Scientific Papers. Series B, Horticulture. Vol. LXVIII, No. 2, 2024
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

STUDY ON THE EFFECTIVENESS OF SOME INSECTO-FUNGICIDE COMBINATIONS IN THE CONTROL OF PATHOGENS AND PESTS IN SWEET POTATO CROP IN THE FIELD

Gheorghe COTEȚ, Aurelia DIACONU, Alina PARASCHIV, Cristina BÎRSOGHE, Ștefan NANU[1], Maria BĂJENARU

Research Development Station for Plant Culture on Sands Dăbuleni,
217 Petre Baniță Street, Călărași, Dolj, Romania

Corresponding author email: nanu.st@scdcpndabuleni.ro

Abstract

In the conditions of the sandy soils of Dăbuleni, in the period 2020-2022, the aim was to identify some combinations of active substances, to test their effect in preventing and combating pathogens and pests reported during the vegetation period in the sweet potato crop, but also to establish the effectiveness of the application of these products. The best control over the attack of the harmful organisms taken in the study was ensured by the variants in which the Cabrio top and Ortiva 250 SC fungicides were applied in complex with the Mospilan 20 SG insecticides. The combinations of products used in the experimental variants had different effectiveness in terms of the control of harmful organisms that appeared during the vegetation period in the sweet potato crop, depending on the year of the study. Thus, in the variants in which the Ortiva 250 SC product was used in combination, the effectiveness in combating the pathogen Alternaria spp. had values between 82.0% and 89.5%, and in combating the pathogen Botrytis cinerea the effectiveness was between 74.7% and 88.0%.

Key words*: sweet potato, treatment, fungal diseases, effectiveness, pest control.*

INTRODUCTION

Climatic changes in the last decade, manifested by increased air temperature, drought or excessive precipitation, have led to changes in the frequency and virulence of the attack of harmful organisms on different plant species, including sweet potato. In this sense, different combinations of insect-fungicide products have been tested in order to combat diseases and pests. Recent research has highlighted the results obtained in the sweet potato in combating *Alternaria* spp. pathogens by using the mixture of azoxystrobin-difenoconazole which was the most effective in reducing the intensity of the disease. Fungicides based on pyraclostrobin-boscalid, unizeb, azoxystrobin-chlorothalonil and cymoxanil-mancozeb were also effective (KANDALO et al., 2016). The active substances pyrimethanil, cyprodinil, fludioxonil, azoxystrobin, difenoconazole and potassium bicarbonate have been used successfully in the USA as control measures (OLSON et al., 2012). In our country, the sweet potato plant is considered to be relatively less susceptible to diseases and pests, compared to countries that have a tradition of growing it. However, in case of non-compliance with the technology, it can be affected by viral, bacterial or fungal diseases, but also by nematodes or foliar pests and tuber pests (DIACONU et al., 2018). The use of virus-free tested material can increase yields up to 7 times (Loebenstein et al., 2009). In vegetative beds, the most destructive diseases are rhizoctoniosis and rots, and *Fusarium* wilt, root rot and stem rot can be responsible for severe yield losses (Clark and Moyer, 1988). In the field, the most important diseases are anthracnose, *Fusarium* wilt and *Alternaria*, and storage or post-harvest diseases include *Rhizopus* soft rot, Java black rot and charcoal rot, among others. These diseases usually develop after harvest or after packaging for long-distance transport (Clark and colab., 2009; Ames and colab., 1997). After Ames et al., 1997, Clark et al., 2015, Ekman and Lovatt, 2015, cited by Boiu-Sicuia et al., 2015, and 2018, mycotic diseases commonly encountered in culture are represented by soil pathogens, foliar diseases and storage diseases.

More than 40 species of arthropods harmful to the sweet potato crop are listed globally, grouped according to the importance of the attack (Iamandei et al., 2014; Davis, 2014). Soil insects can be controlled by applying insecticides before planting or at planting (Brandenberger et al., 2014).

