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RESEARCH ARTICLE

DETECTION OF GREEN SEEDS IN SOYBEAN LOTS BY THE SEED ANALYSIS SYSTEM (SAS)

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ABSTRACT

Nowadays, one of the major problems of soybeans production in Brazil is the presence of green seeds in lots with drastic consequences on physiological quality. The development of methods for detection of green seeds by image analysis technique can speed up the process and reduce the subjectivity of manual methods. To evaluate the use and efficiency of the equipment SAS ® (Seed Analysis System) was used five lots of commercial soybean seeds, from which samples were prepared with different proportions of green seeds (5% to 50%). The evaluation of the samples were performed by visual analysis, capture and image processing using the SAS ® version Pro. To review the characteristics of the seeds were built Artificial Neural Networks (ANNs) using color characteristics, histograms of color and texture channels. A Network of Decision (ND) which allowed measure each side of the seed and obtain classification as green or yellow. Through the image analysis of the seeds was possible to determine the efficiency of the equipment in the detection of green seeds at level hit 99.51% in relation to the visual analysis, thus indicating the possibility of using the SAS ® equipment to detecting soybean green seeds.

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INTRODUCTION

Soybean is one of the most important cultures in the world, with social and economic importance (Braccini *et al*., 2003). The production in Brazil, mainly in the Midwest of the country is been affected by a problem that also requires attention in other countries, which is the occurrence of green seeds in commercial lots (Zoratto *et al*., 2007). The detection of green seeds in soybean lots is currently realized in programs of quality control of the companies through the visual analyzes of samples. This method is subjective, slow and not always efficient, mainly when the number of lots evaluated is big, what negatively affects the acuity of the analyst.

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Beyond the visual analysis, are used another techniques for determination of chlorophyll in seeds, which varies since their density evaluated trough the gravity table, electronic selectors of color and the chlorophyll fluorescence of seeds coat by the method developed by Jalink *et al*. (1998). Some author have been reporting reduction in vigor and germination of soybean lots with green seeds in different levels (Costa *et al*., 2001; Pádua *et al*., 2007; Zoratto *et al*., 2007; Rangel *et al*., 2011; Pardo *et al*., 2015). Onyilagha *et al*. (2011) working with canola seeds with different quantities of chlorophyll conclude that seeds with high level of chlorophyll are more susceptible to the deterioration in unfavorable environmental conditions. Computer science and the electronic science become possible the substitution of visual evaluation by human methods by automated means and with this has increasing the number of researches in this area (Venora *et al*., 2009). Automated

methods can be grounded in seeds images, by means of which the categorization of aggregated characteristics to the size, color, form, texture are acquired in an easy way (Granitto *et al*., 2005). Many authors like Pinto *et al*. (2012), Gomes Junior and Cicero (2012), Carvalho *et al*. (2010), Forti *et al*. (2010) and Flor *et al*.(2004) studied the analysis of images through the X-ray technique to evaluated the seeds quality in seeds of different cultures. Another technique of analyze of images used in seeds is through digital media using software's, which allows to evaluate the characteristics of seeds. Benor *et al*. (2011) used the MARVIN Digital Seed Analyser® equipment to measure and evaluate the morphological caracteristics of *Corchorusolitorius* seeds. Some authors like Shahin *et al*. (2006) reported the importance of the use of image analyzes when compared to the visual analyzes. Tourian and Padilha (2008) obtained success with the use of this technique and authors like Dalen *et al*. (2004) concluded that the analysis of images is a quick and easy method to be used. Thinking in that, companies are looking for today for new market technologies that combines the optimization of their operations in a short period of time. In front of this search for automatization, in 2011, a Brazilian company named Tbit, situated in Lavras, Minas Gerais, developed a system of image analyzes (SAS®),that evaluates the characteristic of seeds and seedlings. It is an important tool that aim in the fast and efficient detection of green soybean seeds. Studies that evaluates the efficiency of these equipment's using techniques of images analyzes, for the detection of green seeds in soybean lots are scarce. With this, the objective in this study was to adequate the methodology and to verify the efficiency of SAS® equipment in the detection of green seeds in soybean lots.

MATERIALS AND METHODS

Seeds obtainment

The experiment was realized in the Central Laboratory of Seeds in the Department of Agriculture at Universidade Federal de Lavras –MG and in the company Tbit, incubated at UFLA. Were used soybean seeds of 5 commercial lots produced by the COODETEC Company in the crop 2012/2012 and separated in two categories: green soybean and non-green soybean (yellow). Seeds were submitted to the visual separation for the definition of categories, capture and image analyzes.

