine the speed of seedling emergence, the number of emerged
coleoptiles from soil surface was counted daily per plot and measured for two weeks. To determine the percentage of seedling emergence, all of emerged coleoptiles were counted 14 days after germination. To determine the rest of morphological characteristics like yield and yield components, 10 plants were chosen per plot and then were measured with general methods. Data were analyzed by using the analysis of variance technique (ANOVA) and Microsoft-MSTAT-C, and the mean differences were calculated by Duncan’s test at the probability levels of 5 and 1% (Gomez and Gomez, 1984).

Results and Discussion

Phenological traits

Results showed that the numbers of days from the planting date until 8- and 12-leaf stages were significantly influenced by planting date, year, and interaction effects of experimental factors (Table 2). Table 3 shows that the minimum numbers of days from the planting date until 8- and 12-leaf stages were obtained by early planting (27 July) in the 1st year (2015). Decreasing the numbers of days from the planting date until 8- and 12-leaf stages was caused by increasing the crop growth rate (CGR) and decreasing the plant growth period (PGP) from planting until harvesting stages. This result is not in agreement with earlier works (Khan et al., 2002; Rafiee and Asgharpour, 2009) that have shown that late planting decreased the number of days from the planting date until different stages of growth like 12-leaf and maturing stages. Seed priming with distilled water decreased the number of days from the planting date until 8- and 12-leaf stages (Table 3). Wahid et al. (2008) also found that the seed priming treatment of sunflower decreased the number of days from the planting date until 50% germination and increased the speed of seedling emergence. Plant height was significantly affected by year, planting date and density (Table 2). Table 3 shows that the maximum plant height (241.48, 245.91 and 241.23 cm) for early planting date (27 July) and planting density (9 plants/m²) were measured in the first year (2015). Rafiee and Asgharpour (2009), Feyzbakhsh and et al. (2010), Atrashi (1998), Hassan (2000) and Bazi et al. (2005) have found the same results.

Germination traits

The percentage of seedling emergence was significantly influenced by year and seed priming and their interaction with planting density (Table 2). This result is in agreement with the earlier study by Abotalebian et al. (2006). Table 3 statistically shows that the percentage of seedling emergence was higher in the 1st year (88.92%) than in the 2nd year (83.22%). The maximum generation (87.80%)
The effects of seed priming, planting date and density on the silage yield of corn was obtained in control treatment (Table 3) and a higher interaction effect was found between control treatment and planting density (90.97%) (Table 4).

### Table 2. Square means of quantitative, qualitative and phonological characteristics of the silage corn S.C704 in summer delayed planting.

| Source of variation     | df  | Seedling emergence | Speed of seedling emergence | Planting until the 8-leaf stage | Planting until the 12-leaf stage | Plant height |
|-------------------------|-----|--------------------|-------------------------------|--------------------------------|----------------------------------|--------------|
| Replication             | 3   | 187.36**           | 78.52**                      | 44.52**                        | 66.08**                         | 197.95**     |
| Year                    | 1   | 1040.42**          | 314.002**                    | 153.13**                       | 56.008*                         | 2150.45**    |
| Error (a)               | 3   | 28.18              | 20.39                        | 29.94                          | 24.78                           | 166.82       |
| Planting date           | 1   | 32.11**            | 425.23**                     | 488.28**                       | 249.40**                        | 9311.86**    |
| Year*Planting date      | 1   | 3.51**             | 946.89**                     | 148.78**                       | 4.25**                          | 304.27**     |
| Error (b)               | 6   | 36.50              | 10.96                        | 39.41                          | 47.70                           | 1186.32      |
| Planting density        | 1   | 99.60**            | 1511.95**                    | 4.50**                         | 14.67**                         | 1897.67**    |
| Density*Year            | 1   | 2.37**             | 211.58**                     | 0.13**                         | 5.56**                          | 346.03**     |
| Density*Date            | 1   | 37.79**            | 0.15**                       | 3.78**                         | 1.53**                          | 583.75**     |
| Year*Density*Date       | 1   | 64.48**            | 41.93*                       | 0.03**                         | 9.39**                          | 0.11**       |
| Error (c)               | 12  | 61.60              | 18.89                        | 27.55                          | 26.47**                         | 379.71**     |
| Seed priming            | 3   | 86.42*             | 29.56*                       | 20.17**                        | 22.78**                         | 60.97**      |
| Year*Priming            | 3   | 8.08**             | 3.86**                       | 1.46**                         | 2.43**                          | 37.18**      |
| Date*Priming            | 3   | 60.09**            | 9.71**                       | 0.36**                         | 8.94**                          | 48.11**      |
| Year*Date*Priming       | 3   | 5.67**             | 0.36**                       | 6.20**                         | 10.08**                         | 53.68**      |
| Density*Priming         | 3   | 88.62*             | 14.58**                      | 12.50**                        | 5.95**                          | 37.84**      |
| Year*Density*Priming    | 3   | 16.35**            | 12.75**                      | 5.46**                         | 4.74**                          | 176.72**     |
| Date*Density*Priming    | 3   | 1.23**             | 1.55**                       | 4.36**                         | 14.008**                        | 47.83**      |
| Year*Date*Density*Priming | 3  | 7.26**             | 4.58**                       | 1.28**                         | 5.54**                          | 133.33**     |
| Error (abc)             | 72  | 29.68              | 7.53                         | 7.92                           | 9.72                            | 233.34       |