MATERIALS AND METHODS

The experience was located at RDSPCS Dăbuleni, Romania, located on the 4th terrace of the Danube at an altitude of 44 m. The geographic coordinates are: North latitude: 43° 48′, and 24° 5′ East longitude. During the experience, the effectiveness of combinations of phytosanitary products in the control of Alternaria spp. and gray rot (*Botrytis cinerea*) was monitored, and among the pests reported in the culture on the aphids and larvae of defoliating insects, especially *Spodoptera* sp. and *Helicoverpa armigera*. The period analyzed in the experience was 2020-2022, with excessive temperatures accompanied by drought and with precipitation during the sweet potato vegetation period with values below the sum of multiannual precipitation. The aim was to identify combinations of active substances for the complex combating of pathogens and pests in the sweet potato crop in the field. The monofactorial experiment was arranged in randomized blocks with 10 variants in three replications, using the genotype "KSP 1". The surface of the experimental plot was 7.65 m2 and contained 3 rows with 10 plants per row, spaced 30 cm apart. between plants in a row and at 90-100 cm. between the lines. The experimental variants were:

V 1 - Cabrio top - 0.2 % + Mospilan 20 SG - 0.02%;
V 2 - Cabrio top - 0.2 % + Laser 240 SC - 0.05%;
V 3 - Cabrio top - 0.2 % + Karate Zeon - 0.02%;
V 4 - Score 250 EC - 0.05 % + Mospilan 20 SG - 0.02%;
V 5 - Score 250 EC - 0.05 % + Laser 240 SC - 0.05%;
V 6 - Score 250 EC - 0.05 % + Karate Zeon - 0.02%;
V 7 - Ortiva 250 SC - 0.1 % + Mospilan 20 SG - 0.02%;
V 8 - Ortiva 250 SC - 0.1 % + Laser 240 SC - 0.05%;
V 9 - Ortiva 250 SC - 0.1% + Karate Zeon – 0.02%;
V 10 - Untreated control variant.

Attack frequency, attack intensity, attack grade and efficacy were calculated for each treatment option. The interpretation of the obtained results was done by the statistical method, both for each year of experimentation and for their average (2020-2022). The effectiveness of treatments (%) was calculated according to the formula (ABBOT, 1925):

$E\%=[(DA_{Mt} – DA_{v})/ DA_{Mt}] \times 100$, where:

DA_{v} = degree of attack (%) in the treated variant.

DA_{Mt} = degree of attack (%) in the control version.

Score 250 EC is a systemic fungicide with rapid uptake into the plant. The active substance difenoconazole 25% acts against fungi at the moment of penetration into the plant (germination of fungal spores) and during the formation of haustoria and stops the development of pathogenic fungi (https://www.syngenta.ro/product/crop-protection/fungicid/score-250ec).

Cabrio top, contact fungicide, effective thanks to the active substance pyraclostrobin. It has preventive action and is approved for the control of *Alternaria solani* in tomatoes.

Ortiva 250 SC, contact fungicide, but also with local systemic action, contains azoxystrobin and difenoconazole, and ensures the fight against alternariosis in several crops, both in the greenhouse and in field conditions.

Mospilan 20 SG (acetamiprid 20%), systemic insecticide, with fast and effective action in combating different pests, regardless of their development stage. In the southeastern United States, the insecticide is used successfully to control aphids and other insects harmful to the sweet potato plant (Vegetable crop handbook for Southeastern United States, 2020).

Karate Zeon (lambda-cyhalothrin 50 g/l), insecticide that acts by contact and ingestion, pyrethroid, with action on the insect's nervous system.

Laser 240 SC (spinosad 240 g/l) is an ecological insecticide with high activity in the plant, acting on harmful insects by contact and ingestion. It belongs to a new family of biological insecticides: Naturalyte, which includes insecticides derived from metabolites of living organisms.