Visual separation of soybean seeds

Were visually separated from each sample of 1kg of soybean, green and yellow seeds with individual and accurate evaluation of seeds. For the calibration of the equipment were done a visual separation of 100 green seeds and 100 of yellow seeds from the 5 lots used. Capture and image analysis of soybean seeds. The equipment used was the SAS Pro®, version which presents a double vision of seeds, what means that this equipment captures two faces of the object in study. SAS® is composed by a module of catchment and a software for analysis. The module of catchment is composed by an acrylic tray where the seeds are placed for the capture of images by the two cameras of high resolution. The software for analysis, forms information's that will be captured and will result in graphics and worksheets that will facilitate the interpretation of seeds images. To calibrate the coloration of the background was used the color system CIEL*a*b, where the luminosity presented values of 0, 0 to 74, 00; the dimension varies between -120, 0 a 120,0 and the dimension b between 120,0 a 0,0. From the characteristics of color evaluated, were constructed artificial neural networks (ANN´s) which allowed the separation of the two categories of green and yellow seeds in three characteristics, like color, histograms of color channels and texture. Like complement of ANN´s was developed in SAS® a network decision (ND) to confirm the final classification of seeds. The ND, use the result that ANN shows from each face of seed, what means, if the ANN define like being green any face, this seed will be automatically classified by the DN like being green. In other hand, if the both faces presents yellow coloration, the final classification will be yellow. Ending the analysis, is issued a report with the analysis realized in the equipment with the percentage of green and yellow seeds of each sample, the result of ANN´s and also the result of network decision. For the evaluation of results efficiency was measured the accuracy level of the equipment in each sample with appropriate percentage of green seeds.

Statisticalanalysis

Were used 4 replications of 300 seeds for each analyzed sample with different pre-defined proportions of green seeds (5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, and 45% e 50%). The percentage of equipment error was calculated by the subtracting of the percentage of green seeds sample defined, with the percentage of green seeds calculated by the equipment. The average error of each sample studied, was obtained with the calculation of error average calculated by the equipment. Beyond the percentage analysis of error, was used also a completely randomized design with 4 replications, which evaluated factors were the mixture of green, yellow and error. Was realized the variance analysis, using regression analysis at 1% of probability with aim of SISVAR ® software (Ferreira, 2008).

RESULTS AND DISCUSSION

The average of time spent by the SAS® equipment to realize the capture of images was of 30 seconds for each replication, confirming the speed and the optimization of the process of image analysis computed.

Table 1. Percentage of accurancy by the SAS® equipment in the identification of green seeds in samples with pre-defined mixtures of green seeds of soybean

Real percentage (constructed)	%Average of yellow	% Average of green	% Average error
5%	94,42	5,58	0,58
10%	88,75	11,25	1,25
15%	84,58	15,42	0,42
20%	79,83	20,17	0,50
25%	74,67	25,33	0,33
30%	69,67	30,33	0,33
35%	64,92	35,08	0,08
40%	60,08	39,92	0,08
45%	55,00	44,99	0,33
50%	51,00	49,00	1,00
Level of accuracy by SAS®		0,49	

Table 2. Results of analysis of variance relative to the percentage of yellow seeds and green seeds analyzed by the SAS ® equipment

V.S	DF	Mean square and significance of F	
		Yellow seeds	Green seeds
Treatment	9	860,69**	860,69**
Error	39	0,23	0,23
Total	30		
CV(%)		0,67	1,74

**- Significative at 1% by the test F

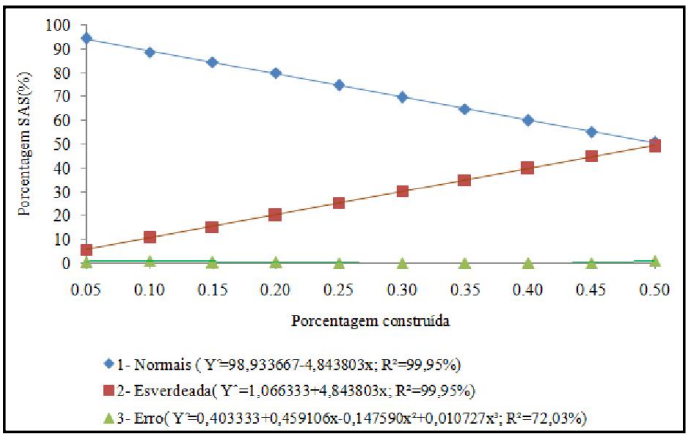

Figure 1. Percentage of normal seeds, green seeds and average error of SAS® equipment in relation to the constructed percentage of green seeds

