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Analysis of the action of lunar phases and agrochemical factors in the growth of crops in the San Quintin Valley, Baja California, Mexico

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ABSTRACT

An investigation was developed to determine at a scientific level the effect generated by the lunar phases and the agrochemical factors in the cultivation of some crops, grown in agricultural fields in the city of San Quintin, which is located in the south of the state of Baja California, Mexico. In this scientific study, the aspects of indices and production costs of the mentioned product, grown in greenhouses with specialized personnel and equipment, were evaluated. The research also included an evaluation of the percentage of incidences of animal pests and diseases of the cultivated product, being able to evaluate the impact on the yield and profitability of the cultivated product in order to establish parameters with this scientific study for farmers in the region and for other regions of the country with the same weather. A comparative analysis of the crop was prepared with the two stages (the first stage being the period from April to July 2019 and the second stage from the period from October 2019 to January 2020), considering the factors of productive yield of cucumber, as well such as humidity levels, temperature, proper use of agrochemicals and pest control, in this case of plant pests such as thrips and ash, and animal pests such as the soldier worm the red spider, which was the one that was presented in this investigation carried out in two greenhouses (greenhouse 1, where 500 pickle cucumber plants were transplanted and in greenhouse 2, where another 500 pickle cucumber plants were transplanted, being 1000 plants in total. The investigation was made from 2019 to 2020.

Keywords. Agricultural production, greenhouses, lunar phases, agrochemicals factors, animal pests

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INTRODUCTION

This research was developed to evaluate the productivity levels of the pickle cucumber in greenhouses located in agricultural fields in the city of San Quintin, Baja California. Analysis of water, soil, productivity indices of the pickle cucumber and the incidence of lunar phases and the presence of animal pests in the cultivation process were developed. This scientific study is of great relevance and

usefulness for the producers of the region, in order to consider the main parameters required for the cultivation of the mentioned product and for other types of crops, as well as to elaborate a comparative analysis of cultivating crops in greenhouses in closed areas and with open surfaces (outdoors), and know if the same parameters can be applied. The experimental process was developed in two greenhouses of 1000 cucumber pickle plants, being 500 plants for one greenhouse with a specific treatment and 500 plants to the other greenhouse with another specific treatment. The basic information of any treatment of plants or crops for their growth in each zone of the world, depends on several factors such as those represented in table 1:

Table 1 Basic information for plant and crop growth

Basic Information Parameters	Characteristics
Agrochemicals	The appropriate chemical compounds for each type of plant and crop are included
Diseases of plants and crops	Possible diseases that may appear in the different stages of their growth are contemplated
Irrigation process	Includes the various types of irrigation, which can be drip or flow at a small or large scale
Moon phases	The phases that occur at different times of the year, and that have an effect on the growth of plants and crops, are considered
Planting density	It refers to the space that each plant or crop requires to grow optimally
Presence of pests	All type of pests (animal, plants and pathogens) that can damage plants and crops are considered
Soil	It contemplates methods of its preparation (movement of the soil) and having the nutritional elements for the plants and crops that you want to grow
Sunlight	There are plants and crops that require sunlight and others require shade for optimal growth
Type of plant and crop	The types of plants and crops are considered to determine the type and size of the area to be cultivated
Water	Physicochemical properties such as types of chemical compounds, hardness, electrical conductivity and pH are considered, essentially
Weather	It includes the variables of humidity represented in percentage levels (%) and temperature measured in degrees centigrade (° C) regularly in the Mexican Republic

Based on the previous table, the conditions are established, as well as the types of plants and crops for each area of our country and achieve the development of the agricultural industry, which is a very relevant factor in the economy of each region of the Republic. Mexican and generates a large part of the Gross Domestic Product (GDP) of each country.

Demographic aspect of San Quintin

The city of San Quintin was recently proclaimed as the sixth municipality of the state of Baja California in 2020, which is located in the northwest of the Mexican Republic, being considered a region with most of agricultural activities, where it is mainly cultivated the red tomato that is also called tomato. This municipality has a territorial extension of 35,191.9 km2 and according to the census prepared by the National Institute of Statistics and Geography (INEGI) in 2020, this city has a population of 117,568 inhabitants (INEGI, 2020). The municipality of San Quintin is divided into two areas, which are presented below:

1 Valley. Where the communities of Colonett, Camalú, Vicente Guerrero, San Quintín, Emiliano Zapata, Lazaro Cárdenas and Rancho Los Pinos are located.