Three treatments were made during the sweet potato vegetation period, applied preventively, based on the forecast and warning. Observations were made on the frequency and intensity of the attack of the pathogens *Alternaria* spp. and *Botrytis cinerea*, and among the pests appearing in the crop, on aphids (*Aphis* sp.) and *Spodoptera* sp. larvae, after which the degree of attack was calculated (DA %) and the effectiveness of treatment options (E %).

RESULTS AND DISCUSSIONS

The factors that determine the appearance and evolution of pathogens and a large number of pests are: unfavorable temperatures, humidity in the soil and air outside the required limits, abundant fertilization with nitrogen, water drops on the leaves (from sprinkler irrigation, heavy rains) and heavy rainfall or excessive drought. The three years studied were very different from a climatic point of view. The average monthly air temperature exceeded the multiannual average temperature in all months of the plant's vegetation period. In the year 2020 (Figure 1), the precipitation during the sweet potato vegetation period (335.4 mm.) had values below the sum of the multiannual precipitation, but the precipitation was distributed much more evenly in all months.

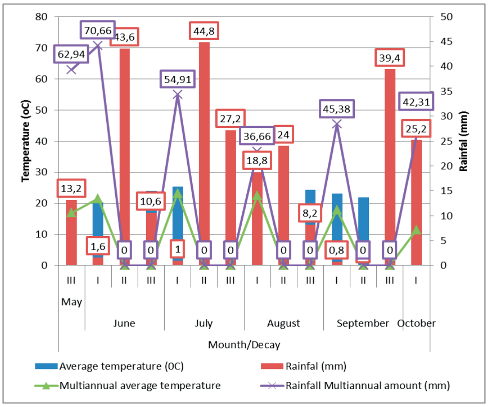

Figure 1. Meteorological characterization of the year 2020 during the sweet potato vegetation period

In the year 2021, the precipitation during the sweet potato vegetation period had values below the sum of the multiannual precipitation, they were missing in the first decade of July, in the first and second decades of August, as well as in the first decade of September (Figure 2).

During the vegetation period of the sweet potato plant in 2022, the average air temperature showed values between 13.3°C in October and 25.2°C in July, with maximum temperatures above 40 °C (respectively 41.6°C in July), as early as May registering 31.8°C. Precipitation was reduced, their value being lower than the multi-annual amount.

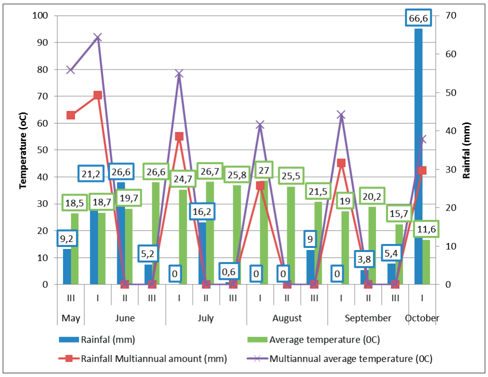

Figure 2. Meteorological characterization of the year 2021 during the sweet potato vegetation period

The product combinations used in the experimental variants performed differently in terms of prevention and control of harmful organisms appearing during the vegetation period in the sweet potato crop. Thus, in 2020 (Table 1), the best combinations of insecticides and fungicides to combat *Alternaria* spp. were those used in the variant V 7 (Ortiva 250 SC 0.1% + Mospilan 20 SG 0.02%) and V 1 (Cabrio top 0.2% + Mospilan 20 SG 0.02%), the effectiveness of the treatment being 88.9%. In the variant V 9 (Ortiva 250 SC 0.1% + Karate Zeon 0.02%), the effectiveness in combating *Botrytis cinerea* was 83.3%, and for combating aphids and *Spodoptera* sp. the best variant was V 4 (Score 250 EC 0.05% + Mospilan 20 SG 0.02%), having efficacy of 87.1% and 85.0% respectively.

