AGRICULTURA EM BASES AGROECOLÓGICAS E CONSERVACIONISTA

HIGO FORLAN AMARAL
KÁTIA REGINA FREITAS SCHWAN-ESTRADA
(ORGANIZADORES)

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APRESENTAÇÃO

A obra “Agricultura em Bases Agroecológicas e Conservacionista” tem foco e discussão principal sobre técnicas e práticas agrícolas consolidadas e em perspectiva para avanços consistentes na agroecologia e agricultura baseadas no conservacionismo.

O objetivo foi apresentar literatura para assuntos emergentes dentro da temática central da obra, sendo que do capítulo 1 ao 8 os leitores encontraram revisões de literatura sobre homeopatia, alimentação alternativa de animais e insetos, comunicação em agroecologia, novas tecnologias na era 4G, bioativação e remineralizadores de solo. Já do capítulo 9 ao 20 foram apresentados trabalhos e investigações aplicados dentro desses assuntos e outros complementares.

Participaram desta produção científica autores da Universidade Estadual de Maringá, Universidade Estadual do Oeste do Paraná, Universidade Federal do Mato Grosso e Universidade Federal do Paraná.

Os temas diversos discutidos neste material propuseram fundamentar o conhecimento de acadêmicos e profissionais das áreas de agroecologia e agricultura conservacionista e destinar um material que demonstre que essas vertentes agrícolas são consistentes e apresentam ciência de fato.

Deste modo, a obra “Agricultura em Bases Agroecológicas e Conservacionista” apresenta material bibliográfico relevantemente fundamentado nos resultados práticos obtidos pelos diversos pesquisadores, professores, acadêmicos e profissionais que arduamente desenvolveram seus trabalhos que aqui foram apresentados de maneira didática e valorosa para o leitor.

Higo Forlan Amaral
Kátia Regina Freitas Schwan-Estrada

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SUMÁRIO

CAPÍTULO 9

PHYSICAL AND PHYSIOLOGICAL QUALITY OF RICE (*Oryza sativa* L.) AND COMMON BEAN SEEDS (*Phaseolus vulgaris* L.) FROM LANDRACE POPULATIONS CULTIVATED IN TWO QUILOMBO VILLAGES, IN PARANA STATE, BRAZIL

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ABSTRACT: In Brazilian Quilombo Villages, many species of edible plants have been cultivated on small acreages where women-working forces have been applying rudimentary, cooperative and successful agro-ecological methods since long ago. There, we collected seed samples of landrace populations of rice (*Oryza sativa* L.) and common beans (*Phaseolus vulgaris* L.) to investigate the weight of one hundred seeds, moisture contents, seed formation, storage insects, and seedling emergence using washed river sand. The weight (SW100) of the rice hulls ranged from 2.45 to 3.26 gm and common bean grain ranged from 12.76 to 35.32 gm, and the moisture contents were about 10%. The mean percentage of emergence of the rice populations was below 60% and the common bean had values from 0 to 93%. We found the usual, negative and significant correlations of the percentage of normal seedlings with the non-germinated seeds.

1 I INTRODUCTION

In Brazil, agriculture villages have been established over time and space by African and Indigenous citizens to survive against the odds from slavery and land grabbing. Along centuries, the affected populations have been designing villages where smallholder agriculture has been applied by members who have been teaching rudimentary, cooperative and successful agriculture practices of food production to the next generations. Technical background about the biodiversity of plants and mammals as well as the physiological quality of agriculture inputs like seeds, for example, are still rudimentary, but edible plants have still been supplied to these ethnic citizens through cooperative handy-labour. Understanding the know-how behind such practices is imperative, but still difficult to achieve because of the scarce financial support, and the current social organization of the national society which did not allow yet consolidate profitable agriculture advancements. In the America Continents, Indigenous citizens in the last 10,000 (Moreno-Mayar 2018) and Africans in the last 500 years have been faced historical survival odds (Brasil, 2008; Castro, s/d; Pimenta and Gomes, 2016) despite both ethnic groups have somehow maintained their traditions, religion, and the faith in the future.

Currently, the census from 2017 does not have yet figures describing the state of the agriculture art in these villages. There has been an expectation to collect data in the census 2020 (IBGE, 2018), despite the produce quality will not yet be motive of investigation. Thus, the opportunity to collect information from these villages has been acquired major importance in agriculture colleges where scholars can help public policies for empowering and putting all of these citizens in the chain of edible food production. The objective of these exploratory data is to report the seed quality from rice and common bean landrace populations of plants stored in situ for sowing the agriculture lands in two villages of the Paraná State, Brazil.

