

**Crambe development under lime application in sandy soil**

Tiago Roque Benetoli da Silva<sup>1\*</sup>, Tainara Vanessa Carraro<sup>1</sup>, Poliana Frigo<sup>1</sup>, Natalia Alves Barbosa<sup>1</sup>, Maria Gabriela Gurtler Tiburcio<sup>1</sup>, Deonir Secco<sup>2</sup>, Reginaldo Ferreira Santos<sup>2</sup>, Charline Zaratini Alves<sup>3</sup>

<sup>1</sup>Universidade Estadual de Maringá (UEM), *Campus Umuarama*, Paraná, Brazil.

<sup>2</sup>Universidade Estadual do Oeste do Paraná (UNIOESTE), *Campus Cascavel*, Paraná, Brazil. Programa de Pós-Graduação em Engenharia Agrícola (PGEAGRI). 2069, Cascavel, Paraná.

<sup>3</sup>Universidade Federal do Mato Grosso do Sul, Chapadão do Sul – MS.

Autor for correspondence: [trbsilva@uem.br](mailto:trbsilva@uem.br)

Article submitted in 13/02/2017, accept in 01/04/2017.

**Abstract:** Crambe (*Crambe abssynica* Hoechst) is belonging to the Brassicaceae family oilseeds with high oil content, very useful as a feedstock source for biodiesel production. This work was conducted in the Umuarama city, Paraná State, Brazil, in pots containing soil classified as Oxisol typical and aimed to determine dolomitic limestone rates effects (using the V% original, rates to increase the basis saturation to 60, 70, 80 and 90%) on oil content, yield crambe and soil pH. The completely randomized design with four replications was used. Lime application increase the saturation to 70%, provides conditions for higher yields crambe, this makes the ideal pH range to its cultivation soil.

**Key words:** *Crambe abyssinica* Hochst., oil content, biofuel.

**Desenvolvimento de crambe sob calagem em solo arenoso**

**Resumo:** Crambe (*Crambe abssynica* Hoechst) é uma planta pertence à família Brassicaceae, com alto teor de óleo, muito útil como fonte de matéria-prima para a produção de biodiesel. Este trabalho foi realizado na cidade de Umuarama, Estado do Paraná, Brasil, em vasos contendo solo classificado como Latossolo Vermelho, para determinar os efeitos das doses de calcário dolomítico (V% original, doses para elevar a saturação por bases a 60, 70, 80 e 90%) no teor de óleo, produtividade do crambe e pH do solo. O delineamento foi o inteiramente casualizado com quatro repetições. Aplicação de calcário calculada para aumentar a saturação por bases a 70%, fornece condições para maiores produtividades do crambe, o que torna a faixa de pH ideal para o seu cultivo.

**Palavras chave:** *Crambe abyssinica* Hochst., teor de óleo, biocombustível.

**Introduction**

Biodiesel is a nontoxic liquid fuel, biodegradable, produced through different materials. Results from a chemical reaction in alkaline medium, where they react vegetable oils (animal fats) and an alcohol

(ethanol or methanol). Currently, the industry uses soybean oil as a vegetarian source, followed by sunflower and beef tallow. New sources are being studied (BRASIL et al., 2007). Growing economic concerns and the environment, in

addition to forecasts that non-renewable energy reserves are exhausted in the next 50 years have encouraged the search for new energy sources such as biofuels (NASCIMENTO et al., 2006).

Crambe plants (*Crambe abssynica* Hoechst) is an alternative feedstock for biodiesel production. Being considered as winter crop, highly resistant to drought and its establishment has short cycle ranging from 90 to 100 days. There are good development in hot and cold soils, considered sort of winter, may not develop properly in hot times, is resistant to pests and diseases, with oil content of approximately 35% (MACHADO et al., 2007).

Research conducted by the MS Foundation in Maracajú city, Mato Grosso do Sul State – Brazil indicate yield between 1,000 and 1,500 kg ha<sup>-1</sup>. In tests conducted in the extraction of oil from crushing by presses, we obtained yield 25 liters of oil per 100 pounds of grain (SILVA, 2007; ENDRES and SCHATZ 1993).