CV%: - 6.33 11.44 6.81 5.35 6.44 ns, *, **; Non-significant, significant and very significant at the levels of 5% and 1% respectively.

Seed priming with the PEG method increased the speed and percentage of seedling emergence and the ratio of ear fresh weight to total silage weight and that is why seed priming can be suggested for other crops under dry climate conditions where the speed and percentage of seedling emergence are the most important objectives of all researchers and farmers. As Table 2 shows, planting date and year and their interaction effects influenced the speed of seedling emergence. Feyzbakhsh et al. (2010) have also found that planting date affects the speed of seedling emergence and the rest of plant phonological stages. Planting density and seed priming also significantly affected the speed of seedling emergence. The seed priming treatment of wheat increased the speed and percentage of seedling emergence, tillering and earlier flowering (Harris et al., 2001). Moradi and Yonesi (2009) have shown that seed hydro-priming increased the speed of seedling
emergence. Table 3 shows that the speed of seedling emergence was higher in the 1st year (25.56 seeds/day) than in the 2nd year (22.43 seeds/day). The maximum speed of seedling emergence was also related to planting density of 9 plants/m² (27.43 seeds/day). The maximum value of the speed of seedling emergence (30.85 seeds/day) was also attained by interaction effects between year (1st year), early planting date (27 July) and planting density (9 plants/m²) (Table 4).

Table 3. Mean comparison of simple effects of experimental treatments on quantitative, qualitative and phonological characteristics of the silage corn S.C704 in the summer delayed planting.

| Treatment                  | Seedling emergence percentage (%) | Seedling emergence speed (per day) | No. of days from planting until the 8-leaf stage | No. of days from planting until the 12-leaf stage | Plant height (cm) |
|---------------------------|----------------------------------|-----------------------------------|-----------------------------------------------|-----------------------------------------------|------------------|
| Year                      |                                  |                                   |                                               |                                               |                  |
| 2015                      | 88.92                            | 25.56                             | 40.22                                         | 57.65                                         | 241.48           |
| 2016                      | 83.22                            | 22.43                             | 42.41                                         | 58.97                                         | 233.28           |
| Planting date             |                                  |                                   |                                               |                                               |                  |
| 27 July                   | 86.57                            | 22.17                             | 39.36                                         | 56.92                                         | 245.91           |
| 13 August                 | 85.57                            | 25.82                             | 43.27                                         | 59.71                                         | 228.85           |
| Planting density          |                                  |                                   |                                               |                                               |                  |
| 7 plants/m²               | 85.19                            | 20.56                             | 41.50                                         | 58.65                                         | 233.53           |
| 9 plants/m²               | 86.96                            | 27.43                             | 41.13                                         | 57.97                                         | 241.23           |
| Seed priming              |                                  |                                   |                                               |                                               |                  |
| Control                   | 87.80                            | 24.61                             | 41.00                                         | 57.99                                         | 236.74           |
| Distilled water           | 86.99                            | 24.98                             | 40.88                                         | 57.48                                         | 238.52           |
| PEG                       | 84.12                            | 22.92                             | 42.50                                         | 59.47                                         | 235.74           |
| KNO₃                      | 85.39                            | 23.48                             | 40.88                                         | 58.31                                         | 238.53           |

The given means per each column with the same letters do not show significant differences statistically (p<0.05).