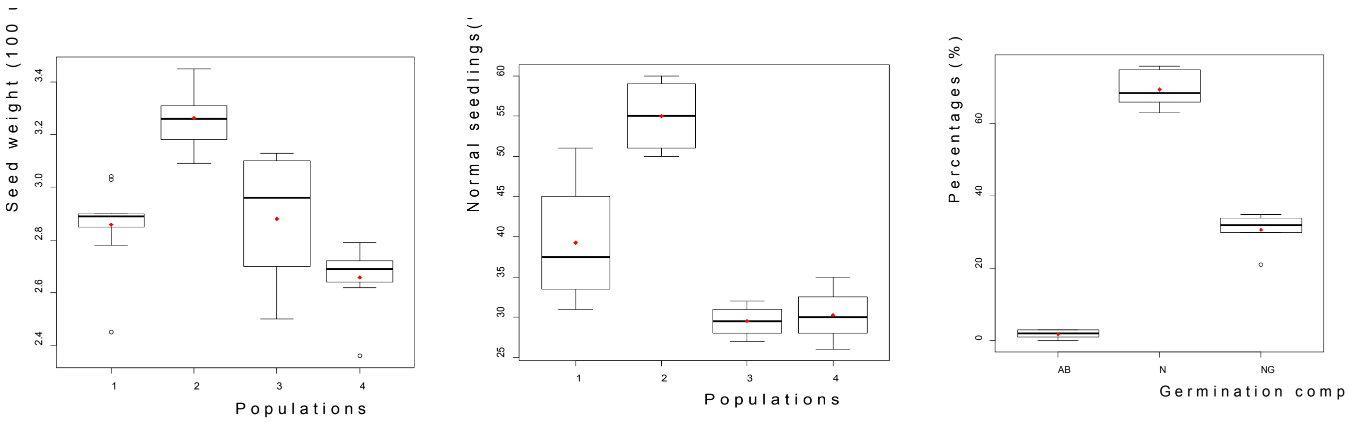
2 I MATERIAL AND METHODS

In February 2018, we collected four samples of rice and nine samples of common bean seeds of landrace plant populations which were stored in situ using dark glass recipients for further analysis in the Seed Science and Technology Laboratory, Iguatemi Research Station at 23° 21’ SL, 52° 04’ WL and 542 m of altitude, 20 km apart the University Central Campus at Maringá, Paraná State, in Brazil. The weather conditions in the Iguatemi Research Station is classified as Cfa where the temperature randomly ranged from 5 to 30 ˚C, and relative humidity from 53 to 100% from August 1st to September 30th, 2018 when we evaluated the emergence. We decided by non-destructive tests as the seed weight (8 replications of 100 seeds), seed sample purity, seed integrity, and seedling emergence using washed river sand because of the small quantity of seeds in the samples supplied by the oldest woman crop field manager. In contrast, the seed moisture contents were evaluated under temperature of 103 ˚C for 24 hrs when samples with one hundred dry seeds were weighted following the recommendation in the national Rules for Seed Testing (BRASIL, 2009). The percentage of normal and abnormal seedlings in the Figures 3a, 3b, and 3c, and the non-germinated seeds were the components of the emergence test. Four landrace populations of rice seeds and six populations of common bean germinated from eight replications of fifty seeds. Three populations of common beans had four, and one had only two replications of fifty seeds. The seed integrity of the rice caryopses were analyzed under stereo microscope looking for the presence of storage insects.

The preliminary results were analyzed by box-and-whiskers plots (Krzywinski and Altman, 2014; Spitzer, Wildenhain, Rappsilber and Tyers, 2014) based on Exploratory Data Analysis (EDA) to maximize our insight into data set, detect outliers, and highlight important variables for future studies (Waltenburg and McLauchlan, 2012). Next, we verified the effect size (Maher 2013) by the Pearson r correlation (https://www.statisticssolutions.com/statistical-analyses-effect-size/ Access in April 25, 2019) as well as to communicate the results to the rural community. In many fields, the effect size has been a good practice for empirical research findings. In scales (Cohen, 1988 and 1992; Akbaryan, 2013; Maher et al. 2013), small r = 0.1, medium r = 0.3, and large r = 0.5 and very large = 0.70, and the possible range is +1 to -1. These estimates provide a description of the size of the observed effects independently of misleading influences from the sample size (Fritz, 2012). The components of seedling emergence tests were photographed to report the possible causes of the morphological abnormalities. The box-and-whiskers plot and the correlation coefficient were calculated by the Action 2.9 Software, free for download. In April 27th, 2019 these results were introduced to the members of the villages for appreciation as part of the dissertation from the first author, Ms Rosiany Maria da Silva. Moreover, at same date, a sample of rice seeds was collected again, but based on the introduced results and analyzed for seed purity, seed germination and seedling emergence for data validation.