Oil extracted from grain crambe can be used as an industrial lubricant, a corrosion inhibitor and also for the rubber synthetic manufacture, due to it is high content of erucic acid in oil (50 to 60%). Can also be used in the manufacture of plastics, nylon, adhesives and electrical insulation (OPLINGER et al., 1991).

Pitol et al. (2010) affirm the crambe is a plant that does not tolerate toxic aluminum, normally present in acid soils, with low base saturation. However, in the world, no specific technical recommendations for improving the chemical environment of the root of this plant species.

Carvalho et al. (2012) In an experiment aimed at observing the

response of the crambe cultivated in cerrado soil submitted to liming, verifying that under the increase of basis saturation the crambe presented increase in height, number of leaves and dry mass of the grains.

Pitol (2008) indicates work with soils with higher pH and fertilizer sowing, 150 kg ha<sup>-1</sup> similar to 6-20-20 formulated, it is being applied to the soil, 9, 30 and 30 kg ha<sup>-1</sup> of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O, respectively, but that is just the authors suggestion, considering that is not being taken into account the soil type and the contents within it.

The present study aimed to determine the effect of liming on the crambe cultivation.

### Material and Methods

The experiment was conducted in greenhouse at the Fazenda da Universidade Estadual de Maringa, Regional Campuses Umuarama – Parana State, Brazil. The collected soil is an Oxisol typical (Embrapa 2013), with sandy texture and initial saturation of bases 35.53 %.

Crambe seeds were donated by Mato Grosso do Sul Foundation - FMS. Portions 18 liter pots were made. The sowing date was August 21, 2012, with six seeds per pot and after germination two plants were left per pot.

It used a completely randomized design with four replications, consisting of five treatments (without lime application; rates aimed at raising the V = 60% 70 % 80 % and 90 %). The application of dolomitic limestone with PRNT = 75 % one month before sowing was performed with irrigation every two days, with the aim of promoting the reaction of limestone with the soil.

Fertilization sowing was done with 150 kg ha<sup>-1</sup> of 6-20-20 formulated according to the indication Pitol (2008). The water management in the pots during crambe cultivation was carried out twice a day, with water to reach the soil field capacity.

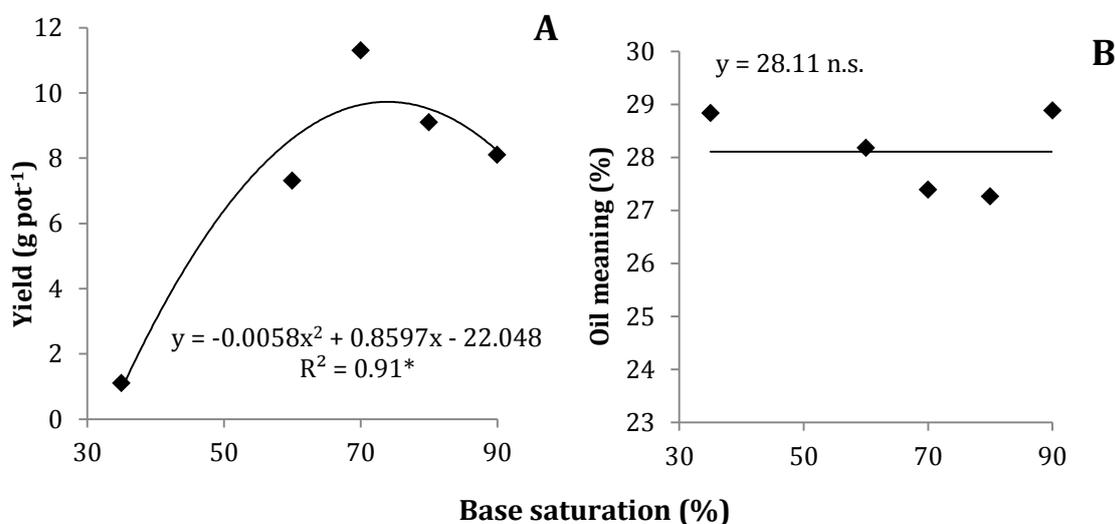
At harvest (about 90 day cycle) cutting the shoot plants located in each plot, which seed for obtaining yield. Finally were removed was performed the assessment of seed oil extraction performed in the laboratory by the methodology of Silva *et al.* (2015), with 0.2 g of seeds, previously dried in a forced ventilation oven at 65 °C for 48 hours. The data obtained on the dry weight and yield were converted to grams per pot. Was also