Table 1. The effectiveness of treatment variants on pathogens and pests in the sweet potato crop in the field in 2020

Variant	Pathogens and pests							
	Alternaria spp.		*Botrytis cinerea*		*Aphis* sp.		*Spodoptera* sp.	
	DA (%)	E (%)	DA (%)	E (%)	DA (%)	E (%)	DA (%)	E (%)
V 1	1.7	88.9	3.3	76.5	2.5	82.4	3.3	74.9
V 2	4.5	70	4	71.8	8.7	39	8.2	38.6
V 3	2.8	81.1	2.8	80	6.2	56.6	5.3	59.9
V 4	2	86.7	3.7	74.2	1.8	87.1	2	85
V 5	3.3	77.8	4.2	70.7	4	71.8	5	62.4
V 6	6.7	55.6	3.7	74.2	8.7	39	5.7	57.4
V 7	1.7	88.9	2.7	81.2	3.4	75.8	4	69.9
V 8	2.7	82	2.5	82.4	7.2	49.3	6.7	49.9
V 9	2	86.4	1.8	87.6	5.4	61.7	5.8	56.1
V 10	15	Mt	14.2	Mt	14.2	Mt	13.3	Mt

In the year 2021 (Table 2). the best combination of insecticides and fungicides was the one used in the V 7 variant (Ortiva 250 SC 0.1% + Mospilan 20 SG 0.02%). variant where the effectiveness in combating *Alternaria* spp. it was 89.5%. and in combating aphids by 79.9%. For the control of *Botrytis cinerea* and *Spodoptera* sp. larvae the most effective combination was in the V 9 variant (Ortiva 250 SC 0.1% + Karate Zeon 0.02%) with an effectiveness of 88.0 % for both.

Table 2. The effectiveness of treatment variants on pathogens and pests in the sweet potato crop in the field in 2021

Variant	Pathogens and pests							
	Alternaria spp.		*Botrytis cinerea*		*Aphis* sp.		*Spodoptera* sp.	
	DA (%)	E (%)	DA (%)	E (%)	DA (%)	E (%)	DA (%)	E (%)
V 1	2.5	83.7	3.2	74.7	3.2	79.4	2.5	80.0
V 2	4.5	70.6	4.0	68.0	4.5	70.8	4.0	68.0
V 3	4.5	70.6	2.8	77.3	6.5	57.8	2.8	77.3
V 4	2.5	83.7	3.2	74.7	4.2	72.9	3.2	74.7
V 5	2.3	84.7	2.8	77.3	4.2	72.7	2.8	77.3
V 6	4.2	72.8	3.8	69.9	7.8	49.1	3.8	69.9
V 7	1.6	89.5	2.7	78.7	3.1	79.9	2.7	78.7
V 8	2.3	84.7	3.2	74.7	7.0	54.5	3.2	74.7
V 9	2.5	83.4	1.5	88.0	5.0	67.3	1.5	88.0
V 10	15.3	Mt	12.5	Mt	15.4	Mt	12.5	Mt

In the year 2022 (Table 3). the best combination of insecticides and fungicides was the one used in the V 7 variant (Ortiva 250 SC 0.1% + Mospilan 20 SG 0.02%). variant where the effectiveness in combating *Alternaria* spp. was 87.2%. *Botrytis cinerea* - 83.3%. *Aphis* sp. - 87.6% and *Spodoptera* sp. - 75.8%.
Also. the combination of Ortiva 250 SC 0.1% and Laser 240 SC 0.05% applied in variant V 8. had an efficacy of 84.2% in the control of Alternaria and 76.7 % in the control of gray rot (*Botrytis cinerea*). and the combination of Ortiva 250 SC 0.1% and Karate Zeon 0.02%. applied to variant V 9 had 84.2% effectiveness in controlling *Alternaria* spp. and 80.0% in controlling gray rot (*Botrytis cinerea*).

