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THE ROLES OF ORGANIC EXUDATES ON THE ELECTRICAL CONDUCTIVITY OF SEEDS SOAKING WATER IN THE VIABILITY TEST OF CORN SEEDS (*Zea mays* L.)

(Peranan Eksudat Organik terhadap Daya Hantar Listrik Air Rendaman Benih dalam Rangka Uji Viabilitas Benih Jagung (*Zea mays* L.)

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Didik Indradewa

Ringkasan

Suatu penelitian dengan percobaan telah dilakukan untuk mengetahui peranan eksudat organik (gula, protein dan lemak) yang terkandung dalam air rendaman benih jagung terhadap daya hantar listriknya dan hubungannya dengan daya tumbuh benih tersebut.

Percobaan satu faktor ini menggunakan rancangan acak lengkap dengan tiga kali ulangan. Perlakuan adalah periode penyimpangan yakni kontrol (0 bulan), satu, dua, tiga, empat dan lima bulan. Benih jagung setelah disortasi, disimpan dalam kantong plastik tertutup dengan kadar air awal benih 13%.

Pengamatan dilakukan sejak mulai benih disimpan dan pengamatan berikutnya dengan interval satu bulan. Yang diamati adalah daya tumbuh benih, kecepatan respirasi benih; daya hantar listrik, kadar gula, protein dan lemak pada air rendaman benih.

Hasil-hasil pengamatan menunjukkan bahwa daya tumbuh benih menurun cepat setelah dua bulan disimpan, sementara kecepatan respirasi benih meningkat sejalan dengan meningkatnya deteriorasi benih. Kecepatan respirasi mencapai puncak setelah tiga bulan kemudian menurun tajam, karena benih mulai mati dan mencapai titik nol setelah lima bulan, di mana semua benih mati. Kandungan eksudat air rendaman meningkat dengan meningkatnya deteriorasi benih, mengakibatkan meningkatnya daya hantar listrik. Analisis hasil pengamatan menunjukkan adanya korelasi yang tinggi antara kandungan gula, protein dan lemak dalam air rendaman benih terhadap daya hantar listriknya berturut-turut: 0,891; 0,917 dan 0,826.

Abstract

An experiment was carried out to study the roles of organic exudates (sugars, protein and fats present in seeds soaking water toward the electrical conductivity and the relationship with the germination capacity of the seeds.

A completely Randomized Design was used in this experiment, consisting of one factor, i.e. storage periods withs six levels: 0 month (as control), one, two, three, four and five month for the experiment.

Observations were done starting from control (0 month), followed by the subsequent observations with one month interval. There were six parameters observed: germination capacity, rate of respiration, sugars, protein, and fat content and electrical conductivity of water soaking seeds. After storage the seeds were soaked for 24 hours with distilled water (1: 3 v/v).

Result showed that, seeds with the initial moisture content of 13%, began to lost their germination capacity after two month storage period. Respiration increased due to the deterioration of the seeds, reached the peak after three month storage and then sharply decreased because some seeds were dead. No respiration was found after five month storage when all seeds were dead. The electrical conductivity increased with the course of seed deterioration during the three month storage and continued to the end of observation.

Analysys on seeds soaking water showed that sugar, protein and fat content increased with the course of time for storage, causing the higher electrical conducitivity. Highly positive correlation were observed between electrical conductivity and sugar, protein, or fat and their values were 0.891; 0.917 and 0.826 respectively.

Introduction

Seed deterioration start right after the seeds achieved their physiological maturity and this is inevitable until the death of the seeds (Delouche, 1983). What someone can do is just slowering the rate of deterioration. Seed deterioration means the gradual decrease in quality of the seed i.e. germination capacity, seedling vigor, storability, seed weight, seed performances, seed health and the percent of normal seedlings. The major factors that affects the longevity of seeds during storage (including the condition of the seeds when they were still at the field) were particularly temperature and relative humidity.

There are some methods for testing the viability of seeds in laboratory. The common method is by testing the seed germination which require about 14 days for requires skilled and experienced technicians. The methods mentioned above are too long and too difficult to be practised in seed trade which needs the easier, faster and simple method, without sacrificing the accuration of the test.

Facing this situation, Waller *cit*. Copeland (1976) found that dead and alive seeds showed different electical conductivity, and this can be measured by the use of galvanometer (Copeland, 1976). Based on the above finding (Fick and Hubbard, *cit*. Copeland, 1976) the proposed experiment was conducted.

The seed deterioration can be regarded as the manipulation of genetic deterioration (chromosome aberation, deletion) physiological deterioration (enzymes-inactivation, denaturation, dead), biotechnical deterioration (membrane disintegration, higher permeability or lost of their semi permeability), the rupture of seed coat and the other damages due to the attack by microorganism and others.