evaluated for pH soil, collected at harvest of crambe.

Statistical analysis was performed followed by analysis of variance model, through Sisvar program, using the 5% level of significance. Adjustment of means in regressions (linear and quadratic), with the same level of significance (5 %) will be checked.

## Results and Discussion

Note in Figure 1A that the crambe yield was influenced by the application of lime. The maximum technical efficiency is given when the base saturation reached 74.11 %, proving to be ideal for growing crambe.



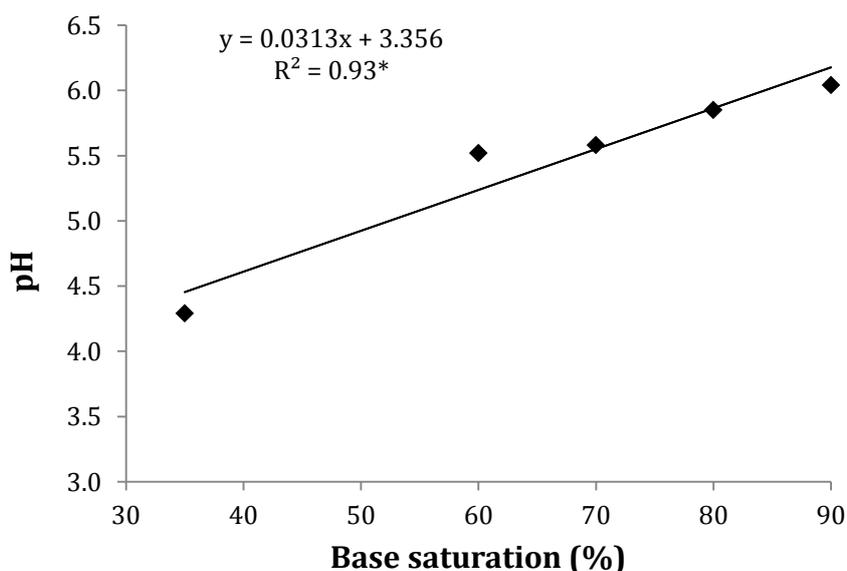
**Figure 1.** (A) Yield (g pot<sup>-1</sup>) and (B) oil meaning (%) of crambe, in function of liming. Umuarama/PR-Brazil - 2013. \* and n.s. = significative and not significative at 5% probability.

Values of 60 % of base saturation recommended for some species of green manures, such as crude, vetch, pigeonpea, mucunas and lupine (Ambrosano and Wutke, 1997) and also for castor bean (SAVY FILHO, 1997), however for crambe, this value appears to be slightly higher. Carvalho *et al.* (2012), verifying that under the increase of basis saturation the crambe increase in height, number of leaves and dry mass of the grains in basis saturation at 75%.

The oil content was not influenced by the application of dolomitic limestone (Figure 1B). The soil, not even lying in range ideal for the crambe cultivation, which influenced the yield did not change the oil formation in the grains,

however, the pH values are below the level considered optimal in cultivar FMS Brilhante, which is 35% (Pitol 2010). This probably occurred by cultivation time, which according to Pitol *et al.* (2008) is not ideal to crambe, due to high temperatures.

