Evaluation of Different Harvest Times of Four Genotypes of Sunflower (Helianthus annuus L.) for Ensiling

Gonçalves[1] L.C., N.M.Rodriguez[1], L.G.R.Pereira[3], J.A.S.Rodrigues[2], I.Borges[1], A.L.C.C. Borges[1], E.OS.Saliba[1]

[1]Professors of Departamento de Zootecnia
Escola de Veterinaria-UFMG, Brazil.

[2]EMBRAPA-Centro Nacional de Milho e Sorgo, Brazil

[3]Graduate student

E-mail: norberto@vet.ufmg.br

1. Introduction

In recent years, the sowing of fodder crops during the rainy season (January to March) has become very popular. Generally, corn and sorghum are used, because they produce a well-preserved silage of good nutritive value. However, their dry matter (DM) yields and quality are uncertain from year to year, because of frequent drought stress.

Sunflower stands out as an alternative for forage production and conservation as silage because of its drought tolerance, its high DM yields, its resistance to cold and heat, its adaptability to different edafoclimatic conditions and its relative independence of latitude, altitude and photoperíod (Cotte 1959, Tomich, 1999).

To obtain silage of good quality and of high nutritive value, the material should be cut at the right point of maturity. Tan and Tumer (1996) ensiled sunflower at several stages of maturity and concluded that the final flowering stage was the best for silage making.

The present study was carried out at the EMBRAPA-National Center of Research in Corn and Sorghum. The objectives were to evaluate the sunflower genotypes V2000, DK180, M734 and Rumbossol-91 grown in a completely randomised block with 3 replications and cut and ensiled 30, 37, 44 and 51 days after flowering.

2. Results

Table 1 shows that many of the plots had inferior stands compared to those recommended by CASTRO *et al.* (1996) of 40 to 50 thousand plants per hectare. Rumbosol-91 was significantly taller than the other cultivars, but had the lowest percentage heads and the highest percentage stem. Dry matter (DM) yield of V2000 was inferior to the others, except for the first harvest time (Table 2). The DM concentration of the material is the most important factor for the quality of the ensiling process (McDonald *et al.* 1991) and it is recommended to be between 30 to 35%.

Laboratory silos of PVC with 40 cm of length and 10 cm diameter were used and the silos were opened after 56 days.

Table 1. Stand (plants/ha), height of the plants (cm), diameter of the heads (cm) and percentages of heads, stems and leaves at 30 , 37, 44 and 51 days after flowering

	Stand	Height	Diameter	Head%	Stem%	Leaf%
V2000						
30	39.59ABa	195.00Ba	16.84Aa	46.34Aa	35.56Ba	18.12Aab
37	26.74Ba	190.00Ba	20.44Aa	42.17Aa	37.34Aba	20.49Aa
44	33.34Aa	178.33Ba	17.56Aa	47.22Aa	37.16Aba	15.61Bab
51	19.44Aa	176.67Ba	15.55Aa	51.85Aa	37.68Ba	10.47Ab
DK180						
30	31.60Ba	205.00Ba	17.56Aa	44.38Aa	35.46Ba	20.16Aa
37	39.58Aba	190.00Ba	15.56Aba	52.00Aa	35.03Ba	12.97Ba
44	25.35Aa	200.00Ba	17.67Aa	45.63Aa	38.32Ba	16.05Ba
51	38.19Aa	203.33Ba	12.22Aa	41.16Ba	42.41Ba	16.43Aa
M734						
30	30.56Ba	193.33Ba	19.67Aa	48.83Aa	32.68Ba	18.49Aa
37	42.71ABa	181.78Ba	14.78ABa	48.99Aa	33.30Ba	17.71ABa
44	46.53Aa	198.33Ba	15.11Aa	50.67Aa	31.25Ba	18.08ABa
51	39.58Aa	191.67Ba	13.22Aa	48.58ABa	35.62Ba	15.79Aa
RUMBOSOL 91						
30	58.33Aa	235.00Aa	16.67Aa	26.52Ba	50.27Aab	23.21Aa
37	57.64Aa	226.67Aa	13.68Ba	33.38Ba	44.20Ab	22.43Aa
44	25.35Ab	228.33Aa	17.78Aa	29.95Ba	46.05Ab	24.01Aa
51	42.36Aab	228.33Aa	15.00Aa	24.78Ca	57.20Aa	18.01Aa
CV	32.80	6.616	18.42	11.90	11.23	20.01

Capital letters compare harvest times among genotypes
Small letters compare harvest times within of each genotype

The largest densities were observed for V2000, which may be explained because of its lowest DM concentration. Within each genotype, the densities decreased with time, due to the higher DM concentrations as plants matured, with the exception of V2000. These results are superior to those reported by Tomich (1999) who studied 13 genotypes with an average density of 677.4 kg/m^3 and they are also above those found for farm silos, with values of

around 600 to 800 kg/m^3 for a good compression (Nussio 1992). The quality of the preservation decreased with age of the plants as shown by increasing pH, particularly for V2000, which also had high ammonia-nitrogen (N - NH_3) levels. In another experiment done at our lab with 13 genotypes (Tomich, 1999) the mean values of ether extract and in vitro DM digestibility of the silages were 13,7 % and 50 %, respectively, and showed normal profiles of lactic acid and AGV production.