2 Delegations. Camalú, Vicente Guerrero, San Quintín, El Rosario, El Mármol, Punta Prieta, Bahía de los Ángeles and Villa Jesús María.

Figure 1 shows the location of the city of San Quintin (illustrated in the blue circle with dotted lines),

located in the northwest region of the Mexican Republic in the state of Baja California, whose state is Border Area with the State of California in the United States, and has trade agreements for agricultural products.

Figure 1. Location of San Quintin city in the Baja California State of Mexico
Source. https://www.elvigia.net/el-valle/2020/9/17/tiene-san-quintin-clave-ante-el-inegi-354906.html

Agricultural industry in San Quintin

In the city of San Quintin, the climate in the summer season is warm with arid floors, and in the winter season it is fresh with wet soils, and with long periods and with clear sky most of the anus, and according to experts In meteorology, it is considered that the temperature in this area of the Mexican Republic ranges between 13 ° C to 31 ° C, and unlikely to be less than 9 ° C or greater than 34 ° C, being conducive to agricultural activities. As mentioned earlier, the tomato is the cultivation of greatest tradition in San Quintin to heaven, mainly at the spring-summer time. In addition, the cultivation of the strawberry, on a large scale, is contemplated, being a competitor at the national level with the state of Michoacán. Also, beans, corn, wheat, potato, celery, broccoli, zucchini, large onion (yellow, white and purple) and onion. In addition, certain products cultivated in greenhouses are considered in areas closed as pea, chili, Cilantro and Pickle cucumber, among the most cultivated. In this investigation, an evaluation of cucumber cultivation pickle in lunar phase was contemplated, with the remoteness in a new moon, weeding and fertilization in full moon, the crop in a lunar phase crescent and fumigation on full moon. The variables contemplated in the scientific study are the lunar phases, adequate mix of agrochemicals, productive yield and production costs of this crop developing the professional competences of researchers, professionals of this branch and students in the processes of crop production, and focused on the new educational model of Mexico. The scientific study was elaborated because in recent years in the San Quintin Valley, event presence has occurred in the cultivation of open-pit vegetables, damaging this type of agricultural product and caused economic losses to farmers of this region. This is as a result of the products grown in the San Quintin Valley, are more likely to pests of this region of the Mexican Republic, obtaining productive performance and increasing production expenses. It is estimated that the presence of pests is because of the quality of water, soil, climate change, greater pest resistance, variety of crops with less tolerance to diseases

and low quality in the formulation of the agrochemicals used in the crops developed in The San Quintin Valley. The cultivation of potatoes and chili was up to a few years, of the most important in this region of Baja California, but by the presence of pests, its agricultural production began to reduce. Currently, onion (yellow, white and purple) is cultivated, being the first place until five years ago, but presently due to the quality factors of water, soil, presence of animal pests, it is tending to be cultivated because the Productive performance and expenses for farmers of this region have increased by the constant presence of animal pests. According to scientific studies from other areas of the world with climate similar to the San Quintin Valley; It has been shown that adequate use in the formulation of agrochemicals and the appropriate use of the lunar phases have generated an optimal productive performance and a decrease in agricultural production expenses, being one of the relevant aspects of this investigation.

Pickle cucumber harvest

This agricultural product is native to Southeast Asia, being highly appreciated in many countries for its bittersweet flavor that is obtained by dressing it with vinegar and spices. To achieve its cultivation the following stages are elaborated:

1. The pickle cucumber seeds were planted in small trenches with topsoil, introducing the roots into the ground, and kept with a humidity level of at least 50%.

2. Before preparing the planting process, manure was added to the soil where the plants of this crop were found, to serve as a fertilizer (being around 4 to 6 kilograms of manure per square meter).

3. At the beginning of May, small trenches were made in the greenhouses to later plant each pickle cucumber seed, at a distance between each plant of 1.5 meters.