Is important highlight too the precision of the obtained results in the calibration of the equipment, which was of 99, 73% of accuracy. In the efficiency evaluation of SAS® equipment was possible to achieve a level of accuracy of 99, 51% in the identification of green seeds in the analyzed samples. It can be observed that independently of the mixture level contained in the sample, the equipment was accurate in the evaluation of mixture of green soybean seeds (Table 1). According with datas of Table 1, it can be suggested that it is possible to use the SAS equipment in the detection of green soybean seeds, mainly when it is observed the level of accuracy obtained. In this way, it is possible with this technique to obtain higher percentage of accuracy in analysis, avoiding with this the unnecessary disposal of lots when compared to others techniques of detection less sensible, like visual inspection or even the density of seeds. Soybean seeds greenish with percentage above 9% affect the physiological potential of seeds (Padua *et al.,* 2007, Rangel *et al.,* 2011). According to this claim, it may be suggested that the results obtained from the analysis performed by SAS you can use this device to detect soybean green seed, especially when you look at the hit levels obtained (Table 1). Thus, with this technique we can obtain a higher percentage of accuracy of the analysis, thus avoiding unnecessary disposal of batches when compared to other less sensitive detection techniques such as visual inspection or even the density of seeds.

Venora *et al*. (2007) working with lentil, used a method of image analysis developed in Canada, where the image is captured by a table scanner. The authors used the equipment to measure the size, form and color of seeds and to differentiate five varieties of lentil. The authors observed that the method of image analysis, when compared to the visual inspection of grain, is faster, being the time spent for the digitalization and measurement less than a minute. Beyond this, highlight that the image analysis is a safe method, non-destructive and that presents high repeatability. One of the advantages verified by the authors in the choice of utilization of image analysis is because the speed in the obtainment of results (TEIXEIRA *et al*., 2006). Beyond this, cause to be a non-destructive technique, allows that when there is any imprecision or uncertainty in the evaluation, the same lot could be processed again to the verification of the results. Beyond the advantages observed in the present study, the SAS® is a practice equipment, which the green seeds used can be placed in the tray in a random form without a defined position, allowing with this, higher speed and optimization in the capture process and analyze of images obtained. This facility in obtaining a quick answer about the correct destiny of soybean seeds lots is an aspect very important which must be considered inside a program of intern quality control of a company producer of seeds, cause it is verified the optimization of the process when compared to other methods used. According the Table 2, was observed that the equipment SAS was efficient to detect green and yellow seeds. We observed according the Figure 1, that the percentage of normal seeds decreased insofar that there is an increase in the constructed percentage of green seeds. However, was observed an increase in the percentage of green seeds detected by SAS® with the addition of constructed percentage. According with these results, it realizes the efficiency of SAS® equipment in detect green seeds in different proportions when mixed with normal seeds. In relation to the error verified by the equipment, was verified that this was not proportional to the increase of constructed percentage of green seeds.

Conclusion

- Is possible to use SAS® for the evaluation of proportion of green seeds of soybean present in lots.
- The image analysis using SAS is a reliable technique, fast and objective that promotes a right level of accuracy of 99,51 in the separation of green seeds in samples of soybean.

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REFERENCES

Benor, S., Fuchs, J., Blattner, F. R. 2011. Genome size variation in *Corchorusolitorius* (Malvaceaes.I) and its correlation with elevation and phenotypic traits. *Revista Genome*, 54: 575-585.

Braccini, A.L., Motta, I.S., Scapim, C.A., Braccini, M.C.L., Ávila, M.R., Schuab, S.R.P. 2003. Semeadura da soja no período de safrinha:potencial fisiológico e sanidade das sementes. *Revista Brasileira de Sementes*, 25(1): 76-86.

Carvalho, M. L. M., Alves, R. A., Oliveira, L. M. 2010. Análise radiográfica em sementes de mamona (*Ricinuscommunis* L.). *Revista Brasileira de sementes*, 32(1): 170-175.

Costa, N.P., França-Neto, J.B., Pereira, J.E., Mesquita, C.M., Krzyzanowski, F.C., Henning, A. A. 2001. Efeito de sementes verdes na qualidade fisiológica de sementes de soja. *Revista Brasileira de Sementes*, 23(2): 102-107.