Table 4. Mean comparison of interaction effects of Year*Date, Density*Priming and Year*Date*Density on some agronomic properties of the silage corn S.C704 in the summer delayed planting.

| Year*Date | Treatment                  | No. of days from planting until the 8-leaf stage | Seedling emergence (%) | Seedling emergence speed (per day) | Plant height (cm) |
|-----------|----------------------------|-------------------------------------------------|------------------------|-----------------------------------|------------------|
| 2015*27J  | 7 plants/m²*control       | 84.62b                                          | 22.07b                 | 236.74                            |
| 2015*27J  | 7 plants/m²*distilled water| 84.43b                                          | 22.98b                 | 238.52                            |
| 2015*13A  | 7 plants/m²*PEG           | 84.34b                                          | 22.98b                 | 235.74                            |
| 2016*27J  | 9 plants/m²*control       | 80.97a                                          | 23.34a                 | 238.53                            |
| 2016*27J  | 9 plants/m²*distilled water| 86.60b                                          | 23.34a                 | 238.53                            |
| 2016*13A  | 9 plants/m²*PEG           | 83.81b                                          | 23.34a                 | 238.53                            |
| 2016*13A  | 9 plants/m²*KNO₃          | 86.84b                                          | 23.34a                 | 238.53                            |
Silage corn yield

The fresh weight of plant was significantly influenced by year and planting date (Table 5). Regarding Table 6, the maximum plant fresh weight was observed in the 2nd year (546.79 g) in earlier sowing time (588.02 g). Year, planting date, their interaction effect and planting density significantly increased the ratio of leaf fresh weight and the part of stem fresh weight to total silage weight. Year, planting date, their interaction effect and planting density also significantly increased the ratio of ear fresh weight to total silage weight (Table 5).

Table 5. Square means of quantitative, qualitative and phenological characteristics of the silage corn S.C704 in the summer delayed planting.

| Source of variation | df  | Plant fresh weight | Ratio of leaf fresh weight to total silage weight | Ratio of stem fresh weight to total silage weight | Ratio of ear fresh weight to total silage weight | Silage yield | Lignin |
|---------------------|-----|--------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|--------------|--------|
| Replication         | 3   | 4072.26**          | 2.54**                                        | 3.25**                                        | 8.04**                                        | 8448561**    | 0.41** |
| Year                | 1   | 19128.21*          | 201.73**                                      | 280.73**                                      | 2.89**                                        | 506100**     | 0.84** |
| Error (a)           | 3   | 6828.61            | 4.59                                          | 2.07                                          | 6.10                                          | 7818870      | 1.82   |
| Planting date       | 1   | 635732.72**        | 331.24**                                      | 52.86**                                       | 119.85**                                      | 3815981661** | 2.39** |
| Year*Planting date  | 1   | 946.37**           | 281.74**                                      | 705.28**                                      | 95.81**                                       | 47974037**   | 1.15** |
| Error (b)           | 6   | 8394.94            | 3.70                                          | 7.40                                          | 14.85                                         | 54823722     | 2.82   |
| Planting density    | 1   | 4196.20**          | 2.55**                                        | 28.03**                                       | 47.53**                                       | 929491333**  | 23.47**|
| Density*Year        | 1   | 2367.75**          | 0.56**                                        | 0.93**                                        | 2.94**                                        | 35608540**   | 0.98** |
| Density*Date        | 1   | 10112.55**         | 0.01**                                        | 2.29**                                        | 1.81**                                        | 492247906**  | 1.44** |
| Year*Density*Date   | 1   | 905.68**           | 0.22**                                        | 15.48**                                       | 12.39**                                       | 64535891**   | 1.62** |
| Error (c)           | 12  | 8246.43**          | 0.18**                                        | 3.84**                                        | 3.80**                                        | 24109684**   | 2.43   |
| Seed priming        | 3   | 736.08**           | 0.18**                                        | 20.06**                                       | 19.18**                                       | 22845777**   | 4.19   |
| Year*Priming        | 3   | 401.85**           | 1.82**                                        | 3.53**                                        | 2.38**                                        | 12430952**   | 4.88   |
| Date*Priming        | 3   | 729.57**           | 0.51**                                        | 11.42**                                       | 16.09**                                       | 19882147**   | 1.12   |
| Year*Date*Priming   | 3   | 421.24**           | 0.43**                                        | 3.91**                                        | 6.36**                                        | 6565978**    | 0.91   |
| Density*Priming     | 3   | 6913.98**          | 0.12**                                        | 1.51**                                        | 1.37**                                        | 10876537**   | 2.82   |
| Year*Density*Priming| 3   | 1039.28**          | 0.23**                                        | 1.92**                                        | 2.85**                                        | 5075946**    | 1.11   |
| Date*Density*Priming| 3   | 6256.09**          | 0.66**                                        | 4.54**                                        | 5.74**                                        | 16733197**   | 1.95   |
| Year*Date*Density*Priming | 3 | 7424.81** | 1.05**                                        | 5.61**                                        | 10.17**                                       | 15976794**   | 2.51   |
| Error (abc)         | 72  | 3093.48            | 0.47                                          | 3.60                                          | 4.80                                          | 31269511     | 1.49   |