4. Prior to step 3, the drip irrigation process had been installed manually, and in a follow-up of this investigation, a drip irrigation system can be installed automatically with the electronic components mentioned above. In addition, it was possible to continue with the irrigation activity for longer periods than at the beginning of germination, and later to cover the small trenches with a black plastic, to prevent the growth of herbs that would damage the pickle cucumber crop. This allowed less evaporation, and water savings, when irrigating for long periods. This activity supports that it can be irrigated as a small-scale flow.

5. At the beginning it was watered every 10 or 12 days, and as each pickle cucumber plant grew, it was watered more frequently at each stage (April and October).

6. A layer of grass was placed on one side of each small ditch to prevent weeds from growing, in addition to walking dry to one side of the small ditches and giving natural fertilizer to the soil.

7. The supervised process was developed to obtain healthy and homogeneous products. This process was carried out with the inverted cloud method, with gray hair and a hutch on both sides. In addition, 2.5-meter-high tubes were placed around the small ditches and a mesh to obtain shade, and thus be able to protect the pickle cucumber crop from the intense rays of the sun in this agricultural region of the northwest of the Mexican Republic., in addition to rain, dust and air pollutants.

8. The process of pruning the plant was carried out, leaving the stem uncovered, and gradually removing the old (yellow) and diseased leaves.

9. Irrigation was increased and by having flowering the harvest was achieved by preparing it daily.

Greenhouse crops

The development of crops in greenhouses is of great importance because agricultural activities can be carried out at a smaller scale in production quantity, but with optimal conditions of climate, use of water, control of animal pests and herbs. This has helped improve agricultural products in terms of quality as they are organic and resistant to pests. The most common crops in greenhouses are tomatoes, peppers, zucchini, melons, cucumbers and strawberries; being the tomato, the most profitable crop. The plastic or glass material that the greenhouses contain on their roofs or walls, help to keep the heat, generating a protection in the crops, obtaining a suitable microclimate for the type of cultivation. With high efficiency in greenhouse cultivation processes, large quantities of agricultural products can be obtained. In the figure 2 is presented a greenhouse with tomatoes.

Figure 2 Greenhouse with tomatoes crop
Source. https://www.novagric.com/es/blog/articulos/cultivos-invernadero-hortalizas

Lunar phases

The moon contemplates has four phases that consist of changes in which it is possible to be seen illuminated either a part or the entire moon. The changes occur based on certain periods, according to the position of the sun and the earth. These changes are explained below in a basic way:

a) Full moon. It occurs when our planet is between the sun and the moon and is also called the full moon.

b) New moon. In this period the moon is very dark and difficult to observe.

c) Crescent moon. It occurs when the moon changes position between the sun and the earth, and is closer to the earth and it is possible to observe a greater amount of lunar surface.

d) Last quarter moon. It occurs when the moon changes position between the sun and the earth, and is further away from the earth and a smaller amount of lunar surface is observed.

In figure 3 is illustrated the lunar phases, and showing a relation with the agricultural activities.

