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ORIGINAL ARTICLE

The Effect of Sowing Dates and Different Levels of Nitrogen on Yield and Yield Components of Second Crop Corn Var. 704-KSC in Miyaneh County

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ABSTRACT
This study was conducted to investigate the effect of different levels of nitrogen and sowing dates on yield and yield components of corn (var. 704-KSC) which is cultivated as second crop at Research Farm of Islamic Azad University-Miyaneh Branch (Iran) during 2013-2014 growing season as factorial based on randomized complete block design with three replications. The study consisted of four N rates (Urea sources): zero (control), 75, 150 and 225 kg N ha^{-1} and three sowing dates as June10, June 26 and July 11. In the view of yield, results showed that there is significant difference between early and other sowing dates. The highest and the lowest grain yield were that of June 10 and July 11 sowing dates respectively. Moreover the highest and the lowest kernel yield were obtained in 225 kg N ha^{-1} and control treatment, respectively.
Keywords; *Sowing Date, Corn, Yield, Nitrogen, Corn Ear, Miyaneh County*

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INTRODUCTION

Maize (*Zea mays* L.) is a member of the grass family (Poaceae). It is a cereal grain that was first grown by people in ancient Central America. It is now the maize is the fourth largest grown crop in the world after wheat, barley and rice with approximately 320000 hectares of field corn were grown with a production of 2.560.000 tons an average grain yield of 8000 kg ha^{-1} in Iran in 2010 [1]. Population growth in the world, especially in developing countries is growing day by day, while the possibility of expanding agricultural land is very low due to lack of fertile land and economically competitive products in farm system. Given the importance of this issue, achieving the ways to crop yield increase is important. Human beings are at the centre of concerns for sustainable development so increasing the yield per unit area as the most important way to save people from hungry and poverty because developing nations were more interested in getting the needs of their poor met, which is largely depend on plant breeding, selection of high yielding varieties with high potential and high quantity and quality specification, good farming practices and application of crops fertilizers and observing well sowing date[2]. The choice of sowing date is an important management option to optimize grain yield including corn. The perfect combination of optimum crop varieties with farming factors is required to achieve maximum performance [3]. Well sowing date of corn in each region, one of the factors that are very significant role in the performance of the product, as well as with choose of optimum nitrogen rate for each crop, can help to economic production and yield increase [4]. Nitrogen is a nutrient most likely to be deficient for profitable corn production and inadequate N availability during the first two to six weeks after planting can result in reduced yield potentials [5]. There is a straight line relationship between corn yield and N rate; such that the more N you apply, the more grain you harvest. Therefore providing adequate nitrogen (N) is a major factor in building a successful corn production program [6]. There are numerous reports in relation to the positive effect of N on kernel weight and corn kernel yield [7]. Gehl *et al* [8] reported that the highest kernel yield achieved with applying 185 kg N ha^{-1}. Sobedi *et al* [9] reported that application of 225 kg compared to 75 and 150 kg N ha^{-1}, increased kernel yield. Di-Palo and Rinaldi[10] quoted that the highest corn yield achieved by 300-250 kg N ha^{-1}. Villarmir *et al* [11] reported that corn uptakes up to 350-300 kg N ha^{-1} from soil. Majidian and Ghadiri[12] stated that N fertilizer is essential for corn performance and estimated that average corn yields would decline by 9-25 percent with nitrogen (N) fertilizer deficiency. On the other hand, several studies showed that adding nitrogen to the soil at the excessive than levels of plant demand, would increases the risk of nitrate leaching and contributing to air and water pollution and chances that leaching will cause some portion of the N to be lost prior to crop uptake [13]. If farmers reduce their fertilizer application rates, would lower the production costs and environmental pollution associated with it, while their yields, and subsequently their incomes will likely decrease [14]. Lak *et al* [15] reported that under optimal N conditions, kernel yield increased with increase in plant density; however, in case of nitrogen limitation, kernel yield was not increased in response to high plant density.