Table 3. The effectiveness of treatment variants on pathogens and pests in the sweet potato crop in the field in 2022

Variant	Pathogens and pests							
	Alternaria spp.		*Botrytis cinerea*		*Aphis* sp.		*Spodoptera* sp.	
	DA (%)	E (%)	DA (%)	E (%)	DA (%)	E (%)	DA (%)	E (%)
V 1	2.5	81.2	3.3	66.7	4.2	72.2	3.3	71.5
V 2	3.7	72.4	4.8	51.7	5.7	62.2	6.8	41.6
V 3	3.2	76.2	3.2	68.3	3.5	76.7	5.7	51.6
V 4	3.0	77.4	4.3	57.0	3.8	74.4	4.5	61.5
V 5	4.2	68.7	3.3	66.7	8.3	44.4	5.3	54.4
V 6	4.2	68.7	4.5	55.0	5.7	62.2	6.5	44.4
V 7	1.7	87.2	1.7	83.3	1.9	87.6	2.8	75.8
V 8	2.1	84.2	2.3	76.7	9.6	36.0	6.8	41.6
V 9	2.1	84.2	2.0	80.0	6.4	57.6	7.5	35.9
V 10	13.3	Mt	10.0	Mt	15.0	Mt	11.7	Mt

Regarding the attack of the pathogen *Alternaria* spp., the values of the degree of attack in the three years of the study oscillated between 1.7 % in the variants V 1 (Cabrio top - 0.2% + Mospilan 20 SG - 0.02%) and V 7 (Ortiva 250 SC - 0.1% + Mospilan 20 SG - 0.02%) and 15.0% in the control version (in 2020), in 2021 between 1.6% in V 7 (Ortiva 250 SC - 0.1% + Mospilan 20 SG - 0.02%) and 15.3% in the control variant, and between 1.7% in the V 7 variant (Ortiva 250 SC - 0.1 % + Mospilan 20 SG - 0.02 %) and 13.3 % in the control variant (in 2022). The attack of the pathogen *Botrytis cinerea* recorded values between 1.8% in the V 9 variant (Ortiva 250 SC - 0.1% + Karate Zeon

- 0.02%) and 14.2% in the control variant (in 2020), in 2021 - between 1.5% in the variant V 9 (Ortiva 250 SC - 0.1% + Karate Zeon - 0.02%) and 12.5% in the control variant, and between 1.7% in the V 7 variant (Ortiva 250 SC - 0.1% + Mospilan 20 SG - 0.02%) and 10.0% in the witness version (in 2022). As can be seen from these data. the values of the degree of attack in the control variant were higher in the case of the pathogen *Alternaria* spp. oscillating between 13.3% and 15.0% and in the case of *Botrytis cinerea* between 10.0% and 14.2%. The degree of attack in the case of aphids had values between 1.8% in the V 4 variant (Score 250 EC - 0.05% + Mospilan 20 SG - 0.02%) and 14.2% in the control variant (in 2020), between 3.1% in the V variant 7 (Ortiva 250 SC - 0.1% + Mospilan 20 SG - 0.02%) and 15.4% in the control variant in 2021 and between 1.9% in the V 7 variant and 15.0% in the control variant (in 2022). In the case of defoliating caterpillars belonging to the species *Spodoptera* sp. the degree of attack had values that oscillated between 2.8% in the V 4 variant (Score 250 EC - 0.05% + Mospilan 20 SG - 0.02%) and 13.3% in the control variant (in 2020), between 4.5% in the V 9 variant (Ortiva 250 SC - 0.1% + Karate Zeon - 0.02%) and 12.5% in the untreated control variant (in 2021) and between 2.8% in the V 7 variant (Ortiva 250 SC - 0.1% + Mospilan 20 SG - 0.02%) and 11.7% in the control version (in 2022). The results showed that among the analyzed pests, the highest values of the degree of attack in the control variant were recorded in the case of aphids, values that oscillated between 14.2% and 15.4%, while, in the case of the defoliator *Spodoptera* sp., the values were between 11.4% and 13.3%.

Analyzing as a whole the data obtained in the three years of the study regarding the effectiveness of the treatment variants, it was found that the best control over the attack of the harmful organisms taken in the study. It was ensured by the variants in which Cabrio top and Ortiva 250 SC fungicides were applied in complex with Mospilan 20 SG insecticides.