Soil pH increased with the application of dolomitic lime rates (Figure 2). This demonstrates that there was a chemical reaction between lime and soil. In the range of saturation to 70 %, the pH is at 5.58. Pitol (2010) points out that the optimum pH range in water is 5.5 to 6.2, demonstrating that with increasing saturation to 70 %, decreases the soil reaches the level of acidity, providing suitable conditions for growing crambe.



**Figure 2.** Soil pH do solo in function of liming. Umuarama/PR-Brazil - 2013. \* = significative at 5% probability.

It should be noted that in order to reduce production costs for crambe, the recommendation of lime should be used in commercial crops. However, it is observed by the experiment that the rate of saturation desired bases were the same for most commercial species.

### Conclusion

Lime application to increase the saturation to 70%, provides conditions for higher yields crambe, this makes the ideal pH range to cultivation soil.

### References

- AMBROSANO, E.; WUTKE, E.B. Leguminosas adubos verdes. In: RAIJ B. van, CANTARELA H., QUAGGIO, J.A.; FURLANI, A.M.C. **Recomendações de adubação e calagem para o Estado de São Paulo**. 2ªed. Campinas: IAC, 1997. p.200. (Boletim Técnico, 100).
- CANTARELLA, H. Nitrogênio. In: NOVAIS, R.F., ALVAREZ, V.V.H., BARROS, N.F., FONTES, R.L.F., CANTARUTTI, R.B., NEVES, J.C.L. (Eds.). **Fertilidade do solo**. SBCS: Viçosa. 2007. p.376-449.
- CARVALHO, K.S.; BONFIN-SILVA, E.M.; CABRAL, C.E.A.; LEITE, N.; KOETZ, M. Crambe cultivado em latossolo do cerrado submetido à calagem. **Enciclopédia Biosfera**, Goiânia, v.8, n.15; p.552-558. 2012.
- DINIZ NETO, M.A., SILVA, I.F., TOSCANO, B.L.M., PEREIRA, A.A., PEREIRA, A.R. Componentes de produção de mamona em função de níveis de adubação nitrogenada e desfolha. **Revista Ciência Agrônômica**, Fortaleza, v.43, n.3, p.546-553, 2012.
- EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA. **Sistema Brasileiro de Classificação dos Solos**. Rio de Janeiro: EMBRAPA/CNPQ, 2013. 353p.
- EPSTEIN, E., BLOOM, A.J. **Nutrição mineral de plantas: princípios e perspectivas**. Londrina: Editora Planta, 2006. 402p.
- KMEC, P., WEISS, M.J., MILBRATH, L.R., SCHATZ, B.G., HANZEL, J., HANSON, B.K., ERIKSMOEN, E.D. Growth analysis of crambe. **Crop Science**, Madison, v.38, n.1, p.108-112, 1998.
- MALAVOLTA, E.; VITTI, G.C.; OLIVEIRA, S.A. **Avaliação do estado nutricional de plantas: princípios e aplicações**. Piracicaba: Potafos, 1997. 308p.
- PITOL, C.; BROCH, D.L.; ROSCOE, R. **Tecnologia e produção: Crambe 2010**. Maracaju: Fundação MS. 2010. 60p.
- SAVY FILHO, A. Mamona. In: RAIJ B. van, CANTARELA H., QUAGGIO, J.A.; FURLANI, A.M.C. **Recomendações de adubação e calagem para o Estado de São Paulo**. 2ªed. Campinas: IAC, 1997. p.201. (Boletim Técnico, 100).
- SILVA, T.R.B., LEITE, V.E., SILVA, A.R.B.; VIANA, L.H. 2007 Nitrogênio em cobertura na cultura da mamona em plantio direto. **Pesquisa Agropecuária Brasileira**, Brasília, v.42, n.8, 1357-1359. 2007.
- SILVA, T.R.B.; ROGÉRIO, F.; SANTOS, J.I.; POLETINE, J.P.; GONÇALVES JUNIOR, A.C. Quantificação de óleo em sementes de crambe pelo método da calcinação em forno tipo mufla. **Journal of Agronomic Sciences**, Umuarama, v.4, n.1, p.106-111, 2015.