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Cropping Architect and Planting date on Forage Quantity and Quality of Ksc704 corn hybrid west of Iran

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ABSTRACT: Determination of best sowing date and cropping architect of hybrid maize for forage production as a second crop is important for livestock growers in the western Iran. There for a field and laboratory study was conducted by using of KSC 704 hybrid at Kermanshah province in 2014. A split factorial model, complete randomized block and three replications were used. The 20th, 30th June and 10th July sowing dates and cropping architects, factorial combination of 80000, 90000 and 100000 plant/hectare plus 55, 65 and 75 cm inter row spaces arranged as main and subplots respectively. Combined analysis of data showed that the 20th June sowing date and 90000 pant/ha at 65 cm inter rows space produced highest forage yield. Delay in planting date reduced forage quantity and quality. Using of higher sowing density resulted in forage quality reduction because of increasing of acid detergent fiber (ADF) and non detergent fiber (NDF) indices.
Nomenclature: Zea maize

Keywords: Forage quality, forage quantity, cropping date, cropping architect ADF, NDF.

INTRODUCTION

Corn is an important crop in conventional cropping systems of Kermanshah province, west of Iran and area of under corn cultivation is more than 35000 ha at 2014. On the other hand, area of winter crops (including bread and durum wheat, barley and rape seed) is more than 130000 ha annually and silage corn production after harvesting of winter plants, as a second crop is important and for livestock growers. Growth period of corn for forage production is shorter than grain corn production (Darby & Lauer, 2002), so it cultivation is possible in large part of country after harvest of cereal till next cropping season. Silage corn production as second crop after cereal harvest in Turkey (Iptas & Yavuz, 2008), after forage crops in Canada (Stewart, 2004) is possible. Shorter growth period of forage corn allowing delay in its planting date in contrast with grain corn (Darby & Lauer, 2002).

Corn forage is an important source of feedstuff for beef and dairy cattles (Yilmaz *et al.,* 2007). Silage corn shows high yield potential among forage crop (Mora 2001) and assumed a one of the best forage crop because of easy and cheap production and storage and higher yield and energy per hectare (Everett, 2008, Schroeder 2004). Quantity and quality of forage corn can affect by cultivation management and practices (Cox *et al* 1994), cultivated hybrid (Darby & Lauer, 2002), sowing density and date, soil fertility and harvest management. Different hybrids have optimum planting dates (Darby & Lauer, 2002) and sowing density of forage corn is 20% higher than grain corn (Bates, 1998). A density of 80000-100000 plant /ha showed highest forage yield (Garcia, 2010) and a inter row spaces less than 76 cm was suitable for silage corn (William and Cort, 2002). Increasing of corn sowing density from 18000 to 42000 plants/acre improved forage yield (Jeschke & Curran, 2008). Crop management practices for corn destined for grain are well established. Contrary to this, crop management practices for corn destined for silage are more controversial among farmers and consultants.

Considering total biomass yield as the only priority, planting corn for silage at high densities may be an attractive approach for dairy farmers to recover forage inventories. However, some major concerns exist with this practice. First, high corn planting densities may exacerbate the negative effects of droughty conditions, thereby resulting in reduced forage yields when they are most necessary. Second, planting corn at high densities may decrease the energy concentration of the resulting silage due to reduced kernel pollination or development (Ferreira *et al.*, 2014).

Quality of product forage is important also. The acid detergent fiber, ADF i.e. amount of cellules and lignin in cell wall composition and non detergent fiber, NDF i.e. amount of cell wall in silage (Schroeder, 1994) are two important quality indices for livestock growers. It means that NDF is ADF + hemicelluloses (Schroeder, 1994).

There is a reverse relation between nutrient soluble fiber and forage quality; as soluble fiber increase quality will decrease because livestock cannot digest this kind of fiber that contains lignin and cellules (Ghasemi *et al.* 2006).

Present study was conducted in order to determination of best planting date, sowing density and inter row spaces (crop architecture) of forage corn production as a second crop after harvesting of winter plants in Kermanshah province, West of Iran.