The membrane disintegration and the increase of membrane permeability causing the leaching of materials from the seeds commonly known as exudates i.e. sugars, proteins, fats, and inorganic exudates (Hibbard and Miller *cit*. Kozlowski, 1972). The kind of exudates leached depends on the chemical compositions of the seeds. In term of corn seeds, the compositions are carbohydrates 51.75% (starch 50.71 %, sugar 1-4%, proteins about 10% and fats about 5.00% (Mayer and Mayber, *cit*. Sadjad, 1975).

This experiment was carried out to study the roles of organic exudates on the electrical conductivity of seeds soaking water of corn seeds and its relationship with the germination capacity of the seeds.

Material and Methods

The experiment was done at the Laboratory of Seed Technology, Crop Science, and Soil Science, Faculty of Agriculture, Gadjah Mada University, Yogyakarta. The certified corn seeds were obatined from Pusat Pengembangan Pertanian Unit Palawija, Soropadan, Jawa Tengah. Seeds with moisture content of 13 percent, free from pests, were put in sealed plastic bags 1.0 kg for each storage treatments.

A Completely Randomized Design was employed in this experiment consisted of one factor storage period with six levels; 0 month (as control), one months, two month, three month, four month and five months storage periods for each storage treatments.

Observations were done on: germination capacity, rate of respiration; sugar, protein and fat contents and electrical conductivity of leachate water. The preparation of leachate water was done by soaking the seeds in distillated water at the proportions of one part of seeds and three parts of distillated water measured by volumes. Oberservation were done at the end of every storage period and at the start of storage for the control treatment.

Data collected were statistically analysed and tested by Duncan's New Multiple Range Test (5%). Correlation and regression analysis are also presented.

Result and Discussion

Observations were done on germination capacity, rate of respiration; sugar content, protein content and fat content and electrical conductivity of leachate water are presented on the Table 1.

It was shown that the electrical conductivity of seeds soaking water steadily increase with the longer storage period, whereas the germination capacity decreased with the longer storage period. The initial moisture content of corn seeds (13%) was too high to store for more than two months. It was shown that after two months, most

Table 1. The electrical conductivity, germination capacity, rate of respiration, sugars, protein and fat contents of corn seeds as affected by storage periods

Observations	Storage Periods (Mo)					
	0	1	2	3	4	6
1. Elec. Conductivity (mS/cm^3)	1.13 f	1.47 c	1.75 d	3.13 c	7.20 b	7.60 a
2. Germination capacity (&)	97 a	97 a	84.5 b	27.5 c	2.0 d	0 d
3. Rate of respiration ($m/CO_2/g/weeks$)	0.29 c	0.82 c	1.04 b	2.19 a	1.09 b	0 c
4. Sugar content (%) of seeds soaking water	0.000 c	0.000 c	0.000 c	0.000 c	0.010 b	0.024 a
5. Protein content (%) of seeds soaking water	0.007 c	0.010 d	0.012 d	0.017 c	0.035 b	0.049 a
6. Fat content (%) of seeds soaking water	0.001 d	0.008	0.009 c	0.010 c	0.034 b	0.050 a

Note : Mean values in the same rows, followed by common letters are not significantly different at 5% level.

seeds were deteriorated sharply due to faster respiration, which attained its peak after three months, most seeds were damaged but were still viable. After that period the rate of respiration declinces sharply due to the death of seeds (Fig. 1). Seeds deterioration was also manifested by the presence of leachates due to the disintegration and disruption of cell membranes. This could be the higher sugars, protein and fat content in leachate water with the longer storage period.

From the measurement on electrical conductivity of the seeds soaking water showed that higher values were found with the longer storage period. Regression and correlation analysis between electrical conductivity and sugars content, protein content, and fat content in leachate water were done. The results were as follows.

EC vs Sugars $Y = 10.003 + 0.621 \ln x$;
$r = 0.891$ (Fig.2)

EC vs protein $Y = 19.358 + 3.835 \ln x$;
$r = 0.977$ (Fig.3)

EC vs Fat $Y = 10.986 + 1.561 \ln x$;
$r = 0.826$ (Fig.4)

The regression and correlation analysys between germination capacity and electrical conductivity of seeds soaking water gave the regression curve of $Y = 6.823\ e^{-0.01}\ x$ and $r = 0.976$ (Fig.5). It was calculated that the two parameters had a high degree of correlation. It was clear that the longer storage period resulted in seed deterioration, which could be detected by the increase in rate of respiration, the decrease in germination capacity, the increase of leachates (sugars, protein, and fat) concentration and resulting the increase in electrical conductivity.

Conclusion

It could be concluded that :

1. Exudates content (sugar, protein and fat) in seeds soaking water increase with the longer storage period, resulting in the higher electrical conductivity.
2. A significant negative correlation was observed between germination capacity of seeds and the electrical conductivity due to the organic exudates.
3. The degree of seed deterioration could be detected by the decrease of germination capacity, the changing of seed respiration rate or by the increase of organic exudates content in seeds soaking water and it electrical conductivity.

