



## The chemical composition of sunflower seed for animal feed in agroforestry system in Brazil's subtropical.

A. C. V. de Oliveira<sup>1</sup>; A. de Moraes<sup>1</sup>; M. F. S. Ribeiro<sup>2</sup>; V. P. da Silva<sup>3</sup>; C. R. Lang<sup>2</sup>; R. R. Nogueira<sup>2</sup>; E. B. de Oliveira<sup>3</sup>; J. L. Moletta<sup>2</sup>

<sup>1</sup>UFPR- Universidade Federal do Paraná, <sup>2</sup>IAPAR-Instituto Agrônômico do Paraná,  
<sup>3</sup>EMBRAPA FLORESTAS- Empresa Brasileira de Pesquisa Agropecuária.

**Keywords:** *crude protein; eucalyptus; Helianthus annuus L.; integrated systems.*

### Introduction

The Agroforestry system is a sustainable alternative to produce crops, forest and livestock. The sunflower (*Helianthus annuus L.*) has been increasing in the Brazilian agricultural scenario due to its adaptability to different climatic conditions and diversity of products from the plant, increasing the profitability of the producer (Castro *et al.*, 2005). Fernandes *et al.* (2007), Selvaraj and Purushothaman (2004) and Silva *et al.* (2002) highlighted the wide use of sunflower and its byproducts in the animal feed due the high protein content and the excellent nutritional value of the lipids present into this oilseed. Given the growing increase in commodity prices of corn and soybeans impacting the cost of feed, combined with the increase in the area of sunflower produced in the country and the lack of information on the crop in agroforestry systems, this study aimed to compare the chemical composition of sunflower grown in full sun and into agroforestry system with eucalyptus to animal feed and detect effects of the shading in the quality of the sunflower seed.

### Materials and methods

The full sun (FS) and agroforestry system (AFS) experiments were conducted at the IAPAR, Ponta Grossa, Fazenda Modelo Experimental Station, Brazil (25°07'22" S; 50°03'01" W), during August 2011 to January 2012. The experimental design was in randomized blocks with three genotypes and four replicates. The genotypes Aguará 04, Catissol and NTO 2.0 were sown in a plot of 5 rows of 5 m long, spaced 0.7 m between rows and 0.3 m between plants. The plots into the AFS were arranged in five tracks 4, 8, 12, 16 and 20m away from the rows of eucalyptus. Only the three central rows per plot were considered for evaluation. The crop management was performed following the recommendation of research Castro *et al.* (2005). After harvesting, the capitula were dried, threshed and weighed. Then the samples were analyzed in the laboratory of animal in the IAPAR located in Ibiporã in the State of Paraná, Brazil, for determination of dry matter, crude protein and ether extract. The chemical composition of sunflower was performed according to Silva and Queiroz (2002) and statistically analyzed using Statistical Analysis System (SAS) version 8.1, with GLM, applying the F test for variance. Means were compared by Tukey test.

### Results and discussion

The highest crude protein content was found in sunflower grown into AFS. Conversely, the highest percentages of ether extract were observed in the grains established in the full sun experiment (Table 1).

Leonel *et al.* (2009), studying the yield of intercropping maize and *Brachiaria* evaluated the composition of dry matter and crude protein and concluded that in situations of increased shading, the crude protein content in dry matter was higher. This increase in protein content can be explained by the dilution factor, because the lower dry matter production results in higher crude protein content. Another explanation is that soil moisture is higher in shade,



especially in the upper layer, which favors the decomposition of organic matter and nitrogen mineralization, making it available for plant uptake.

Thus, we can infer that the leaves and fallen branches of eucalyptus on the ground contributed to enrich it with higher nitrogen concentration into AFS, allowing a higher concentration of crude protein in sunflower seeds.

Table 1. The Chemical composition of three genotypes of sunflower into AFS and FS.

Treatments	Crude Protein (%)			Mean
	Aguara 04	Catissol	NTO 2.0	
FS	17.36b	19.4b	17.53b	18.10b
AFS	19.29a	21.36a	23.24a	21.29a
Treatments	Ether extract (%)			Mean
	Aguara 04	Catissol	NTO 2.0	
FS	51.84a	47.02a	42.88	47,25a
AFS	47.64b	44.49b	42.84	44,99b

Means followed by different letter in the same column differ ( $P < 0.05$ ) by Tukey test.

There was a reduction in the ether extract content of the grains that were shaded by eucalyptus trees into AFS. Similarly, Aguirrezábal *et al.* (2003), working with shading levels in sunflower research concluded that a reduction of photosynthetically active radiation intercepted during the grain filling negatively affects the concentration of lipids in addition to affecting productivity.

