Hormonal Effect of EM on Citrus Germination

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Abstract

The energy supply of seeds decreases during germination, exposing seedlings to pathogen attack. The survival probability increases if the period of germination is reduced. The potential of seedling survival is called vigor, which is measured by emergence speed and is used to estimate the potential of success in the field. Knowing that effective microorganisms (EM) have hormonal action as gibberellic acid, the emergence speed was evaluated in tangerine cv. Cleopatra treated with metalaxyl (1.05 g. a.i./kg of seeds) as control, in comparison to EM 0.1 % v/v per 30 minutes and weekly spray 0.05 % v/v. A sterilized substract and non-contaminated water were used in the whole experiment with 108 replications and 13,824 seedlings per treatment. The emergence speed of the EM treatment was superior to the control and the percentages of vigor increase were 810 %, 944 %, 646% and 552% at 20, 21, 22 and 23 days, respectively. The hormonal effect of EM was superior during the initial 4 days of emergence. The effect of vigor increase on seedling growth was evaluated on the 40^{th} day of seeding and showed statistically ($p \leq 0.01$) that EM produced larger plants than the control.

Introduction

During seed germination, the embryo act as an heteroptrophic organism consuming the cotyledon nutrients. The seed energy decreases rapidly and may reach a very low level exposing the seedlings to pathogens.

This situation is only reverted after seedling emergence and the onset of leaf photosynthesis. As the stem tissue differentiates forming pericycle and cortex, the seedling becomes resistant to damping off and root rot pathogens. This transformation is proportional to energy accumulation in the seedling. In this dynamic process the probability of seedling survival increases if the time spent in the heterotrophic and transition period is reduced to a minimum.

Therefore, the potential of seedling survival, which is called vigor, is one of the basic seed qualities. The seed vigor can be evaluated by the emergence speed which is used to measure the potential of the plant survival during germination under field conditions.

According to Perry (1987) “Vigor is a physiological characteristic determined by genotype and modified by the environment which controls the seed capacity of growing into seedling and the limit of stress toleration of environmental factors. The influence of seed vigor can persist through the plant life and affects the productivity”. Since the effect of vigor extends to the plant’s whole life, it will affect productivity.

In the citrus culture the effect of seed vigor, as in cereals, changes the seedling emergence speed and exposure time to the attack of damping off and root rot. The probability of survival under adverse conditions during the heterotrophic period of germination increases with more vigor and higher emergence speed Figure 1, Tokeshi (1992).

According to Harakawa and Higa (1989), Sangakkara and Attanayake (1993), Siqueira et al (1993) and Chiwachinda et al. (1995), Higa (1996), effective microorganisms (EM) have hormonal effects similar to the gibberelic acid. In an attempt to improve the vigor and emergence speed of citrus seedlings, we tested the EM as an accelerator of emergence and as a protector against damping off and root rot during germination.