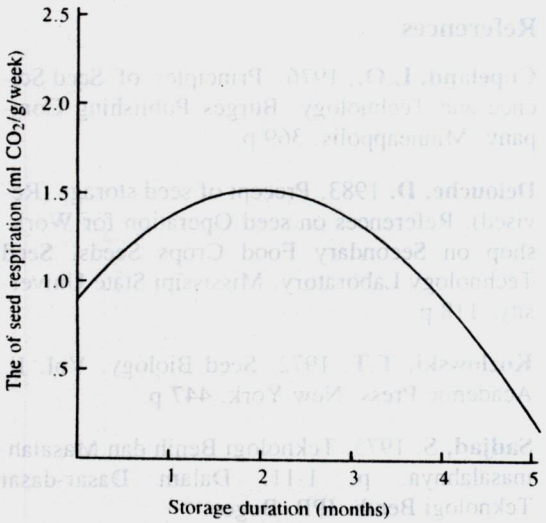

Fig. 1. The relationship between storage duration and the rate of seed respiration.

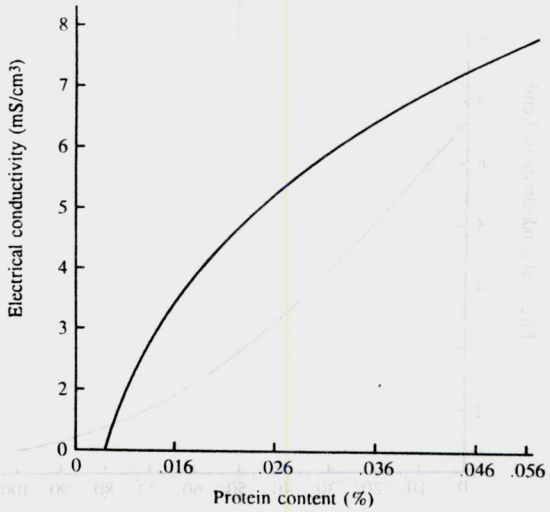

Fig. 3. The relationship bertween protein content and electrical conductivity.

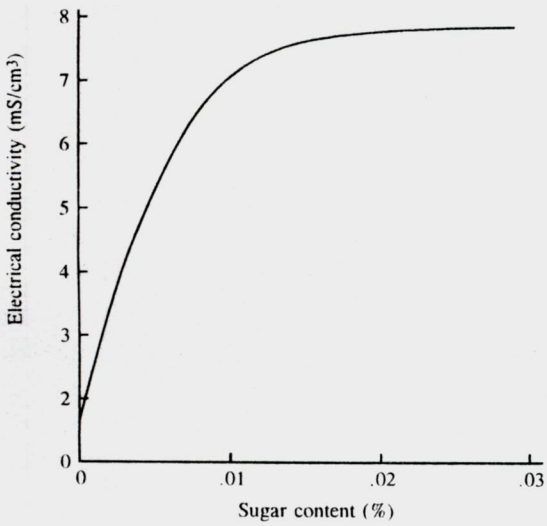

Fig. 2. The relationship bertween sugar content and electrical conductivity.

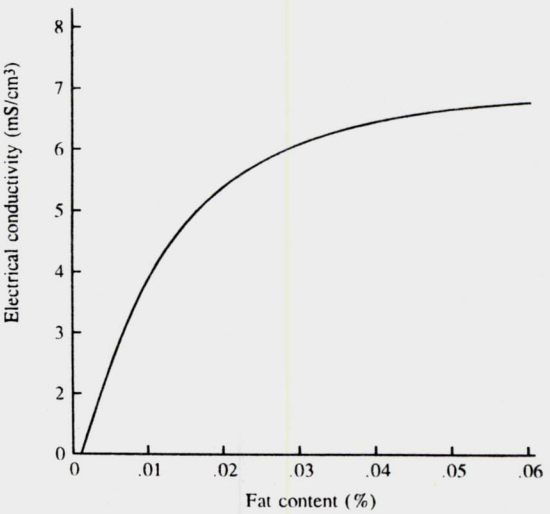

Fig. 4. The relationship bertween fat content and electrical conductivity.

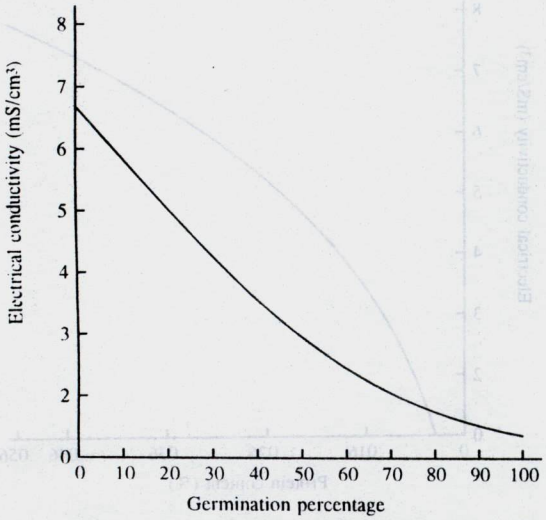

Fig. 5. The relationship bertween germination and electrical conductivity.

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