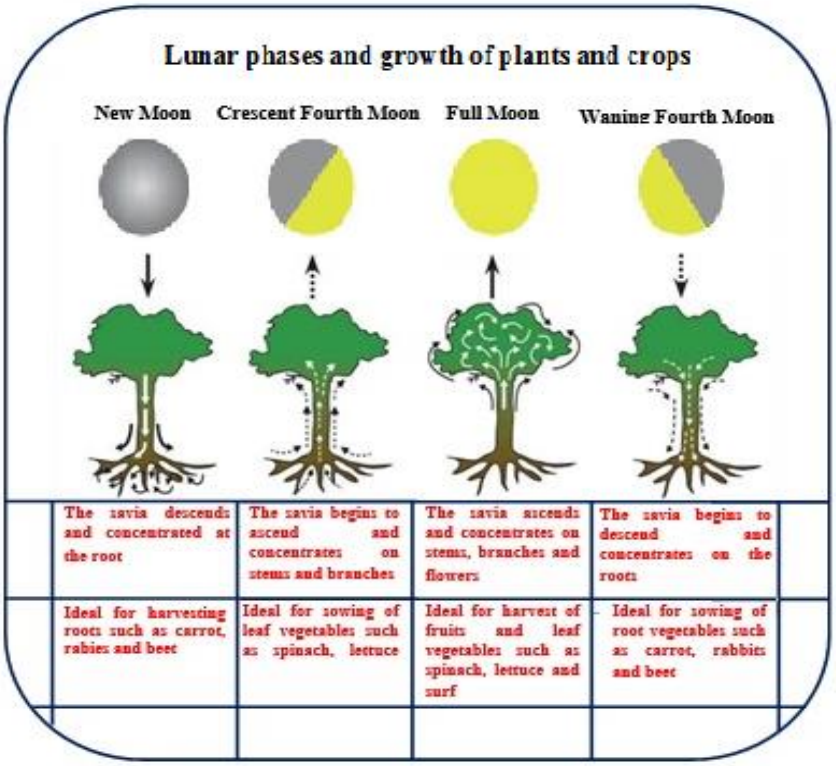

Figure 3 Lunar phases and it s relation with agricultural activities
Source. https://www.facebook.com/1064814503718810/photos/las-fases-lunares-en-el-comportamiento-de-las-plantasplantas-campo-agricultura-c/1504994216367501/

Lunar phases and their effect on agricultural activities

Another aspect of importance was to determine the effect generated by the lunar phases in the cultivation process of the pickle cucumber, where according to agricultural activities experts, referring to the productive yield and the quality of agricultural products. It is mentioned that the different phases of the Moon, have an effect on the bodies or areas with water, so that one of the goals of this investigation was to contemplate the lunar phases in the cultivation of Cucon Pickle. According to each lunar phase basically, various situations may be presented, such as those mentioned below:

a) New Moon in April 2019. According to agricultural specialists, in this phase the water level tends to climb on all aquifer mantles, allowing seeds to absorb an amount of water sufficient to develop an optimal root growth process and leaves, being a period of the adequate year to start preparing the land for crops. This lunar phase start on April 5, 2019, elaborating the first stage of the research project.

b) Fourth Crescent Moon in April 2019. This lunar phase is considered as relevant in the effect of agricultural activities. The period of this Lunar phase began on April 13, 2019 of the first stage of the research project, continuing with the second phase of the first stage of the research project, elaborating the transplantation process of Pickle cucumber plants to small Greenhouse ditches.

c) Full Moon in April 2019. It has an equal importance that the two previous lunar phases, being the second phase of the first stage of the research project, carrying out the process of irrigation of Pepino Pickle plants to the small greenhouse ditches. This Lunar phase began on April 19, 2019.

d) Fourth Waning Moon in April 2019. It is relevant as much as the three lunar phases mentioned, developing adequate manure and agrochemical accession activities and pest control, to continue with

cultivation care. This Lunar phase began on April 25, 2019.

e) New Moon in October 2019. The explanation resembles that of subparagraph a), only mentioned in this paragraph belongs to the second stage of the research project, which the beginning of this lunar phase in this month was 1 October 2019, so that it will begin to prepare the land for the cultivation of the pickle cucumber.

f) Fourth Crescent Moon in October 2019. It is similarly explained to that of paragraph B), only that mentioned in this paragraph belongs to the second stage of the research project, which the beginning of this lunar phase in this month was On October 8, 2019, elaborating the transplantation process of Pickle cucumber plants to small greenhouse ditches.

g) Full moon in October 2019. The explanation resembles that of paragraph c), only mentioned in this paragraph belongs to the second stage of the research project, initiating this Lunar Phase in this month on October 13, 2019, performing the process of irrigation of pickle cucumber plants to small greenhouse ditches.

h) Fourth Waning Moon in October 2019. It is similarly explained to that of paragraph B), only that it is mentioned in this paragraph belongs to the second stage of the research project, developing adequate manure and agrochemical activities and the control of pests, to continue with the care of the crop. This Lunar phase began on October 19, 2019.