MATERIEL AND METHODS

This experiment conducted at Miyaneh Branch, Islamic Azad University Research Farm (Iran) during 2013-2014 growing season which is located in km 5 Miyaneh-Zanjan road- Iran. The area geographically bounded by 47°- 51' east longitude and 37° - 30' north latitude and 1013 m sea level above. According to the soil analysis results, 50 kg ha^{-1} triple super phosphate before planting and 45 kg ha^{-1} potassium was applied at planting time. In this experiment, the factor of net nitrogen including four levels; zero (control), 75, 150 and 225 kg N ha^{-1} (Urea sources) and three sowing dates as June10, June 26 and July 11 were considered which each block contains 12 plots in dimensions (4 × 4 m) and each plot contains 4 rows with row spacing of 75 cm and plants spacing on rows of 20.5 cm. In late spring after land levelling and performing planting design, in the area at barley harvest time, seeds were planted manually and then post emergence in 4 to 6 leaf stage, seedlings were being thinned (density of 5-6 plants m-2). For weed control plots were hand weeded during the experiment on several times to maintain a weed-free environment. During the experiment, the mentioned hybrid was planted according to planting design and different sowing dates (June10, June 26 and July 11). Irrigation of each plot was done at planting time and for preventing water penetration to the unplanted plots, plots marginal were bound with soil. To calculate the kernel yield at physiological maturity stage, 4 outer rows were discarded as guard for deleting marginal effects so 5.3 m2 harvested. For measuring traits such as plant height, number of kernel per ear and grain weight, 10 plants from each plot were selected randomly after physiological maturity. For variance analysis and compare means with Duncan 5 % test, MSTAT-C (ver. 2.10, Michigan State University, USA) software was used.
The objective of this study was to investigate the effect of sowing dates and use of different levels of nitrogen on yield and yield component scorn var. 704-ksc.under second crop conditions in Miyaneh [East Azarbaijan province, Iran] county.

RESULTS AND DISCUSSION

Plant height

Table 1– ANOVA of influence of sowing dates and different levels of nitrogen on corn (KSC-704 var.) kernel yield and yield components

Source of variation	Df	Mean of squares			
		Plant hieght	Number of kernel per ear	Weight of 1000 kernel	Kernel yield
Replication (Block)	2	2.057^{ns}	641.23**	29.08**	10.43^{ns}
Nitrogen level (N)	3	39.93**	7173.40**	617.41**	896.25**
Planting date (P)	2	23.08**	127798.10**	8558.30**	28320.40**
N × P	6	0.323^{ns}	170.40^{ns}	18.41**	12.81^{ns}
Error	12	1.945	73.39	1.568	20.937
C.V. (%)		12.60	10.52	11.08	10.21

** and ^{ns}: Significant at 1% probability level and insignificant, respectively.

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Corn height responded to N additions and plant height was affected by different nitrogen levels (Table 1), reaching maximum value at the 225 kg N $ha^{-1}$and minimum height was obtained in case of control (0 kg N ha^{-1}). According to Table 2, it is observed that there is no statistically significant difference between rates of 225 and 150 kg N ha^{-1} and also between 150 and 75 kg N ha^{-1}. The effect of nitrogen on maize height have also been reported by Prasad and Singh [16], Hamidi *et al* [17] and Khodadadi *et al* [18] were corn height responded to N applications and corn plant height increased with N addition. According to the experiment, sowing dates are strong factor in influencing maize height. The effects of sowing dates on maize height were significant (Table 1). Maximum (160.61 cm) and minimum height (157.8 cm) was obtained in case of early (June 10) and late sowing dates (July 11) respectively (Table 3). These results suggest that the plants faced with high temperatures immediately after emergence as well as shortening the days, accelerated development, reducing the emergence to flowering and maturity phase. It seems they are major limitations on maize height, resulting in we have a shorter plant height at third planting date. Rahmani *et al* [19] reported that the period following successful emergence is defined as the vegetative phase in corn and represents the important time frame for determining plant growth but late planting will reduce plant height. Corn height potential goes down with delayed planting because of a number of factors, including a shorter growing season so plants have no enough time to complete their vegetative phase and weather is also less favourable this is why plants height declines for late-planted corn.