MATERIALS AND METHODS

Field studies: The field's study was conducted at Islamabad-e Gharb agricultural research station in the Kermanshah province, west of Iran in 2014. The geographical position of station was 46,50E, 24, 16N and 1346 m from sea level. The KSC 704 hybrid introduced by seed and plan improvement institute (SPII), Karaj, Iran, was studied by using of a split factorial model, complete randomized block and three replications. The planting date levels including 20th, 30th June and 10th July and cropping architects, factorial combination of 80000, 90000 and 100000 plant/ha densities plus 55, 65 and 75 cm inter row spaces, arranged as main and subplots respectively. Each plot included 4 rows, 3 m length. Fertilizers applied according to soil test and irrigation was done each 7 day intervals. Two central rows harvest for data analysis at dough growth stage. Fresh and dry weights of each plots recorded. The plastic pots by 40 cm length and 20cm diameter filled by chopped forage of each plots and sealed for 40 days to fermentation. The ADF (acid detergent fiber) and NDF (neutral detergent fiber) quality indices were measured and combined analysis of data was done by MSTAC and SPSS packages.

RESULT AND DISCUSSION

A. Fresh Yield

Data analysis showed a significant different between planting date and highest yield produced by earliest sowing date (20th June). This is due to late maturity of KSC 704 hybrid that delay harvest till beginning of cold weather of winter (Table 1 and 2). Reduction of yield and forage quality due to delay in planting date reported by other researcher also (Lauer 1995).

Effects of inter row spaces was meaningful; highest and lowest fresh weight produced by 65 and 75 cm inter row space respectively (Table 3). There are different reports about this issue; Shapiro and Wortman (2006) found that changing of inter row space at fixed density per ha showed no effect on forage and grain yield but Cox *et al.* (1998) showed that narrower row spaces will increase fresh yield with out any change in quality, opposite with Shapiro and Wortman (2006) and Asadi (2004).

Table 1: AOVA table of fresh and dry yield of data (2008 and 2009).

S. o V.	Df	MS	
		Fresh Yield	**Dry Yield**
Replication	2	614.9ns	124 ns
Dates	2	2096.2**	613**
Error	8	47.04	9.8
Row spaces	2	215.3**	63.2**
Dates*row spaces	4	97.2*	23.88*
Density	2	4976.2**	1052.2**
Dates*density	4	105.4*	38.7**
row spaces*density	4	110.9**	30.5*
Dates*row spaces*density	8	117.8**	24.3*
Error	48	34	9.7
C.V.	7.77		8.85

Table 2: The effect of planting dates of fresh yield, dry yield, NDF and ADF.

Planting dates	Fresh Yield	Dry Yield	NDF	ADF
20th June	82.8	39.2	55.5	32.4
30th June	72.3	33.7	55.4	33
10th July	71.6	33.1	53.5	34
LSD	5.48	2.92	2.35	1.53

Table 3: The effect of inter row spaces of fresh yield, dry yield, NDF and ADF.

Inter row spaces	Fresh Yield	Dry Yield	NDF	ADF
55 cm	74.5	34.9	52	29.2
65 cm	77.9	36.6	54	35
75 cm	74	34.6	55.5	35.8
LSD	5.4	2.9	2.45	1.6

Densities affects fresh yield; by increasing of density from 80000 plant/ha to 90000 plant/ha fresh weight increased so highest yield produced by second density (Table 4). Densities more than 90000 plant /ha reduced fresh weight because of extra intra specific competition. Armestrang and Albert (2008) found that 80000 plants/ha is desirable density for forage production. Similarly, Asadi (2004) found 90000 plants/ha as optimum density for silage production.

Planting date and inter row space interactions was non significant hence highest fresh yield produced by earliest planting date and 65 cm inter row spaces (Table 5). No significant interaction observed between planting dates and densities the 20th June panting date and 90000 plants/ha showed but highest fresh yield (Table 5). In contrast, interaction of inter row space and density was non significant. Density of 90000 plants/ha and 65 cm inter row space showed highest fresh yield; lowest fresh yield produced by 85000 plants/ha and 55 cm inter row space (Table 5).

B. Dry Yield

Data analysis of dry yield showed significance different between planting dates (Table 2). There was a reduction in dry yield because of delay in sowing date. In contrast dry yield affected by inter row space severely.

Table 4: The effect of sowing density spaces of fresh yield, dry yield, NDF and ADF.

Densities (Plants/ha)	Fresh Yield	Dry Yield	NDF	ADF
80000	66.8	31.4	52.2	31.9
90000	85.9	40.1	54	33.2
100000	74.1	34.5	56.3	34.8
LSD	5.1	3.2	2.4	1.65

Table 5: The effects of Interaction of sowing date, inter row space and density on fresh yield, dry yield, NDF and ADF.