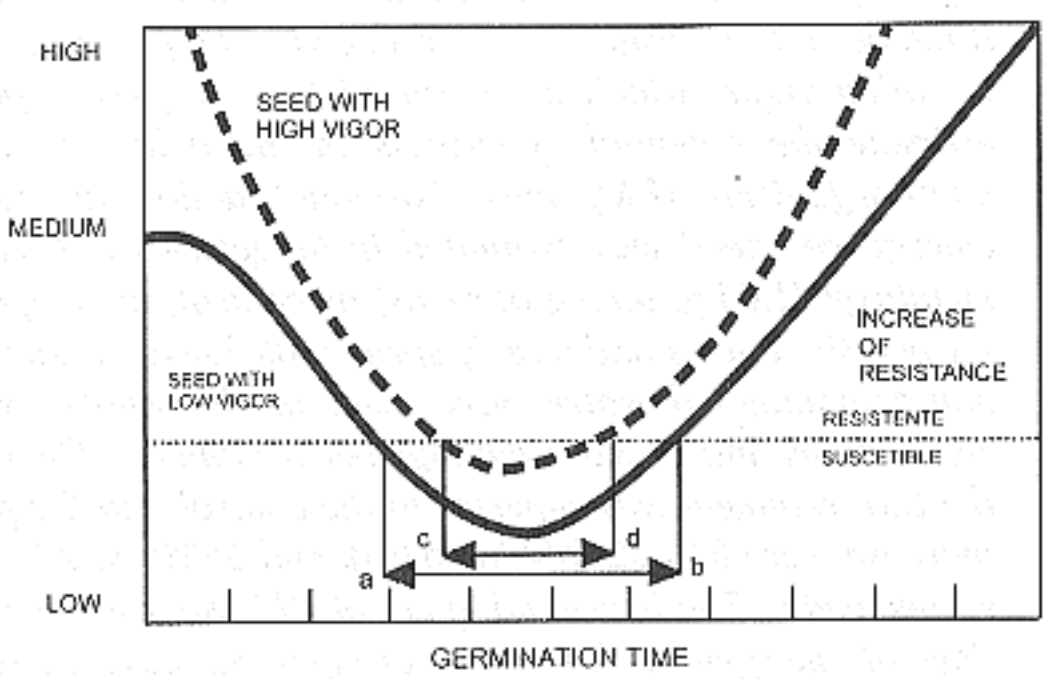

Fig 1. Effect of seed vigor in germination and disease

Materials and Methods

Seeds of Cleopatra tangerine were divided into 2 equal parts. In the control treatment seeds were treated with metalaxyl 1.05 gr. ai. per kilogram of seed (Apron Ciba Geigy 3g/kg/seeds). The growers consider this treatment the best method to protect seed during germination. The other half was treated with effective microorganisms (EM) 0.1% v/v for thirty minutes, shade dried and sowed the next day, (Harakawa and Higa 1989, Sangakkara and Attanayake 1993, Siqueira et al 1993), and sprayed with EM 0.5% v/v twice a week and cover fertilized every other week with Bokashi (organic fertilizer with EM, 200 g m^{-2}, Higa (1993). Germination was done in substract of Plantimax PXC from Eucatex Co., in trays with 128 cells measuring 3.5 x 3.5 x 12cm. Two or three seeds were planted per cell and kept under greenhouse conditions with two irrigation per day with potable water from a semi artesian well.

The basic objective of the vigor test (emergence speed) was the identification of possible differences in physiological qualities of seeds that had initially the same vigor and germination power according to Popinigis (1977), Marcos et al. (1987). If the treatment increases the emergence speed, it indicates hormonal effect of EM in the seed.

The evaluation of vigor through emergence speed was done using the equation, described by Popinigis (1977) and Marcos et al (1987) in 108 plots for each treatment.

Vigor = Emergence speed = Number of germinated seeds ÷ Days from sowing

The growth was evaluated in 12 replications (trays with 128 cells) per treatment 40 days sowing using the scale of grades from 1 to 5 (Figure 2.). The most developed plant was chosen ignoring polyembryony and other germinated seeds.

The data analysis of growth were submitted to statistical analysis using the completely randomized plot with 2 treatments and 12 replications (Zonta and Machado, 1992).