Table 2. Production of fresh matter (FM t/ha), DM (t/ha), DM (%) of plants, heads, leaves and stems at 30, 37, 44 and 51 days after flowering.

	FM/ha	DM yld	Plants	Heads	Leaves	Stems
V2000						
30	30.94Aa	5.63Aa	17.85Aa	23.45Aa	20.35Ab	22.45Aa
37	16.31Ab	3.05Bb	19.13Ba	6.23Aa	29.27Bb	16.17Ba
44	10.28Ab	3.27Bb	32.80Ba	26.77Aa	48.43Aab	21.37Ba
51	7.57Ab	2.73Bb	35.17Ba	30.30Ba	58.13Aa	22.73Ba
DK180						
30	24.58Aa	6.03Aa	24.53Ab	24.20Ab	31.77Ab	21.00Aa
37	21.49Aa	6.22Aa	29.30ABb	27.43Ab	46.30Bab	26.47Aba
44	12.85Ab	5.50Aa	42.57ABa	32.10Ab	60.70Aa	24.80ABa
51	11.39Ab	6.40Aa	59.60Aa	51.30ABa	71.97Aa	31.00Ba
M734						
30	29.93Aa	6.53Aa	22.10Ab	21.70Ab	22.27Ab	19.20Aa
37	20.21Ab	6.24Aa	32.27ABb	25.73Ab	31.30Bb	20.80ABa
44	13.51Abc	7.49Aa	55.43Aa	37.30Aab	68.43Aa	25.70Ba
51	10.35Ac	6.57Aa	67.33Aa	49.73ABa	78.10Aa	32.30Ba
RUMBOSOL 91						
30	24.38Aa	6.15Aa	25.70Ac	24.77Ab	38.43Ab	31.60Ab
37	12.57Ab	5.32Aa	43.20Ab	39.83Ab	70.10Aa	37.90Aab
44	15.77Ab	6.95Aa	49.23ABb	42.40Ab	76.43Aa	41.80Aab
51	7.43Ab	4.79Aa	68.57Aa	68.97Aa	84.50Aa	55.13Aa
CV	26.50	19.97	26.60	32.62	24.59	31.88

Capital letters compare cutting times among genotypes
Small letter compare cutting times within each genotypes

Table 3. Density (kg/m^3), DM (%), CP (%) of the silages cut and ensiled at 30; 37; 44 and 51 days after flowering.

	Density	DM	CP	pH	N - NH_3
V2000					
30	2092,50^{A}a	18,60Aa	13,09 Aa	4,43	14,76
37	1821,33^{A}a	22,28Aa	13,37Aa	5,26	24,27
44	1559,00Aa	31,10Ba	13,18Aa	5,28	12,52
51	1494,33Aa	32,79Ba	12,66Aa	5,24	21,59
DK180					
30	1673,67Aa	23,06Ab	11,17Aba	4,42	11,00
37	1570,67Abab	28,70Ab	10,31Ba	4,18	9,72
44	1261,00Aab	39,40Abb	11,40Ba	5,14	9,51
51	1050,33Bb	56,56Aa	10,69Ba	*	*
M734					
30	1921,00Aa	21,06Ab	11,25Ba	4,42	8,46
37	1575,00Aba	31,83Ab	10,62Ba	4,17	14,38
44	1240,33Ab	52,05Aa	11,25Ba	5,14	7,75
51	914,67Bb	61,30Aa	12,06Aba	*	*
RUMBOSOL91					
30	1615,67Aa	25,70Ac	9,18Ca	4,07	8,64
37	1189,33Ba	41,24Ab	9,94Ba	4,84	7,48
44	1084,00Aa	44,90Abb	9,44Ca	5,25	9,35
51	666,00Bb	64,57Aa	7,00Cb	*	*
CV	18,87	24,49	8,45		

Capital letters compare harvest times among genotypes
Small letters compare harvest time within each genotype
*Not determined

3. Conclusions

1. The best harvest time for ensiling varied according to genotype, and was 37 days after flowering for DK180 and M734, more than 51 days for V2000 and about 30 days for Rambosol-91.

2. V2000 had the highest CP concentrations, but even though with 35% DM at ensiling provided silages with undesirable pH and N-NH_3. Within each genotype there were no differences between harvest times in the CP concentration, with the exception of Rumbosol-91, which had lower values at 51days.

4. References

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