Table 2 – Mean comparison of studied corn traits affected by nitrogen levels

Nitrogen levels (kg.ha^{-1})	Plant height (cm)	Number of kernel per ear	Kernel yield (Kg.ha^{-1})
0	156.42^{c}	519.07^{c}	6744.00^{c}
75	159.20^{b}	550.67^{b}	7119.22^{b}
150	160.43^{a}	580.71^{a}	7503.89^{ab}
225	161.23^{a}	584.93^{a}	7603.67^{a}

Means in each column, followed by similar letter(s) are not significantly different.

Table 3 – Mean comparison of studied corn traits affected by planting dates

Planting date	Plant height(cm)	Number of kernel per ear	Kernel yield (Kg.ha^{-1})
June10	160.61^{a}	627.32^{a}	8182.42^{a}
June 26	159.49^{b}	550.68^{b}	7178.75^{b}
July 11	157.85^{c}	437.53^{c}	5720.92^{c}

Means in each column, followed by similar letter(s) are not significantly different.

NUMBER OF KERNELS PER EAR

The effect of nitrogen factor on the number of kernels per ear was significant at the 1% level (Table 1). Of these experiments, the greatest (584.93) and lowest (519.06) number of kernels per ear occurred in The 225 and 0 kg N ha^{-1}, respectively (Table 2). As Table 2 shown, by increasing the amount of nitrogen, the number of kernels per ear increased. As the difference between the 0 and 225 kg N ha^{-1} for this trait was strongly significant. But statistically there was no significant difference between 225 and 150 kg N ha^{-1}. Lak *et al*. [15] and Ulger *et al*.[20] have been reported that there is a significant increase in the number of kernels per ear with increasing nitrogen.

Effect of sowing date factor on kernel number per ear was significant at 1% probability level (Table 1). It is true that relative kernel yield potential of corn declines with delayed planting after about June 10. Table 2 illustrates that the highest (627.3) and lowest (437.53) number of kernels per ear, were belonging to the first (June 10) and third planting dates (July 11), respectively. This agrees with Oktem *et al*. [21], who have stated that the number of kernels per ear is affected by sowing date. Sowing date in turn extending the window of time needed to accomplish complete the number of kernels per ear, which translates into considerable increase of kernels number. According to the correlation attribute table (Table 4), it can be seen there is significant and positive correlation between the number of rows per ear and number of kernels per ear. It seems there may have been a direct effect of the number of rows per ear on the number of kernels per ear because increases occurring in a number of kernels per ear by increasing the number of rows per ear.

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Table 4 – Correlation of studied corn traits using Pearson coefficient affected by nitrogen and planting date

Traits	Plant height	Number of kernel per ear	Weight of 1000 kernel
Number of kernel per ear	0.175		
Weight of 1000 kernel	0.104	-0.701**	
Kernel yield	0.398*	0.886**	0.401*

**and *: Significant at 1 and 5% probability level, respectively.

THE WEIGHT OF 1000 KERNELS

The interaction between nitrogen × sowing date on 1000 kernels weight was significant at 1% probability level (Table 1). Effect of sowing date on 1000 kernels weight were significant in all three levels of nitrogen, so that the 1000 kernels weight in the third planting date (July 11), showed a significant increase, but the amount 0 kg of nitrogen per hectare, allocated the highest 1000 kernels weight in the three planting dates to itself (Figure 1). Kernel set refers to the degree to which kernels have developed up and down the cob. One of the causes of incomplete kernel set is sowing date. A sever reduction in the number of kernels distinguished from the third sowing date. When kernels loss occurs, number of kernels on plants may compensate in response to reduction number. This compensation may occur in terms of greater kernel weight because products of assimilation accumulate in a small number of kernels. Chougan and Mosavat [22] reported an increase in 1000 kernels weight in response to delay in planting date.