3 I RESULTS AND DISCUSSION

The one hundred seed weight (g) of the rice seeds had different responses from the four landrace populations. The populations 1 and 4 had the lowest estimates range. We found two outliers in the population 1 and one outlier in the 4, and all of the four responses were right-skewed. The seed population 2 had similar mean and median and the number 3 had large box with small number of right-skewed data (Figure 1a). The percentage of normal seedlings (Figure 1b) had data left-skewed (population 1), normal data (population 2), and large boxes accounting for 50% of the replications in both cases. In contrast, the populations 3 and 4 had the lowest percentage of normal seedlings but they had small boxes. These values below 60% were lower than reported in the literature (Marques et al. 2018), but the causes still require further investigation. One reason for these responses may be explained by the presence of empty and semi-developed hulls (r = - 0.95; P ≤ 0.01) because the local produce storage system had not graded the rice seeds, yet. The validation test indicated the percentage of seed purity for landrace rice seeds of 99.87% with components of the seed germination 85.25% of normal seedlings, 11.75% of abnormal seedlings, and 3% of non-germinated seeds under temperature of 30°C in the seed germinator. Under washed sand in the controlled temperature of 30°C, the percentage of normal seedlings corroborated the initial values (Figure 1b and 1c) but suggesting non-vigorous seeds available for rice crops. These values were similar to the population 2 (Figure 1b).



a **b** **c**

Figure 1: **a**) Box-and-whiskers plots indicating the weight of one hundred seeds (g) and **b**) percentage of normal seedlings emergence (%) by using washed river sand from four populations of landrace rice seeds, and **c**) validation test using washed river sand where N = normal seedlings, AB = abnormal seedlings and NG = non-germinated seeds. The validation test was carried out under controlled temperature of 30°C.

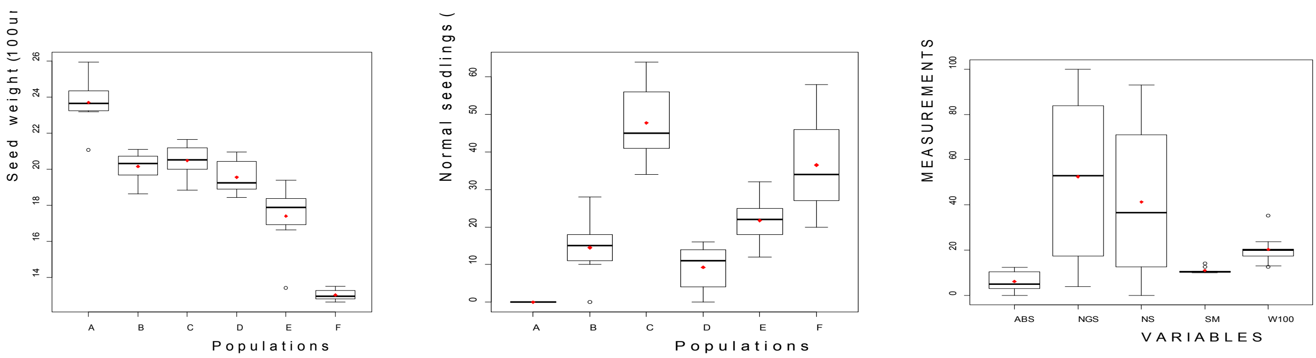
The r test (r = - 0.92) significantly correlated the weight of 100 seeds with non-germinated seeds (P ≤ 0.10) and suggests the presence of damaged hulls in the rice samples (Figure 4c). In the Table 1, negative and significant effect (r = - 0.99, P ≤ 0.01) was found correlating normal seedlings with non-germinated seeds because the correlation with the percentages of abnormal seedlings were non-significant (P > 0.10). The weight of 100 seeds corroborated the percentage of normal seedlings (P ≤ 0.01). The weakness effect (r = - 0.05) of the seed moisture on the percentage of normal seedlings was non-significant (P > 0.10).