The period of the investigation was developed in two stages, being the first of April to July 2019, because it is the crop and harvest period of the pickle cucumber (four months, approximately). In the following ESES, the lunar phases were contemplated to continue with the cultivation and harvesting process of the aforementioned agricultural product, on the indicated days of the lunar phases. The second stage was of the month of October 2019 to January 2020, contemplating the factors of the appropriate mix to agrochemicals and pesticides for pest control, as well as used soil and water quality, and humidity and temperature levels, for the optimal growth of pickle cucumber plants. The explanation of humidity and temperature levels was mentioned above, and agrochemicals for an optimum productive performance of the pickle cucumber, in addition to pesticides for pest control are explained in the following sections.

Agrochemicals in agricultural activities

They have the function of supporting the growth of plants and fruits, to obtain the maximum productive performance and good quality of agricultural products, being in this case of the pickle cucumber. This is why the importance of having the appropriate mixture for the cultivation process efficient. This is contemplated to obtain greater productivity and quality in food and crops, which every day is more required by the large number of populations worldwide and developed agrochemical mixtures, according to soil types, water quality, Temperature and humidity levels, environmental conditions, presence of pests and herbs, lunar phases and period of year for crops. For this investigation, they developed in a specialized chemical laboratory, the suitable mixtures for the cultivation process of the pickle cucumber. To obtain the maximum productivity and quality of this agricultural product, and that the agrochemicals act efficiently, it was required to have a fertile soil free of weeds. In this investigation, the jar test was used, showing that an adequate compatibility of the agrochemicals was obtained with the Pickle cucumber plants. The mixing compatibility test was also used in tank, to regulate the pH of the mixture and with it in the application on soil and water in the small ditches elaborated, where the Pickle cucumber plants were transplanted. In addition, the vessel method was used, to achieve stability in the mixtures. The agrochemicals used were in the form of powders and granules (granulated glyphosphates and liquid, tebuconazoles, chlorpyrifos, cypermethrin and nitrofoska, among the most essential).

Pickle cucumber plant diseases

Following are indications of the pests that caused damage to the pickle cucumber plant, even in the greenhouse, explaining that of the five main plant pests that occur regularly in the pickle cucumber crop (thrips, mildew, corynespora, white mite and ash), there were only two vegetal pests and two animal pets, which are explained below:

a) Trips. It is the most common pest in the pickle cucumber plant, and sufficient care had to be taken because the pickle cucumber plants tended to generate kinks in their products, causing damage to them and even with the adequate quantity and quality of agrochemicals can cause severe damage to products and decrease their productive efficiency. Some agrochemicals were used to prevent the presence of this plant pest, the main ones being: (1) Spinosad at a dose of 0.5 ml to 1 ml per liter of water, (2) Lamda cyhalothrin at a dose of 1.5 ml per liter of water, (3) Methomyl at a dose of 1 g per liter of water and (4) Spinotoran at a dose of 1 ml per liter of water

b) Ash. It is another plant pest that damages the pickle cucumber plant, having its scientific name as Erysiphe Cichoacearum is mentioned, and as it is its name it is similar to ash. It reproduces easily at temperatures of 15 ° C to 40 ° C, so it is necessary to quickly apply the necessary agrochemical to eliminate it and prevent the optimal productive performance of the pickle cucumber from not being obtained. To combat this pest, the agrochemical Cornet was used with two applications in each stage (April and October).

c) Animal pests. Regarding the animal plague presented in this research project, it was the soldier worm and the red spider, the pesticide called Expander, which fights the soldier worm, and neem oil were used to combat the red spider.

Productivity and Costs

It is an important factor in the agricultural industry that has a great relationship between these terms and with the production processes where economic gains or losses can be determined. Productivity is considered an economic measurement action, managing to calculate goods (products manufactured in industrial companies) and services (activities that are offered by companies that provide services to consumers). Figure 4 represents the balance factor of costs and benefits in industrial companies, where productivity and costs are involved for a better understanding of this relevant relationship (Marin J et al., 2009). In productivity, certain aspects are determined such as the number of workers and their skills and abilities, as well as investment capital, production times, distribution and delivery to customers. Productivity is associated with the quality factor, which in turn is related to manufacturing costs and is a relevant aspect in the growth or decline of industries. The link between productivity and quality is essential and is focused on the application of a very strict discipline so as not to generate economic losses, which is associated with cost analysis