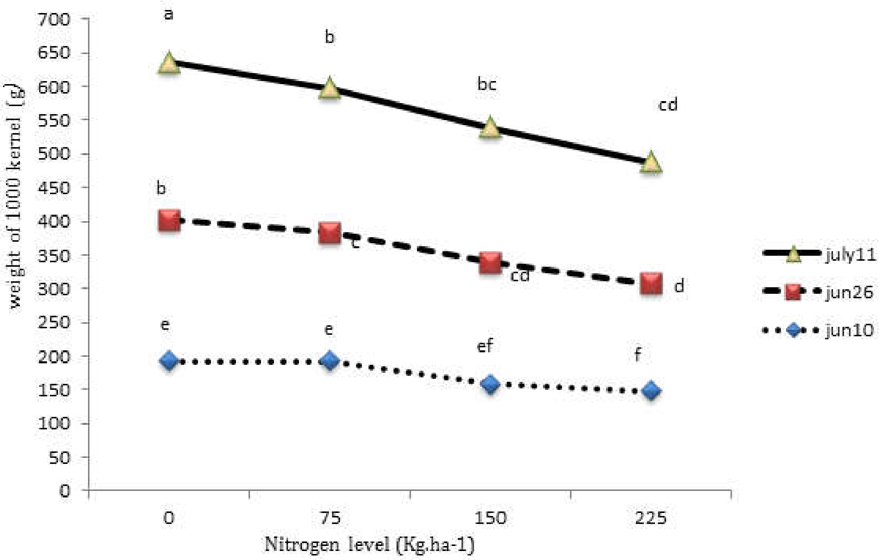

Figure 1 – Corn weight of 1000 kernal affected by different levels of nitrogen in three planning date

KERNEL YIELD

Different levels of nitrogen significantly affected the kernel yield at 1% probability level (Table 1). Results of the experiments showed that, the maximum (7603.67 kg ha^{-1}) and minimum kernel yield (6744 kg ha^{-1}) occurred in 225 and 0 kg N ha^{-1}, respectively. But there is no significant difference between 225 and 150 kg N ha^{-1} statistically (Table 2). Costa *et al* [23] reported a significant increase in kernel yield by increasing the nitrogen. Based on traits correlation table (Table 4), significant positive correlation is observed between the number of kernels per row and the number of kernels per ear and kernels yield. It seems, kernel yield increased in response to increasing the number of kernels per ear.

Effect of sowing date on kernel yield was significant at 1% probability level (Table 1). It could be seen its bottom line is kernel yield losses due to delayed planting (see Table 3).

Oktem *et al* [21] have also reported yield reduction due to delays in planting. Given that the corn kernel yield is determined by yield components such as the number of rows per ear, number of kernels per ear and 1000 kernels weight [24], our findings in this study on the third compared with early sowing date indicate sever reduction of these traits except 1000 kernel weight. The third sowing date is undesirable for maize and led to yield components were suppressed considerably and may bigger than which is 1000 kernels weight could compensate the yield losses.

NITROGEN USE EFFICIENCY (NUE)

According to Table 5 the effect of nitrogen on nitrogen use efficiency was significant at the 1% level. In addition to the effect of planting date on NUE was significant at 1% level. The interaction between nitrogen × sowing date on NUE was not significant. Based on above results, NUE mean comparison carried out.

NUE was calculated to different levels of nitrogen using the following formula (Equation 1).

$$NUE = \frac{\text{Yield by use of nitrogen} - \text{Yield without the use of nitrogen}}{\text{The amount of applied nitrogen}} \quad \text{(Equation 1)}$$

While nitrogen use efficiency (NUE) was the largest for the 75 kg N ha^{-1}, the lowest NUE registered for 225 kg N ha^{-1} (Figure 2). NUE study shows that by the increase of nitrogen addition from 75 to 150 kg N ha^{-1}, the NUE is not reduced significantly. Higher N applications did not provide a yield advantage. For example, with an increase from 150 to 225 kg N ha^{-1}, reducing the NUE can be seen. As showed in Figure 3, the largest and the lowest NUE were for the early (June 10) and third sowing dates (July 11), respectively.