CV%: 10.40, 6.59, 4.08, 5.10, 15.77, 5.79

ns, * and **: Non-significant, significant and very significant at the levels of 5% and 1%, respectively.

The results showed that the maximum ratios of leaf fresh weight and stem fresh weight to total silage weight were attained in the 1st year (0.12) and in the 2nd year (0.48) respectively. The maximum values of the ratio of leaf fresh weight to total silage weight were attained by the early planting (0.12) and the maximum
values of the ratio of stem fresh weight to total silage weight were also reached by the late planting (0.47) (Table 6). The present studied variety (S.C 704) of the corn plant includes the maximum leaf fresh weight because of its late maturity (Heydar-Qolinezhad Kenari et al., 2003; Genter and Camper, 1973). Planting density (9 plants/m²) increased the ratio of leaf fresh weight and stem fresh weight to total silage weight at the maximum values of 0.11 and 0.47, respectively. The maximum ratio of ear fresh weight to total silage weight was related to the late planting date (0.44) and planting density of 7 plants/m² (0.44) (Table 6). Seed priming significantly affected the ratio of stem fresh weight and ear fresh weight to total silage weight. The interaction effect between seed priming and planting date also affected these characteristics significantly (Table 5). Treatments of the interaction effect between the late planting (13 August) and seed priming attained the maximum ratio of stem fresh weight to total silage weight (0.49) with the KNO₃. This result was obtained on wheat and barley plants by Karaki (1998). The maximum ratio of ear fresh weight to total silage weight (0.46) was achieved by the interaction effect between the late planting date (13 August) and seed priming with the PEG method (Table 8). The maximum ratio of ear fresh weight to total silage weight (0.45) was also obtained by the interaction effect between the late planting date (13 August) and year (1st year) (Table 7). Planting date, plant density and their interaction effect increased silage yield significantly (Table 5).

Table 6. Mean comparison of simple effects of experimental treatments on quantitative, qualitative and phonological characteristics of the silage corn S.C704 in the summer delayed planting.

