ISSN: 3048-6181 www.wjphr.org 2024, Volume 1, Issue 3. Page: 01-07.

World Journal of Pharmaceutical and Healthcare Research

Research Article

MANAGEMENT OF REMINI APPLE PRODUCTION IN DRY AREAS (UNDER UNFAVORABLE CONDITIONS OF WATER SHORTAGE AND SOIL TEXTURE)

Hamid Kheyrodin*

Assistant Professor Semnan University-Iran.

Article Info

Article Received: 20 August 2024,
Article Revised: 10 September 2024,
Published on: 01 October 2024.

***Corresponding author:**
Hamid Kheyrodin*
Assistant Professor Semnan University-Iran.
hkhyrodin@yahoo.com
hamid.kheyrodin@semnan.ac.ir

ABSTRACT

In order to investigate the effect of water stress and soil texture on the yield and growth indicators of potato cultivar Aiola, the flooding method with different volumes of water has been used in Semnan University.

The effects of drought stress on changes in dry matter of plant organs, total plant dry matter TDM, relative growth rate RGR, crop growth rate CGR, leaf area index LAI, leaf area durability LAD and net absorption rate NAR were very high.

Dehydration stress has caused a decrease in CGR, and this is the reason why tubers and potato performance are reduced. In general, the effects of stress on growth indicators are different depending on the intensity of stress and cultivars, and the research results indicate a decrease in growth indicators. It is due to the lack of water. The maximum production of potatoes occurs when the soil moisture is at its optimum level. The optimum level of soil moisture is 60 to 70% of the total water available to the plant, depending on the growth stage. Our results have shown that irrigation at the rate of 200 mm reduces the dry matter of the aerial part of the plant, the dry matter of the root, the dry matter of the tuber and the yield of the tuber. Of course, the application of dry stress has reduced the dry weight of potato roots and the amount of this reduction is correlated with the intensity of the stress.

KEYWORDS: Management, potato cultivation, water stress, soil texture.

INTRODUCTION

The policies of the notification of the government and the Ministry of Agricultural Jihad regarding the production of basic products and the development and promotion of healthy potato cultivation in areas of Semnan province were put on the agenda. Potato is a plant from the eggplant family that has compound and cut leaves and white or purple flowers. Its fruit is small, spherical, red, set. Potato is the fourth most cultivated agricultural product in the world after corn, wheat and rice.

Potato is a one-year herbaceous dicotyledonous plant that has the potential to be multi-year due to propagation through tuber. Potato has more than 90 genera and 2800 species in this family. Although the plants of this family are found all over the world, they are mainly distributed in the tropical regions of Latin America. The genus of potato plant is Solanum, which has approximately 2000 species. Most of the commercial varieties of potato are tetraploid, the number of potato chromosomes is mostly 2n=4x=48.

There is another classification based on which certain diploids and triploids are included in the range of S. tuberosum species. Cultivated potatoes are diploid 2n=2x=24.

The potato tuber is a non-photosynthetic organ whose performance depends on the activities of the source and reservoir and genetic factors, leaf area index, fertilization, temperature, soil including physical, chemical and biological properties, light intensity and humidity are involved in it. and have mutual effects. The roots of the potato plant are scattered and 85% of them are located at the depth of 20-30 cm in the rhizosphere of the soil, and for this reason, they are sensitive to drought stress and water stress and need sufficient moisture in the light soil during the entire growth period. Drought stress occurs in plants when potential evaporation and transpiration exceeds actual evaporation and transpiration. The results of recent years of researchers and scientists have shown that drought stress up to 80 to 90 percent of the water required by the plant, both before and after the formation of the potato tuber, causes significant differences in potato production. The tuber bulking stage is one of the important stages of potato growth that happens after the

flowering stage. At this stage, the plant invests most of its resources on newly formed tubers. At this time, several factors are very important to get a good product. Among them, sufficient humidity and optimal temperature of the soil (soil texture), availability and availability of sufficient nutrients in the soil and their balance. The maturity stage of the tubers is very important for the food. Potatoes contain toxic compounds called glycoalkaloids. Glycoalkaloids are a type of potentially toxic compounds found in plants of the potato family. These compounds are found in all the organs of the potato and their highest concentration is in the flowers. One of the dangers of these poisons is for the nervous system. The most important of these poisons is solanine. Solanine in potato is determined by the appearance of green color, especially in the cortex under its skin, which is necessary to study it in many soil tissues. The exact mechanism and function of this toxin is not known, but it seems that this substance, by affecting the cell membrane and disrupting the function of proteins and channels on the surface of the mitochondrial membrane, causes the imbalance of calcium ions and finally the death of cells. Identification, determination and analysis. Storage root yield and shoot fresh weight, number of leaves, number of branches, storage root weight, storage root diameter, plant length and storage root length are of particular importance.

Potato growers face many challenges. Some of these risks are caused by pests and diseases, others are the lack of sufficient water supply and irrigation. The onset of stress begins with providing less than 80% of the plant's water needs, and the plant's maximum sensitivity to water stress occurs during the rapid growth of the tuber in July. is. The water requirement of the plant is 6640 cubic meters during the growth period. Some others are caused by inappropriateness of agricultural soil structure, texture and chemical and physical properties. whose identification and study fulfills some of the needs of producers (Arzani 2017).