Table 5– ANOVA of influence of sowing dates and different levels of nitrogen on corn (KSC-704 var.) nitrogen use efficiency

Source of variation	Df	Mean of squares
		Nitrogen use efficiency
Replication (Block)	2	0.58^{ns}
Nitrogen level (N)	2	14.87^{**}
Planting date (P)	2	12.45^{**}
N × P	4	3.04^{ns}
Error	16	2.21
C.V. (%)		8.21

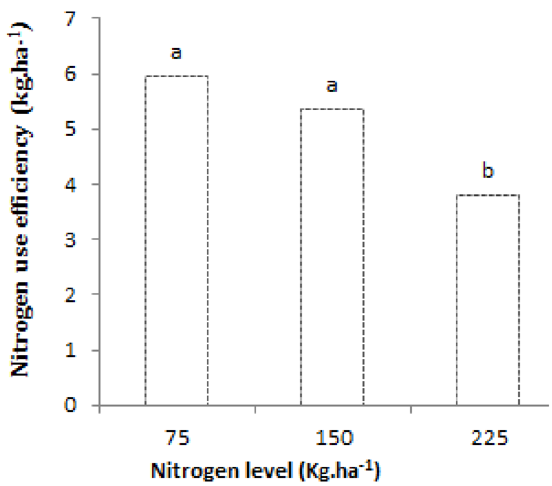

Figure 2 – Mean comparison of NUE affected by different levels of nitrogen

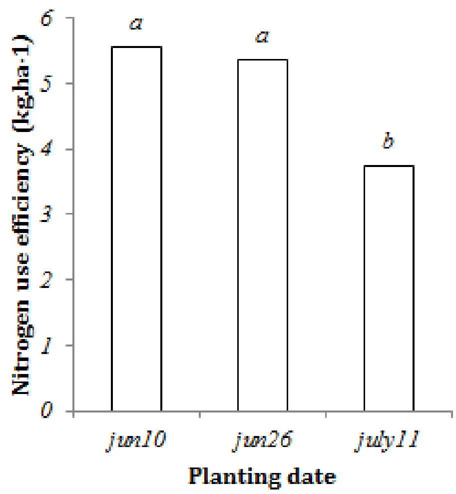

Figure 3 – Mean comparison of NUE affected by different planting date

CONCLUSION AND RECOMMENDATIONS

1- Compared with the second and third (June 26 and July 11), the early (June 10) sowing dates, generally had more number of kernels per ear, the greater number of kernels per ear translated into more kernel yield. A delay in sowing date reduced the number of kernels per ear due to increased ambient temperature. Delaying planting generally decreased days to flowering in other words days from planting

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to harvest steadily decreased. This cannot fulfill the temperature requirement for kernel setting in ear thus kernel yield consistently decreased in the delay planting date.

2- Significant differences were observed between different levels of nitrogen. But statistically there is no significant difference between 225 and 150 kg N ha^{-1}.

3- Given that kernel yield was greatest for corn (KSC-704 variety) in the fourth N level (225 kg N ha^{-1}), but due to the lack of difference between the 225 and 150 kg N ha^{-1} and nitrogen use efficiency (NUE), to reduce production cost, the rate of 150 kg N ha^{-1} is recommended.

In the end, consideration should be given to the many aspects before making the decision because many factors are involved in the planting decision. It should evaluate data from multiple locations and years whenever possible. Regardless of these results; yearly variation in temperature and precipitation can alter characteristics of hybrids. Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary so further research is needed regarding the influence of sowing dates and different levels of nitrogen on corn kernel yields and how they may affect yield trends over time.