MATERIALS AND METHODS

If base of the information of the crop process of the pickle cucumber phases mentioned above, the investigation activities was made in two stages of the cultivation process, one being at the beginning of April and the other at the beginning of October. The phases of the phases are mention follows:

A. Analysis of adequate information of the pickle cucumber cultivation process, with respect to adequate levels of temperature (in degrees centigrade) and relative humidity (in percentage indices), in addition to the optimal percentages of agrochemicals and pesticides to obtain the maximum productive performance of the pickle cucumber and thus avoid the generation of diseases and the presence of acorn worms due to the presence of flies inside the greenhouse 2.

B. Analysis of adequate information on the use of agrochemicals and pesticides, as well as the quality of the soil and water used in the pickle cucumber cultivation process, developing the tests in a chemical laboratory.

C. The pickle cucumber cultivation process was generated in stages 1 and 2, were explained above.

For stage 2, which began in October, the process of cultivating pickle cucumbers, to that of stage 1, which began in April, only with the differences in the control of humidity and temperature levels, to achieve optimal productive performance. In this case, in order to produce the open-air cultivation process, it is necessary to delay the root growth process for 20 days, until the soil temperature is between 18 ° C and 20 ° C.

D. A comparative analysis of the two stages was carried out, the first being from the beginning of April and the second from the beginning of October, regarding the costs and profits obtained in each stage developed

In addition, an exploratory type analysis was developed using the statistical regression and correlation tools. The sample was 1000 of pickle cucumber plants (500 floors in each of the two greenhouses used in this investigation). The process of activities carried out in the two greenhouses and in the two stages was as follows:

a) Preparation of planting in a lunar phase.

b) Realization of low moon lunar phase remoteness.

c) Development of throbbing in lunar phase of full moon.

d) Preparation of fertilization in a full lunar phase.

e) Realization of crop harvest in a growing quarter moon.

f) Development of fumigation in a lunar phase of full moon.

The numerical information of the investigation was organized into tables and in this way of analyzes were carried out with tables and graphics, to determine the productive performance and cost factors, which are shown in the next section.

RESULT AND DISCUSSION

In this investigation, was observed that the full moon phase, which is when the water rises so quickly to the surface of the soil, a higher productive yield of the pickle cucumber was generated as shown in tables 1 and 2, for the first stage that was from the April-July 2019 period and the second stage that was from the October 2019 to January 2020 period.

Table 1 Analysis of the productive performance of pickle cucumber (April-July 2019)

Productivity Performance Lunar Phases	Productivity, %	Quality, %
New Moon	83	85
Crescent Fourth Moon	81	82
Full Moon	87	89
Waning Fourth Moon	82	83

Table 2 Analysis of the productivity performance of pickle cucumber (October 2019-January 2020)

Productivity Performance	Productivity, %	Quality, %

Lunar Phases		
New Moon	73	75
Crescent Fourth Moon	71	74
Full Moon	78	76
Waning Fourth Moon	70	72

As observed in tables 1 and 2, they show the percentage indices of productivity (quantity of pickle cucumber products) and quality (confidence level for consumption of the pickle cucumber), showing in table 1 the percentage indices greater than 80%, as presented and shown below:

a) For the full moon phase, being the highest percentage with 87% in productivity and 89% in quality.

b) Subsequently, percentage rates for the new moon phase of 83% in productivity and 85% in quality were presented.

c) Thus, the percentage rates of the waning quarter moon phase of with 82% in productivity and 83% in quality.

d) Regarding the crescent moon phase of with 81% in productivity and 82% in quality.

This was due to the fact that in the period from April to July 2019, there was a warm climate with temperature and relative humidity levels from 20 ° C to 40 ° C, which is part of the spring-summer season, which It is suitable for the optimal growth of the pickle cucumber. On the other hand, in the period from October 2019 to January 2020, there were low levels of temperature and relative humidity from 15 ° C descending to 5 ° C, so that the percentage rates lower than 80%, of the lunar phases, are presented below:

a) For the full moon phase, being the highest percentage with 78% in productivity and 76% in quality.

b) Subsequently, there were percentage rates for the new moon phase of on 783% in productivity and 75% in quality.

c) Thus, the percentage rates of the waning quarter moon phase of 71% in productivity and 74% in quality.

d) Regarding the crescent moon phase, with 70% in productivity and 72% in quality.