On the other hand, it is observed that the combinations of products used in the experimental variants had different effectiveness in terms of the control of harmful organisms that appeared during the vegetation period in the sweet potato crop, depending on the year of the study.

Thus, in the variants in which the product Ortiva 250 SC was used in combination, the effectiveness in combating the pathogen *Alternaria* spp. had values between 82.0% and 89.5%, and in combating the *Botrytis cinerea* pathogen, the effectiveness was between 74.7% and 88.0%.

In the combinations where Cabrio top fungicide was used the biological efficacy was between 70.0% and 88.9% in the case of the pathogen *Alternaria* spp. and between 51.7% and 80.0% in the case of the pathogen *Botrytis cinerea* (Figure 3).

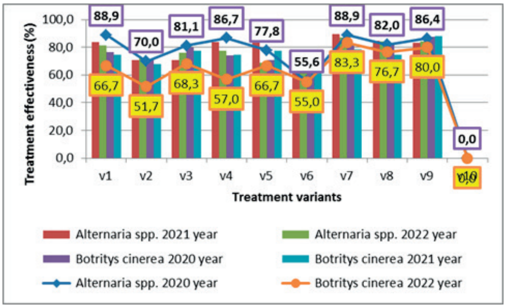

Figure 3. Effectiveness of treatments in combating *Alternaria* spp. and *Botrytis cinerea*

In the variants where the product Mospilan 20 SG was applied alongside the fungicide. efficacies ranging between 72.2% and 87.6% in combating aphids and between 61.5% and 80% in combating defoliating larvae were recorded (Figure 4).

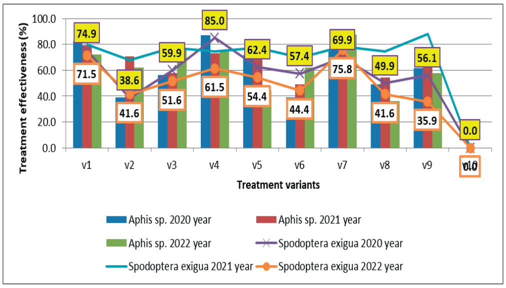

Figure 4. Effectiveness of treatments in combating aphids and defoliating larvae

CONCLUSIONS

- By applying the treatments during the vegetation period to the sweet potato grown on sandy soils with different combinations of insecto-fungicides, a good protection of the plants was ensured against the attack of the studied diseases and pests: *Alternaria* spp. *Botrytis cinerea, Spodoptera* sp. and *Aphis* sp.
- The treatment with the product Ortiva 250 SC - 0.1% was effective in combating alternariosis (efficacy 87.2-89.5%) and the pathogen *Botrytis cinerea* (efficacy 80.0-88.0%). and in the variants in which the product Mospilan 20 SG was applied alongside the fungicide. efficacies ranging between 72.2% and 87.6% in combating aphids and between 61.5% and 80% in combating defoliating larvae were recorded.
- The treatment variant with Ortiva 250 SC 0.1% + Karate Zeon 0.02% gave good results in combating the pathogen *Botrytis cinerea* (efficacy 80.0-88.0%). The best insect-fungicide combination was the one between Ortiva 250 SC 0.1% + Mospilan 20 SG 0.02%. combination where the effectiveness in combating *Alternaria* spp. was between 87.2-89.5%, for *Botrytis cinerea* - between 78.7 and 83.3%, for *Aphis* sp. - 75.8-87.6% and for *Spodoptera* sp. - between 69.9% and 78.7%.

ACKNOWLEDGEMENTS

This research work was carried out with the support of Ministry of Agriculture and Rural Development, Department of Statistics and also was financed from Project 1731/10.10.2018.