REFERENCES

1. Ministry of Agriculture Jihad. (2013). Agriculture statistics. Ministry of Agriculture of Jahad Publication: Tehran, Iran. 1: 123-125.
2. Farsi, M. and Bagheri, A. R. (2013). Principal of plant breeding. Jahad Daneshghahi of Mash'had Press, Mash'had. 368 p.
3. Shahsavari, M.R. (1989). Study of phenotypic and genotypic parameters effects on seed formation and determination of the characteristics of ideotype in common bean. MSc. Thesis in Plant Breeding, Isfahan University of Technology, Isfahan, Iran. (In Persian).
4. Arshi, A. Facts cultivation and processing of oilseeds (28 and 29). (2001). Oilseeds Company of Iran. 45 p.
5. Derby, N.E., Casey, F.X.M., Knighton, R.E and D.D, Steele. (2005). Midseason nitrogen fertility management for corn based on weather and yield prediction. Agron J. 96: 494- 501.
6. Navabi, F. and Malakoti, J. (2002). Effect of balanced nutrition of nutrients on quality and quantity of corn.Water and Soil Science Journal. 16(2): 161-168.
7. Osborn, S.L., Schepers, J.S., Francis D.D., and Schlemmer M.R. (2002). Use of spectral radiance to in- season biomass and grain yield in nitrogen and water-stressed corn. Crop Sci. 42:165-171.
8. Gehl, R.J., Maddux, L.D and Gordon, W.B. (2005). C0rn yield response to nitrogen rate and timing in sandy irrigated soils. Agron J. 97: 1230-1238.
9. Subedi, K.D., MA, B.L and Smith, D.L. (2006). Response of a leafy and non-leafy Maize hybrid to population densities and fertilizer nitrogen levels. Crop Sci: 46: 1860-1869.
10. Di- Paolo, E and Rinaldi, M. (2008). Yield response of corn to irrigation and nitrogen fertilization in a Mediterranean environment. Field Crop Res. 105: 202-210.
11. Villarmir, J.M., Villar-Miir, P., Stockle, C.O., Ferrer, F and M, Aran. (2002). On-farm monitoring of soil nitrat-nitrogen in irrigated cornfields in the Ebro vally (Northeast Spain). Agron J. 94: 373-380.
12. Majidian, M. and Ghadiri, H. (2002). Effect of water stress and different levels of nitrogen fertilizer during different growth stages on on grain yield, yield components, water use efficiency and some physiological characteristics of corn (*Zea mays* L.). Iranian Journal of Agriculture Science. 3(3): 521-533.
13. Jowkin, V and Schoenau, J.J. (1998). Impact of tillage and landscape position on nitrogen availability and yield of spring wheat in the brown soil zone in south-western Saskatchewan. Can. J. Soil Sci. 78: 563-572.
14. Cassman, K.G., Dobermann, A., Walters, D.T ., and Yang, H. (2003).Meeting cereal demand while protecting natural resources and improving environmental quality. Ann. Rev. Environ. Resour. 28: 315-358.
15. Lak, Sh., Naderi, A., Siadat, S., Aynehband, A. and Nourmohammadi, Gh. (2006). Effect of different levels of nitrogen and plant density in different moisture conditions on yield, yield componenets and wateruse efficiency of corn (SC 704). Iranian Journal of Crop Science. 8(2): 153-170.
16. Prsad, K., and singh, P. (1990). Response of promising rainfed maize (*Zea mays* L.) varieties to nitrogen application in North Western Himalayan region. Indian J. Agric.Sci, 60(7) :475-477.
17. Hamidi, A., Khodabandeh, N. and Dabagj Mohammadi, A. (2000). effect of plant density and different levels of nitrogen on yield and some characteristics of two corn hybrid. Iranian Journal of Agriculture Science. 31(3): 567-579.
18. Kodadadi, H. (2000). Effect of row distance and sowing date on yield of three corn variety in Shahrehkord (Iran) region. Iranian Journal of Agriculture Science. 16(65): 1-52.
19. Rahmani, A., Khavari, Kh. S and Nabavkalat, M. (2009). Effect of planting date and plant density on yield, yield components anf some agronomical characteristics of corn (cv. KSC-704SU). Seed and Plant Production Journal. 2-25(4):449-463.
20. Ulger, A. C., H. Ibrikci, B. Cakir, and N. Guzel. (1997). Influence of nitrogen rates and row spacing on corn yield protein content, and other planet parameters, J. plant Nuter. 20:1697-1709.

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21. Oktem, A., Gulgun, A., and Coskum, Y.(2004). Determination of Sowing Dates of Sweet corn (*Zea mays* L. Saccharata) under sanlirfa conditions. Turk Journal Agriculture 28:83-91.
22. Chougan, R. and Mosavat, A. (2000). Effect of summer planting date on yield and yield components of hybrids corn and tedermainng relationships by patch analysis method. Seed and Plant Improvement Journal. 16: 88-9.
23. Costa, C., Dwyer, L.M., Stewart, D. W., and Smith, D.L. (2002). Nitrogen effects on grain yield and yield components of leafy and nonleafy maize genotypes. Crop Sci. 42:1556-156.
24. Khodabandeh, N. (1995). Cereals. University of Tehran Publication. 537 p.

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