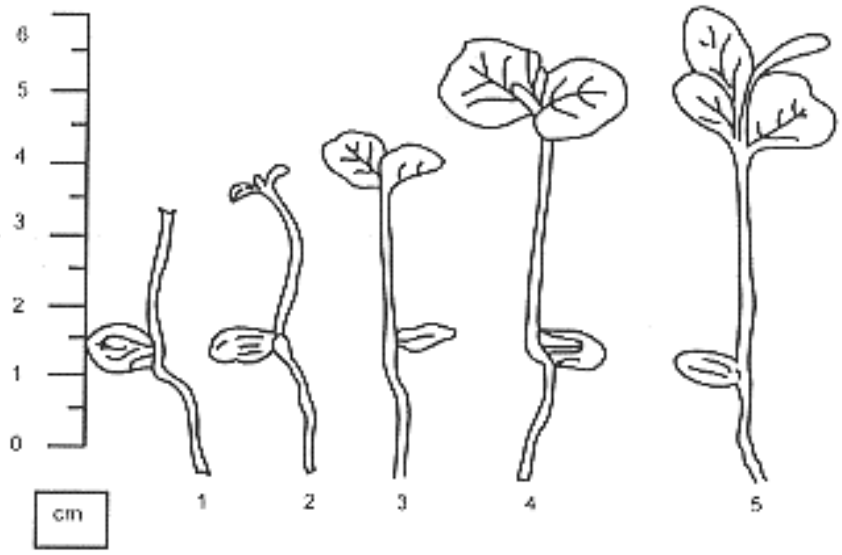

Fig. 2 Grade of seedling growth

Results

The experiment did not show the presence of pathogens interfering in the experimental results and the data of emergence speed were collected in 5 periods (20 to 26 days) after the beginning of emergence (Table 1). Simultaneously with the emergence speed, the percentages of emergence increase were calculated in the EM treatment and the results are shown in Table 1. When the EM treatment reached almost the total emergence the growth of the plants was evaluated using the scale of grades shown in Figure 2 and the total of grades per tray was statistically analysed and compared using Tukey test (Table 2). The means comparison was significant ($p \leq 0.01$) indicating difference between the treatments with coefficient of variation of 6.28 per cent showing excellent experimental conditions.

Table 1. Germination, vigor and percentage of vigor increase in tangerine seeds treated with effective microorganisms (EM) and control.

Days After sowing	EM		Control		Percentage of Increase B/a
	Number of plants A	Speed of emergence	Number of plants B	Speed of emergence	
20	81	4.05	10	0.5	810
21	246	11.71	26	1.24	944
22	536	24.36	83	3.77	646
23	1121	48.64	203	8.83	552
26	4385	168.65	1600	61.54	274

Evaluation of 108 replications and plots with 128 plants

Emergence speed = Number of germinated seeds ÷ Days from sowing

Table 2. Average of total grades and plants per treatment with effective microorganisms (EM) and control in 12 replications.

Replications	Total of grade	
	EM	Control
1	504	412
2	481	364
3	516	352
4	521	295
5	466	325
6	500	357
7	505	398
8	511	351
9	484	403
10	491	347
11	507	369
12	481	398
Averages	497.25 a	364.25 b
Averages per plant	3.88 a	2.84 b

Averages with different letters differ statistically ($p \leq 0.01$)
Plots with 128 cells, M.S.D. = 31.18; C.V.= 6.28 %

Discussion

The EM hormonal effect was detected by the increased vigor measured by the emergence speed and better seedling growth in the heterotrophic and intermediary period. As shown in Table 1, the highest percentage of the increase in emergence speed occurred at 20 and 21 days after sowing, indicating that the hormonal effect was more effective in the beginning of the germination process, as usual for gibberelic acid in seeds.

In Table 2, we verify that after 40 days from sowing the EM treatment showed superior size to the control by Tukey test ($p \leq 0.01$). Coefficient variation 6.28 per cent indicates good experimental accuracy under field conditions.

According to Chiwachinda et al (1995) the EM has similar compounds to para-gibberelic acid in the concentration of 44.96 mg per gram of dried product. The authors Harakawa and Higa (1989) and Sangakkara and Attanayake (1993) described the possible hormonal effect accelerating the germination of weeds and rice under field conditions, where the occurrence of diseases did not allow to detect the isolated hormonal effect of EM in the vigor and growth of plants.

In the present experiment we used the partially synthetic substratum, pasteurized and irrigated with potable water allowing to isolate the hormonal effect from root rot diseases. Similar results were obtained by Siqueira et al (1993). The effect of seed treatment with metalaxyl probably did not act in the system since the fungicide residual effect remains from 7 to 10 days and the plant emergence occurred only 20 days after sowing. Twice a day irrigation accelerated the washing off of the fungicide of the control treatment. The health of roots and stems indicates absence of pathogen interference in the experiment, reinforcing the hypothesis of hormonal effect of EM increasing emergence speed and growth of seedlings.

Conclusions

From the results and discussion the following conclusions were obtained.

- The EM presents similar effect of gibberelic acid enhancing the emergence and vigor of seeds;
- The probability of seedling survival increases with EM seed treatment;
- The growth and survival of citric seedling treated with EM were superior to the control (conventional system).

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