| Treatment       | Lignin (%) | Plant fresh weight (gr) | Ratio of leaf fresh weight to total silage weight | Ratio of stem fresh weight to total silage weight | Ratio of ear fresh weight to total silage weight | Silage yield (kg/ha) |
|-----------------|------------|-------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|---------------------|
| Year            |            |                         |                                               |                                               |                                               |                     |
| 2015            | 21.20      | 522.34                  | 0.12                                          | 0.45                                          | 0.43                                          | 35513.4             |
| 2016            | 21.04      | 546.79                  | 0.09                                          | 0.48                                          | 0.43                                          | 35387.7             |
| Planting date   |            |                         |                                               |                                               |                                               |                     |
| 27 July         | 21.26      | 588.02                  | 0.12                                          | 0.46                                          | 0.42                                          | 40910.6             |
| 13 August       | 20.99      | 481.11                  | 0.09                                          | 0.47                                          | 0.44                                          | 29990.5             |
| Planting density|            |                         |                                               |                                               |                                               |                     |
| 7 plants/m²     | 20.69      | 528.84                  | 0.10                                          | 0.46                                          | 0.44                                          | 32755.8             |
| 9 plants/m²     | 21.55      | 540.29                  | 0.11                                          | 0.47                                          | 0.42                                          | 38145.3             |
| Control         | 20.94      | 537.06                  | 0.11                                          | 0.47                                          | 0.43                                          | 35366               |
| Seed priming    |            |                         |                                               |                                               |                                               |                     |
| Distilled water | 21.05      | 534.22                  | 0.10                                          | 0.47                                          | 0.43                                          | 35800               |
| PEG             | 21.65      | 527.99                  | 0.11                                          | 0.46                                          | 0.44                                          | 34324               |
| KNO₃            | 20.85      | 538.98                  | 0.10                                          | 0.47                                          | 0.42                                          | 36313               |

The given means per each column with the same letters do not show significant differences statistically (p<0.05).

The results of the present study are in agreement with Darby and Laure (2002), Mokhtarpour et al. (2008), Feyzbakhsh et al. (2010), Fallah and Tedin (2009) and Dehqanpour and Vahdat (1996). The maximum silage yield was related
The effects of seed priming, planting date and density on the silage yield of corn

to the early planting date (40,910.6 kg/ha) and the planting density of 9 plants/m² (38,145.3 kg/ha) (Table 6) and their interaction effects (45,566.41 kg/ha) (Table 7). Fayazbaksh et al. (2010) found that the highest silage yield (85,000 plants/ha) was achieved with the planting density of 8.5 plants/m². In addition, the maximum silage yield was obtained with the planting density of 13 plants/m² (Zamaniyan and Najafi, 2002). The results showed that the planting density affected the percentage of lignin significantly at the level of 1%. Seed priming and its interaction effect with year also affected the percentage of lignin at the level of 5% (Table 5). As can be seen in Table 6, the maximum lignin percentage was definite with the planting density of 9 plants/m² (21.55%) and seed priming with the PEG method (21.65%). The highest lignin (21.70) was also found by the interaction effect between year (2nd year) and the seed priming PEG method (Table 8).

Table 7. Mean comparison of interaction effects of Year*Date and Date*Density on some agronomic properties of the silage corn S.C704 in the summer delayed planting.

| Treatment | Ratio of leaf fresh weight to total silage weight | Ratio of ear fresh weight to total silage weight | Silage yield (kg/ha) |
|-----------|-----------------------------------------------|-----------------------------------------------|---------------------|
| Year*Date |                                               |                                               |                     |
| 2015*27J  | 0.12a                                         | 0.41b                                         | 36254.84b           |
| 2015*13A  | 0.12a                                         | 0.45a                                         | 45666.41a           |
| 2016*27J  | 0.12a                                         | 0.43b                                         | 29256.79c           |
| 2016*13A  | 0.06b                                         | 0.43b                                         | 30724.19c           |

The given means per each column with the same letters do not show significant differences statistically (p<0.05).

Table 8. Mean comparison of interaction effects of Year*Priming and Date*Priming and Density*Priming on some agronomic properties of the silage corn S.C704 in the summer delayed planting.