Planting date	Inter row spaces	Density	Fresh Yield	Dry yield	NDF	ADF
20th June	55	80000	75.2	36.1	47.2	27
		90000	94.98	45.5	50.1	28
		100000	79.18	37.3	52	28
	65	80000	71.7	33.7	49.2	31.9
		90000	105.5	50.3	53.8	32.6
		100000	79.2	37.1	53.1	36.8
	75	80000	736	35.1	50.9	34.1
		90000	85.7	40.7	51.2	33.9
		100000	80.2	34.3	56.6	35.6
30th June	55	80000	56.2	26.2	54.2	29
		90000	78.8	38.4	55.6	29.3
		100000	70.6	32.7	57	30.3
	65	80000	68.1	31.8	54.8	32.7
		90000	88.7	41.7	53.3	35.6
		100000	71.7	33.4	56.2	35.9
	75	80000	61.1	29.1	56	35.4
		90000	80.7	37.5	54.8	36.4
		100000	74.8	34.8	54.8	37.1
10th July	55	80000	65.8	30.3	51.9	26.7
		90000	79.7	36.6	53.9	30.5
		100000	70.6	32.6	56.2	32.2
	65	80000	62.8	30	54.1	36.1
		90000	79.9	36.8	54.5	35.7
		100000	73.7	34.5	57.1	37.5
	75	80000	66.6	30.3	55	34.1
		90000	79.4	35.6	57	36.5
		100000	67.3	30.9	58.7	39.6
LSD			9.4	5.1	4.6	3.5

Highest and lowest dry yield produced by 65 and 55 cm inter row space respectively (Table 3). Effect of sowing density on dry yield was significant also and highest dry yield produced by 90000 plants /ha (Table 4).

Interactions of densities and inter row spaces was significant. The 20th July and 65 cm inter row space produced highest dry yield. Interactions of sowing date × density and inter row space and density were significant also. Highest yield belonged to the 20th July sowing date and 90000 plants/ha density. Regarding density and inter row space, highest dry yield produced by 65 cm inter row space and 90000 plants/ha (Table 5).

C. ADF and NDF

NDF reflects the bulkiness of forage. Because forage fiber is bulky, there is a limit to the amount of NDF that will fit into a cow's rumen (first stomach). When that limit is reached, she will stop eating. There is no more room until a significant portion of the fiber in the rumen is digested and/or passes on to the lower gut. The proportion of NDF to body weight is an important fundamental relationship. If we know the percent of NDF in the forage and the cow's body weight, we can estimate maximum forage dry matter intake (DMI).

The effect of inter row space and density on ADF and NDF hence interactions were not significant. Highest NDF and ADF observed in treatment composed of the 20th June, 55 cm inter row space and 100000 plants/ha density. This result confirms those of Iptas and Acar (2003), indicated that increasing of NDF i.e reduction of forage quality. Reduction of forage quality due to increasing of density reported by Bal *et. al.* (2000). Cusicanqui and Lauer (1999) reported increase of NDF and ADF and reduction of silage quality as result of sowing density. Similar result reported by Valdez *et al. (*1989) , Jeschke and Curran (2008) and CHAMPION (2010). In contrast, an opposite result reported by Marsalis *et. al.* (2009). Zeller and Schwarz (2010) investigated hybrids of different maturing groups and observed increasing of NDF by delay in planting date. In contrast to early maturing groups, the NDF values were higher in late maturing hybrids.

Reduction of forage quality due to using of high plantin density reported by Cox. and Cherney (2001). Baron et al (2006) found that NDF and ADF increased as sowing density increased from 75000 to 125000 plant /ha. They concluded no effect of inter row space on forage quality indices. Similarly, Stanton and *et al* (2007) resulted reduction of forage quality in term of NDF and ADF increase because of higher sowing density.

CONCLUSION

Delay in planting date will reduce fresh and dry yield and resulted in quality reduction of forage. Best planting density is 90000 plants /ha and using of higher density will reduce quality and quantity of silage. Better inter row space is 65 also. In addition, the 20th June planting date and using of 90000 plants/ha at 65 cm inter row spaces is recommendable for silage corn producer and livestock growers as second crop after harvesting of winter cereals and rape seed in Kermanshah province.

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