This was when it was presented in the fall-winter season. This was the main factor evaluated in this investigation.

Physicochemical analysis of soil and water

In addition, from the lunar phase analysis, an evaluation of the soil and water used in the cultivation process was carried out, showing its evaluation in tables 3 and 4 with the percentage indexes of correlation between the lunar phases and soil and water analysis.

Table 3 Correlation analysis of lunar phases and physicochemical properties of soil and water (April 2019-July 2019) de 2019)

Physicochemical Properties	**Soil**	**Water**
Lunar Phases	**Productivity, %**	**Quality,%**
New Moon	76	74
Crescent Fourth Moon	74	71
Full Moon	78	77
Waning Fourth Moon	75	73

Table 4 Correlation analysis of lunar phases and physicochemical properties of soil and water (October 2019-January 2020)

Physicochemical Properties	Soil	Water
Lunar Phases	Productivity, %	Quality,%
New Moon	73	72
Crescent Fourth Moon	71	70
Full Moon	75	73
Waning Fourth Moon	72	70

Tables 3 and 4 show the percentage indices of the lunar phase correlation with the percentage levels of soil and water, with respect to their productive performance and quality, observing that the percentage indices range between 70% and 80%. Table 3 shows the correlation indices:

a) For the full moon phase, the percentage index greater than 78% was presented with the productivity ratio and 77% in the quality of the soil and water.

b) Subsequently, there were percentage levels for the new moon phase of 76% with the productivity ratio and 74% in the quality of the soil and water.

c) Thus, the percentage indices of the waning quarter moon phase of 75% in the with the productivity ratio and 73% in the quality of the soil and water.

d) Regarding the crescent moon phase of 74% with the productivity ratio and 71% in the quality of the soil and water.

Regarding table 4, the percentage indexes of the lunar phase correlation with the percentage levels of soil and water are shown, mentioning below:

a) For the full moon phase, the percentage index greater than 75% was presented with the productivity ratio and 73% in the quality of the soil and water.

b) Subsequently, there were percentage levels for the new moon phase of 73% with the productivity ratio and 72% in the quality of the soil and water.

c) Thus, the percentage indices of the waning quarter moon phase of 72% in the productivity ratio and 70% in the quality of the soil and water.

d) Regarding the crescent moon phase of 71% with the productivity ratio and 70% in the quality of the soil and water.

Evaluation of the use of agrochemicals and pesticides

An evaluation of the use of agrochemicals and pesticides for the control of plant and animal pests was carried out, which occurred in the pickle cucumber cultivation process, and which is presented as a correlation in tables 5 and 6.

Table 5 Correlation analysis of lunar phases and use of agrochemicals and pesticides (April 2019-July 2019) de 2019)

Physicochemical Properties	Agrochemicals	Pesticides
Lunar Phases	Productivity, %	Quality,%
New Moon	77	75
Crescent Fourth Moon	75	73
Full Moon	79	77

Waning Fourth Moon	76	74

Table 6 Correlation analysis of lunar phases and use of agrochemicals and pesticides (October 2019-January 2020)

Physicochemical Properties	**Agrochemicals**	**Pesticides**
Lunar Phases	**Productivity, %**	**Quality,%**
New Moon	74	72
Crescent Fourth Moon	73	71
Full Moon	77	74
Waning Fourth Moon	73	72

Tables 5 and 6 show the percentage indices of the correlation of lunar phases with the percentage levels of the use of agrochemicals and pesticides, with respect to their productive performance and quality, observing that the percentage indices oscillate between 70% and 80%., being similar to the analysis of the physicochemical properties of soil and water. Table 5 shows the correlation indices:

a) For the full moon phase, the percentage rate greater than 79% with the productivity ratio and 77% with the use of agrochemicals and pesticides was presented.

b) Subsequently, there were percentage levels for the new moon phase of 77% with the productivity ratio and 75% with the use of agrochemicals and pesticides.

c) Thus, the percentage rates of the waning quarter moon phase of 76% in the productivity ratio and 74% with the use of agrochemicals and pesticides.

d) Regarding the crescent moon phase of 75% with the productivity ratio and 731% with the use of agrochemicals and pesticides.