	Seed weight	Seed moisture	Seed samples purity	Storage insects	Empty or malformation hulls	Normal seedlings	Abnormal seedlings	Non-germinated seeds
Seed weight	1							
Moisture contents	0.91 *	1						
Seed samples purity	0.43 ^{NS}	0.60	1					
Storage insects	0.91*	0.99 ***	0.59 ^{NS}	1				
Empty or malformation hulls	-0.41 ^{NS}	-0.47 ^{NS}	-0.95 **	-0.46 ^{NS}	1			
Normal seedlings	0.90 *	0.68 ^{NS}	0.43 ^{NS}	0.68 ^{NS}	0.54 ^{NS}	1		
Abnormal seedlings	- 0.36 NS	-0.05 ^{NS}	0.47 ^{NS}	0.04 ^{NS}	-0.26 ^{NS}	0.56 ^{NS}	1	
Non-germinated seeds	- 0.92 *	-0.74 ^{NS}	-0.43 ^{NS}	-0.75 ^{NS}	0.61 ^{NS}	- 0.99 ***	0.45 ^{NS}	1

Table 1. Pearson matrix of the weight of one hundred seeds, seed moisture, seed sample purity, and components of the emergence test of rice seedlings by using washed river sand in glasshouse conditions.

*Significant at P ≤ 0.10, **Significant at P ≤ 0.05, ***Significant at P ≤ 0.01, and ^{NS}Non-significant correlations.

The explanation for the above results may be accounted to the moisture contents around 10% (Popinigis, 1977) for many of the populations. We saw some brown hulls suggesting fermentation during the management of the rice seed population, seedborne diseases (*Pyricularia oryzae*) or genetic contamination, but this fact must be motive of further investigation. One possibility to explain of the average emergency figures can be the presence of *Sitophylus oryzae* L. (Figure 4c; Table 1)



a b c

Figure 2. Box-and-whiskers plots from data of one hundred seed weight (a), components of the emergence test in percentage (b - normal seedlings (NS)), abnormal seedlings (ABS) and (c - non-germinated seeds (NGS), and seed moisture (SM)) by using washed river sand conditions of traditional common bean seeds.

Next, the seed weight of 100 seeds of common beans for landrace populations nominated from **A** to **F** had small variation, but ranged from heavy seeds as we can see in the population **A** to light seeds in the **F** (Figure 2a). The physical aspect of the samples of common bean suggests rudimentary cleaning of the seeds using handy round screen. The mixture of different genotypes in every population may also explain these results, but this fact must be investigated by DNA methods. The percentage of emerged normal seedlings using washed river sand ranged from 0 to 93% when the box-and-whiskers plots had three many population with small quantity of seeds (only two hundred seeds were evaluated in the landrace population **I** (Figure 2c)) where **A** was 0 and **C** and **F** had the boxes large than **B**, **D**, and **E** that obeyed the normal distribution unlike the right-skewed as the landrace populations **B** and **C**. The only significant effect ($P \leq 0.01$) was the correlation of normal seedlings with non-germinated seeds ($r = -0.99$). The explanation for the reduced mean figures of normal seedlings was the presence of non-germinated seeds (Figure 2c) but the effect of the medium value ($r = 0.27$) was not significant ($P > 0.05$). Similar discrepancies in the emergence of common beans populations under sand conditions were reported in the literature (Lopes et al., 2017).

	Seed weight	Seed moisture	Normal seedlings	Abnormal seedlings	Non-germinated seeds
Seed weight	1				
Seed moisture	0.06^{NS}	1			
Normal seedlings	0.09^{NS}	-0.28^{NS}	1		
Abnormal seedlings	-0.25^{NS}	0.17^{NS}	0.27^{NS}	1	
Non-germinated seeds	-0.06^{NS}	0.24^{NS}	-0.99^{**}	0.38^{NS}	1

Table 2. Pearson coefficients of correlation for seed weight of one hundred seeds, seed moisture, and the components of emergence test for common bean seedlings by using washed river sand conditions.

*Significant at $P \leq 0.05$, **Significant at $P \leq 0.01$ and ^{NS} Non-Significant correlations.