| Treatment | Ratio of leaf fresh weight to total silage weight | Lignin (%) | Treatment | Ratio of stem fresh weight to total silage weight | Ratio of ear fresh weight to total silage weight |
|-----------|-----------------------------------------------|------------|-----------|-----------------------------------------------|-----------------------------------------------|
| Year * Priming |                                               |            | Year * Priming |                                               |                                               |
| 2015*control | 0.12a                                         | 12.6bc     | 27J*control | 0.46bc                                         | 0.42c                                         |
| 2015*distilled water | 0.12a                                         | 21.16ab    | 27J*distilled water | 0.46bc                                         | 0.42c                                         |
| 2015*PEG    | 0.12a                                         | 21.60a     | 27J*PEG    | 0.45c                                         | 0.43bc                                        |
| 2015*KNO3   | 0.11b                                         | 21.45ab    | 27J*KNO3   | 0.46bc                                         | 0.42c                                         |
| 2016*control | 0.09d                                         | 21.27ab    | 13A*control | 0.47b                                         | 0.44b                                         |
| 2016*distilled water | 0.09d                                         | 20.85abc   | 13A*distilled water | 0.47b                                         | 0.44b                                         |
| 2016*PEG    | 0.09d                                         | 21.70a     | 13A*PEG    | 0.46bc                                         | 0.46a                                         |
| 2016*KNO3   | 0.10c                                         | 20.25c     | 13A*KNO3   | 0.49a                                         | 0.42c                                         |

The given means per each column with the same letters do not show significant differences statistically (p<0.05).
Conclusion

Regarding the obtained results of the present study, the maximum percentage of lignin, seedling emergence, plant height, the ratio of leaf fresh weight to total silage weight and silage yield were attained in the 1st year (2015) which raised crop growth rate (CGR). The maximum values of the percentage of lignin and the percentage of seedling emergence, plant height, plant fresh weight, the ratio of leaf fresh weight to total silage weight and silage yield were achieved with the early planting date (17 July). The number of days with earlier sowing time (17 July) from the planting date until the 8- and 12-leaf stages decreased in the 1st year (2015). On the other hand, the crop plant rate increased, but the plant growth period decreased from planting until harvesting. All of the maximum phonological and morphological characteristics of the corn plant were also attained with the planting density of 9 plants/m², except for the ratio of ear fresh weight to total silage weight. The results show that many treatments showed high values in the 1st year (2015) and with the early planting date (17 July) and the planting density of 9 plants/m². Therefore, it can be concluded that the early planting date (17 July) and the planting density of 9 plants/m² are the best treatment to obtain the maximum silage yield of the corn S.C704 variety in the summer delayed sowing. Thus, this treatment can be recommended for farmers who work in moderate climate conditions.

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UTICAJI POTAPANJA SEMENA, DATUMA SETVE I GUSTINE NA PRINOS SILAŽE KUKURUZA (ZEA MAYS L.) U LETNJOJ ODLOŽENOJ SETVI

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Rezime

Kako bi se utvrdili uticaji potapanja semena, datuma i gustine setve na prinos silaže kukuruza (sorta Ks.c704) kod letnje odložene setve, sproveden je eksperiment potpodeljenih parcela u potpuno slučajnom blok dizajnu sa četiri ponašanja u 2015. i 2016. godini. Tretmani su ispitivani uključujući dva datuma setve (27. jul i 13. avgust) kao glavne parcele, dve gustine setve (7 i 9 biljaka po m²) kao potparcele i četiri nivoa potapanja semena (bez potapanja, destilovana voda, 0,5% KNO₃ i 10% PEG₈₀₀₀₀). Rezultati su pokazali maksimalnu brzinu i procenat nicanja klijanaca u prvoj godini. Broj dana se smanjivao od datuma setve do faze sa 8 i 12 listova kod potapanja semena uz pomoć metode sa destilovanom vodom. Prinos silaže se smanjio (26,69%) u kasnoj setvi (13. avgust), ali se brzina nicanja klijanaca povećala. Gustinom setve (9 biljaka/m²) postignut je najveći procenat lignina, brzina nicanja klijanaca, visina biljke i prinos silaže. Najveći odnos sveže mase klipa i ukupne mase silaže dobijen je pri kasnom datumu setve (13. avgust) i potapanjem semena PEG metodom. Maksimalna vrednost prinosa silaže (45.566,41 kg/ha) dobijena je pri ranom datumu setve (27. jul) i većoj gustini setve (9 biljaka/m²). Kako bi se stoga povećala brzina nicanja klijanaca i postigao maksimalni prinos silaže, preporučuju se rani datum setve (27. jul), veća gustina setve (9 biljaka/m²) i potapanje semena metodom sa destilovanom vodom.

Ključne reči: gustina biljaka, potapanje semena, prinos silaže kukuruza, datum setve.

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