Regarding table 4, the percentage indexes of the lunar phase correlation with the percentage levels of soil and water are shown, mentioning below:

a) For the full moon phase, the percentage rate greater than 77% was presented with the productivity ratio and 74% with the use of agrochemicals and pesticides.

b) Subsequently, there were percentage levels for the new moon phase of 74% with the productivity ratio and 72% with the use of agrochemicals and pesticides.

c) Thus, the percentage indexes of the waning quarter moon phase of 73% in the with the productivity ratio and 72% with the use of agrochemicals and pesticides.

d) Regarding the crescent moon phase of 73% with the productivity ratio and 71% with the use of agrochemicals and pesticides.

Productivity and cost analysis

An analysis of the relationship between the productive yield and the operating costs of the pickle cucumber cultivation activity in the two greenhouses was carried out. From this analysis, relevant information was obtained for the farmers of this region of the Mexican Republic, shown in tables 7 and 8, for each stage of the investigation**.**

Table 7 Correlation analysis of lunar phases and productivity with costs (April 2019-July 2019) de 2019)

Factors	**Productivity Performance, %**	**Costs , %**
Lunar Phases		

New Moon	35	-30
Crescent Fourth Moon	29	-26
Full Moon	32	-29
Waning Fourth Moon	28	-25

Table 8 Correlation analysis of lunar phases and productivity with costs (October 2019-January 2020)

Factors **Lunar Phases**	**Productivity Performance, %**	**Costs , %**
New Moon	15	-20
Crescent Fourth Moon	12	-17
Full Moon	13	-18
Waning Fourth Moon	11	-14

In tables 7 and 8, the percentage levels of productive performance were observed (in positive values), indicating an increase in the amount of pickle cucumber as a final product and costs (in negative values), representing a decrease in operating expenses. by the activity of the pickle cucumber crop.

Suggestion for improvement

It is suggested for a following cultivation cycle (research stage) of the pickle cucumber, to use low-cost automated electronic systems and basic electronic components (electrical resistance, rectifier diode, 2N222 transit and 12-volt direct current relay and converted to 120 volts. of alternating current, to control several electric actuators such as fans and large low-cost heat generators, which can be implemented in a next phase of this research, with the objective of obtaining the adequate humidity and temperature. This is necessary for it to be generated correctly the process of cultivation of the pickle cucumber, developed in the two greenhouses, referring specifically to the second stage that began at the beginning of October, which when continuing with the cultivation process from this point on, the months of November are followed, December and January when temperatures are below 15 degrees Celsius. This is for avoid the generation of diseases and the presence of armyworm and spider mite in the pickle cucumber plant, and thus prevent a low productive yield of the cultivation process of this agricultural product, even developing this activity in the two greenhouses.

CONCLUSION

This investigation is very relevant, because important information was obtained for the farmers of this region regarding the cultivation of the pickle cucumber, to obtain the maximum productive yield and lower costs. The first phase of this relevant research consisted of an analysis of the adequate information from the pickled cucumber cultivation process. This was done with respect to the appropriate levels of temperature and relative humidity (in percentage rates), in addition to the optimal percentages of agrochemicals and pesticides to obtain the maximum productive performance of the pickle cucumber and thus avoid the generation of diseases due to plant pests such as thrips and ash, in addition to the presence and presence of armyworm and red spider inside the two greenhouses. The lunar phase that had a greater effect on the productive performance of the pickle cucumber in the two stages was the full moon, due to the fact that they generate an effect on the bodies of water, which cause it to be close to the surface of the soil and be used by the seeds for quick and easy germination, to better control the plant and animal pests mentioned above in this research. On the other hand, if you want to elaborate, you must be very careful with the aforementioned pests, because they have occurred more frequently, causing economic losses to farmers in the region. Still developing the pickle cucumber crop in the two greenhouses.

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