The Chemical analyses of sunflower grown into the AFS indicated that there are significant differences ( $P < 0.05$ ) for crude protein and ether extract content between the three genotypes in the five tracks. The highest percentage of crude protein and the lowest ether extract content were attributed to NTO 2.0. The Aguara 04 showed the highest tenor of lipids and dry matter (Table 2).

Table 2. Average contents of dry matter, crude protein and ether extract of sunflower genotypes arranged in five tracks between the rows of eucalyptus.

Tracks	Dry Matter (%)			Crude Protein (%)			Ether Extract (%)		
	Aguara 04	Catissol	NTO 2.0	Aguara 04	Catissol	NTO 2.0	Aguara 04	Catissol	NTO 2.0
1	95.62	95.02	94.64	19.02	20.58	22.93	48.42	43.64	42.22
2	95.35	94.97	95.2	19.02	21.09	21.41	47.07	44.94	42.51
3	95.43	95.00	94.7	21.00	22.35	22.02	46.64	44.7	42.14
4	95.53	94.38	95.08	18.92	22.30	22.65	48.57	44.30	44.65
5	95.24	95.3	94.63	18.48	20.47	27.00	47.49	44.86	43.13
Mean	95.43a	94.93b	94.85b	19.29c	21.36b	23.20a	47.67a	44.49b	42.93c
CV%	0.51			9.47			3.63		

Means followed by different letter in the same row differ ( $P < 0.05$ ) by Tukey test.

Regarding the chemical composition of sunflower into the AFS, there was no interaction between cultivars and the tracks of distances ( $P > 0.05$ ) between the rows of eucalyptus (Table 2).

Thus, we could infer that the shading caused by the trees on sunflower did not affect the nutritional quality of oilseed. Therefore, the grains of sunflower grown into AFS and used in



partial substitution of animal feed is feasible and not brings harm when there is suitable sunflower management and the proper inclusion in animal feed. However, studies reporting the influence of shading on the nutritional composition of sunflower are still embryonic.

### Conclusions

The chemical composition of sunflower seed was not negatively affected by shading furthermore, the highest protein content has been observed for the grains from the AFS. The ether extract percentage of the grains obtained from the full sun experiment was significantly higher compared with the Agroforestry system. Further studies on the influence of shading on the nutritional quality of sunflower still need to ensure the feasibility of sunflower into the Agroforestry system.

### Acknowledgements

This work was supported by the Instituto Agronômico do Paraná, Universidade Federal do Paraná, and was sponsored by Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and Financiadora de Estudos e Projetos (FINEP).

### References

- Aguirrezábal, L.A.N., Lavaud, Y., Dosio, G.A.A., Izquierdo, N.G., Andrade, F.H. and González, L.N. (2003) Intercepted Solar Radiation during Seed Filling Determines Sunflower Weight per Seed and Oil Concentration. *Crop Science* 43, 152-161.
- Leite, R.M.V.B. C., Brighenti, A.M. and Castro, C. (2005) *Girassol no Brasil*. Embrapa Soja, Londrina, BR, 641pp.
- Fernandes, A.R.M., Sampaio, A.A.M., Henrique, W., Perecin D., Oliveira, E.A. and Túlio, R.R. (2007) Avaliação econômica e desempenho de machos e fêmeas Canchim em confinamento alimentados com dietas à base de silagem de milho e concentrado ou cana-de-açúcar e concentrado contendo grãos de girassol. *Revista Brasileira de Zootecnia*, 36, 855-864.
- Leonel, F.P., Pereira, J. C., Costa, M.G, Júnior, P.M., Lara, L.A. and Queiroz, A.C. (2009) Comportamento produtivo e características nutricionais do capim-braquiária cultivado em consórcio com milho. *Revista Brasileira de Zootecnia*, 38, 177-189.
- Selvaraj, R.K and Purushothaman, M.R. (2004) Nutritive value of full-fat sunflower seeds in broiler diets. *Poultry Science*, 83, 441-446.
- Silva, C.A., Pinheiro, J.W, Fonseca, N.A.N, Cabrera,L., Novo, V.C.C., Silva, M.A.A, Canteri, R.C., Hoshi, E.H. (2002) Farelo de girassol na alimentação de suínos em crescimento e terminação: digestibilidade, desempenho e efeitos na qualidade de carcaça. *Revista Brasileira de Zootecnia*, 31, 982-990.
- Silva, D.J. and Queiroz, A. C. (2002) Métodos químicos e biológico. In *Análise de Alimentos*, 40-45.