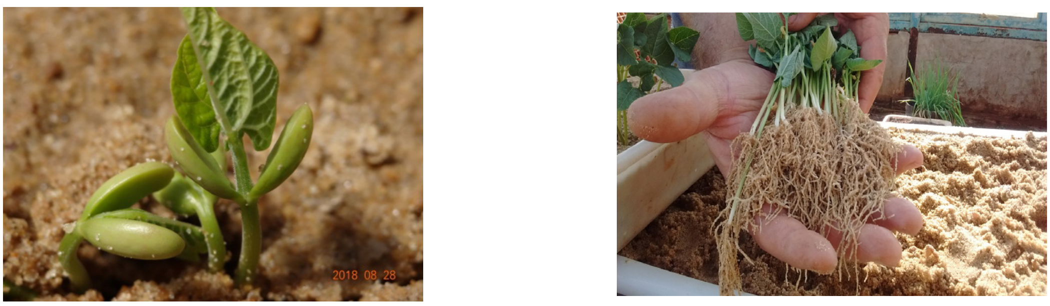
From the harvesting to the qualitative analysis there was no insect attack to the samples. The level of seed moisture may explain the absence of post-harvesting insects because of the impermeable storage glass bottle. This fact could be attributed to the seed drying to safe levels of seed moisture before the storage. We also verified similar absence of insects in the usual plastic bottle storage. Otherwise, the same Figures 3a, 3b, and 3c suggest the presence of mechanical damage likely produced by grainfails during handy fruit threshing. In the Figure 3a, the second and third seedlings at left did not develop the cotyledonary leaves. Fissure in the seedling hook (Figure 3c) is the common seed damage by mechanical threshing tools. Mechanical damages have no effect on edible grain but it is deadly on seed viability.

The alternative mechanism to avoid mechanical damage in small holder agriculture is to avoid grainfails and adapt a domestic horizontal plucking cylinder with the peeling rubbers attached to the outside.

a **b** **c**

Figure 3 – Characteristics of abnormal seedlings of traditional common beans during the emergence under washed river sand conditions; **a**) no-cotyledon pairs, **b**) damaged hook and **c**) hook fissure.

a **b** **c**



d **e**

Figure 4 – Normal seedlings of the landrace cultivar of rice seeds (Figures **a** and **b**); hulls perforation by rice weevil (*Sitophylus oryzae* L.) (Figure **c**); normal seedlings of common beans and the radicular system of the normal seedlings (Figure **d** and **e**)

We found significant effect ($r = -0.99$, $P \leq 0.01$) correlating normal seedlings with the non-germinated seeds; in contrast, the other effects evaluated had estimates lower than values recommended in the literature (Cohen 1988, 1989). The colyledonary leaves, the cotyledons, and the radicular systems (Figures 4**d** and 4**e**) indicate the phenology of the normal seedlings of common beans emerging from washed river sand. Emergence of seedlings from washed river sand is a safety method for reproducing the recommended method in the Rules of Seed Testing (Brazil, 2009) under condition of smallholder agriculture. They must be carried out soon after the seed harvesting and next before the seed sowing. This recommendation allows plant growers to make safe decisions about the seed sowing under field conditions. One test still required in such scope is the Topographic Tetrazolium Test available in the Rules for Seed Testing (Brasil, 2009). Researchers may investigate in depth the additional causes of poor figures from the current analyses because of many aphid insects under field conditions, rain water damages, and high temperature during seed drying. Poor seed samples is usual when we make the decision to collected samples from smallholder agriculture in locus. In the current case, the results were a further step to understand the background of the smallholder agriculture.

Finally, the most important achievement was the massive audience of smallholder farmers in the class room where these results were introduced. There was strong interaction with the presenter and with the agro-ecology team working in the Paraná State University of Maringá. There, we verify the feedback to the villagers about these easy techniques suitable to ameliorate their agriculture system of seed management for better grain harvesting.

4 I CONCLUSIONS

Agriculture system for cropping traditional landrace rice and common bean seeds by the smallholder agriculture in rural villages confirm the significant potential to support the livelihood in the Quilombos as they have did it for centuries. The qualitative characteristics of the plant population will depend only of cost-effective decisions suitable to improve the profits of all the families. Mechanical damages and the lack of seed cleaning and grading are the main constraints to overcome the qualitative levels found for both seed plant inputs. Normal seedling emergence by using washed river sand is an easy method to reproduce under village conditions the similar results from the laboratories.

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