Dalen, G.V. 2004. Determination of the size distribution and percentage of broken kernels of rice using flatbed scanning and image analysis. *Food Research International*, 37(1): 51-58.

Ferreira, D. F. 2008. SISVAR: um programa para análises e ensino de estatística. *Revista Symposium*, 6: 36-41.

Flor, E. P. O., Cicero, S. M., França Neto, J. B.,Krzyzanowski, F. C. 2004. Avaliação de danos mecânicos em sementes de soja por meio da análise de imagens. Revista Brasileira de Sementes, 26(1): 68-76.

Forti, V. A., Cicero, S. M., Pinto, T. L. F. 2010.Avaliação da evolução de danos por "umidade" e redução do vigor em sementes de soja, cultivar TMG113-RR, durante o armazenamento, utilizando imagens de raios x e testes de potencial fisiológico. *Revista Brasileira de Sementes*, 32(3): 123-133.

Gomes Junior, F. G., Cicero, S. M. 2012.Análise de raios X para a avaliação de injúrias mecânicas em sementes de milho doce. *Revista Brasileira de Sementes*, 34(1): 78-85.

Granitto, P. M., Verdes, P. F., Ceccato, H.A. 2005. Large-scale investigation of weed seed identification by machine vision. *Computers and Electronics in Agriculture*, 47(1):15-24.

Jalink, H., Frandas, A., Van Der Schoor, R., Bino, J.B. 1998. Chlorophyll fluorescence of the testa of brassica oleracea seeds as an indicator of seed maturity and seed quality. Scientia Agricola, 55(número especial): 88-93.

Onyilagha, J. C., Elliott, B. H.; Buckner, E., Okiror, S.O., Raney, P. J. 2011.Seed Chlorophyll Influences Vigor in Oilseed Rape (*Brassica napus*L.var*AC Excel*.). *Journal of Agricultural Science*, 3(2): 73-79.

Pádua, G. P., França-Neto, J.B., Carvalho, M. L. M, Costa, O., Krzyzanowski, F. C., Costa, N. P. 2007. Nível de tolerância de sementes esverdeadas em lotes de sementes de soja após armazenamento. Revista Brasileira de Sementes, 29(3): 128-138.

Pardo, F. F., Binotti, F.F.S., Cardoso, E.D., Costa, E. 2015. Qualidade fisiológica de sementes de soja esverdeadas em diferentes tamanhos.Revista de Agricultura Neotropical, Cassilândia-MS, v. 2, n. 3, p. 39–43, jul./set.

Pinto, T. L. F., Vaz Mondo, V. H., Gomes-Júnior, F. G., Cicero, S. M. 2012. Análise de imagens na avaliação de danos mecânicos em sementes de soja. Pesquisa Agropecuária Tropical, 42(3): 310-316.

Rangel, M. A. S., AndréiaMinuzzi, A., LucianePìerezan, L., Teodósio, T. K. C., Ono, F. B.,Cardoso, P. C. 2011. Presença e qualidade de sementes esverdeadas de soja na região sul do Estado do Mato Grosso do Sul., Acta Scientiarum Agronomy, 33(1): 127-132.

Shahin, M.A., Symons, S. J., Poys, V. W. 2006. Determining Soya Bean Seed Size Uniformity with Image Analysis.Biosystems Engineering, 94(2): 191-198.

Teixeira, E. F., Cicero, S. M., DOURADO NETO, D. 2006. Análise de imagens digitais de plântulas para avaliação do vigor de sementes de milho. *Revista Brasileira de Sementes*, 28(2): 159-167.

Tourian, O. K., Padilha, F. R . R. 2008. Reconhecimento de variedades de soja por meio do processamento de imagens digitais usando redes neurais artificiais. *Engenharia Agrícola*, 28(4): 759-769.

Venora, G., Grillo, O., Ravalli, C., Cremonini, R. 2009. Identification of Italian landraces of bean (Phaseolus vulgaris L.) using an image analysis system. Scientia Horticulturae, 121(4): 410-418.

Venora, G., O. Grillo, O., Shahin, M.A., Symons, S.J. 2007. Identification of Sicilian landraces and Canadian cultivars of lentil using an image analysis system. *Food Research International*, 40(1): 161-166.

Zorato, M. F., Peske, S. T., Takeda, C., França Neto, J. B. 2007. Presença de sementes esverdeadas em soja e seus efeitos sobre seu potencial fisiológico. *RevistaBrasileira de Sementes*, 29(1): 11-19.

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