REFERENCES

Abbot, W.S. (1925). A method of computing the Efectiveness of an insecticide, *Journal of Economic Entomology, 18, 265-267.*

Ames, T., Smit, N.E.J.M., Braun, A.R., O'Sullivan, J.N. and Skoglund, L.G. (1997). Sweet potato: Major pests, diseases, and nutritional disorders. *International Potato Center (CIP),Lima, Peru. 81 p.*

Boiu-Sicuia, Oana-Alina, Constantinescu Florica, Iamandei Maria, Drăghici Reta, Diaconu Aurelia, (2015). *Ghid de bune practici agricole pentru reducerea riscurilor fitosanitare în cultura de cartof dulce Ipomoea batatas* L. ISBN 978-973-668-493-7, p. 11-47.

Boiu-Sicuia Oana-Alina, Constantinescu Florica, Diaconu Aurelia, Drăghici Reta (2018). Current status and future perspectives in romania on biological control of sweet potato fungal pathogen, *Muzeul Olteniei Craiova. Oltenia. Studii şi comunicări. Ştiinţele naturii. Tom. 34,* No. 2, 172-179.

Brandenberger , L., Shrefler , J.,R Ebek , E., Damicone, J. (2014). Sweet potato production. *Oklahoma Cooperative Extension Service, HLA-6022. Oklahoma State University, 8 p.*

Clark, C. A., and Moyer, J. W. (1988). Compendium of sweet potato diseases. *APS Press American Phytopathological Society*, pp.7.

Clark, C.A., G.J. Holmes, D.M., Ferrin (2009). Major Fungal and Bacterial Diseases, *The Sweet potato*, 81-103.

Clark CA, Ferrin DM, Smith TP, Holmes GJ (2015). Diseases of Sweet potato (*Ipomoea batatas* [L.] Lam.). *The American Phytopathological Society*. https://www.apsnet.org/publications/commonnames/ Pages/ Sweetpotato.aspx (accessed February 2018).

Davis Noelene (2014). Sweet Potatoes - *Strategic Agrichemical Review Process 2011-2014 for HAL Projects - MT10029 & VG12081. AgAware Consulting Pty Ltd, 25*.

Diaconu, Aurelia, Drăghici, Reta, Cioloca, Mihaela, Boiu-Sicuia, Oana, Mohora, Angela, Croitoru, Mihaela, Paraschiv, Alina, Draghici, I., Dima, Milica, Coteț Gh. (2018). *Ghid de bune practici agricole și de mediu în domeniul optimizării tehnologiei de cultivare a cartofului dulce*, Editura SITECH, Craiova.

Ekman, J., and Lovatt, J, (2015). Pests, Diseases and Disorders of Sweetpotato: A Field Identification Guide. *Horticulture Innovation Press.* Melbourne. 70.

https://www.syngenta.ro/product/crop-protection/fungicid/score-250ec

Iamandei, Maria, Draghici, Reta, Diaconu, Aurelia, Drăghici, I., Dima, Milica, Cho, Eun-Gi (2014). Preliminary data on the arthropod biodiversity associated with sweet potato (*Ipomoea batatas*) crops under sandy soils conditions from southern Romania. *Romanian Journal for Plant Protection, VII,* pp 98-102.

Kandolo, S.D., A.H. Thompson, F.J. Calitz, S.M. Laurie, M. Truter, J.E. Van Der Waals, T.A.S. Aveling, (2016). Field tolerance of selected varieties to and fungicide efficacy against Alternaria blight of sweet potato, *African Crop Science Journal, 24*(3), 235–245.

Loebenstein, G., Thottappilly, G., Fuentes, S., Cohen, J., (2009). Chapter 8, Virus and Phytoplasma Diseases. In: Loebenstein, G. and Thottappilly G. (eds.). *The Sweetpotato,* Springer, Science+ Bussiness Media B.V., p. 105-134.

Olson, S.M., Lamberts, M.L., Dittmar, P.J., Zhang, S. and Webb, S.E. (2012). *Sweet potato production in Florida*. University of Florida-IFAS Extension, HS 738.

Vegetable crop handbook for Southeastern United States (2020). 2020_SEVG_final_web.pdf (aces.edu), pp. 164-244.