Stress during the vegetative growth of the plant reduces the length of the stem and reduces the size and number of leaves, thus reducing the level of photosynthesis. The greatest impact of stress during the vegetative growth of the plant is first on the leaf surface and second on the stem length.

Suitable soil for cultivation is one of the most important concerns of farmers. Planting potatoes, which starts from the beginning of March in Semnan province, especially in Mojan, Shahrood city, requires all-round efforts and care of farmers, including fertilizer, improved potato seeds, fertilizers and plowing, and appropriate modification of the soil texture, which is very expensive has followed for the farmers of the region, which should be studied.

The results of the researchers have shown that the yield of the plant and the concentration of nutrients in potato leaves and tubers decreased with the increase in soil compaction, and this decrease in concentration is more for the three elements nitrogen, phosphorus and potassium. The texture and different levels of soil compaction have a great effect on the yield, quality and absorption of nutrients by the potato plant. By softening the soil around the roots, it is possible to reduce the soil resistance and increase the penetration of the potato roots into the soil, therefore, increasing the yield of the product will be available (Behod, Golchin, Bisharati 2013).

The concentration of nutrients in potato tubers also decreases with the increase of soil compaction and the maximum decrease for nitrogen, phosphorus and potassium elements is 52.3, 34.7 and 45.6% respectively. The results of researchers show that soil compaction, by limiting the growth and development of potato roots, delays and slows down the absorption of nutrients by it and causes a decrease.

MATERIAL AND METHOD

The aim of our research in this article is to study the quantitative and qualitative improvement of potato production in arid and semi-arid regions of Semnan province. This research is carried out in the winter of 1402 in the form of complete randomized block design of Badoo split plot and three replications in the desert research farm of the School of Desert Science. So that the type of cultivation bed as the main factor has three levels (sandy soil, clay soil, compost soil) and the sub-factor includes stress and water stress in 4 levels. . . In this plan, the identification of potato cultivars that tolerate drought stress is one of the most important issues in breeding and production programs. Therefore, the experiment was carried out in winter and its follow-up in spring and summer, and drought stress was also determined separately in potato vegetative growth. In this stage, the cultivation substrate is the main factor (sandy, clay soil, compost) and the drought stress in four control levels and -0.3, -0.6, -1, and -1.5 MPa of soil water potential in two and three replications in split form. The plot was carried out in the greenhouse and the field. The traits evaluated during the growth period include: yield, number of potato tubers, stem height, number of plant branches, number of leaves per plant, tuber size, production leaf area, which is significantly affected by the type of soil texture, and water stress and interaction effect. These two factors are one of the main goals of the project, which are considered and evaluated. The irrigation method was flood and pile irrigation, although it was flooded at the beginning of the season.

To obtain the growth index during the desired growing season, every 10 days, samples of potato plants were separated from each plot, taking into account the margin. After separating the root, stem, leaf and tuber, each statistical analysis was performed.

Root and stem samples were dried separately in an electric oven at a temperature of 75 degrees Celsius. To measure

the leaf surface in each sampling, a leaf surface measuring device and Hennessy diagram were used. Using computer software, the best regression equations for changes in dry weight of plant organs, dry weight of the whole plant and leaf area index were calculated. In this research, instead of the time of day, the degree unit was used using the following equation: (GDD) growth day

$$GDD = \sum_{j=1}^{n} \left[\frac{T_{max} + T_{min}}{2} \right] - T_b \quad 1$$

In the formula above, n is the number of growing days, Tmax is the maximum daily temperature in degrees Celsius, Tmin is the minimum daily temperature (degrees Celsius), and Tb is the base temperature for potato growth in degrees Celsius. , the following quadratic equations were obtained: LAD.

In the above equations, TDM is the total dry matter, LAI is the leaf area index and t is the growth day degree GDD. In order to determine the growth rate of the product, CGR is calculated from the equation of the dry weight of the whole plant, and the following formulas and relationships are used to calculate the relative growth rate of RGR, the net absorption rate, NAR, and the durability of the leaf surface, LAD:

$$L_n\ TDM = a + bt + ct^2 \quad 2$$

$$L_n\ LAI = \acute{a} + b\acute{t} + \acute{c}t^2 \quad 3$$

In the above equations, TDM is the total dry matter, LAI is the leaf area index and t is the growth day degree GDD. In order to determine the growth rate of the product, CGR is calculated from the equation of the dry weight of the whole plant, and the following formulas and relationships are used to calculate the relative growth rate of RGR, the net absorption rate, NAR, and the durability of the leaf surface, LAD:

$$CGR = \frac{d(L_nTDM)}{dt} = TDM \times RGR \quad 4$$

$$RGR = \frac{d(L_nTDM)}{dt} \times \frac{1}{TDM} = b + 2Ct \quad 5$$

$$NAR = \frac{CGR}{LAI} \quad 6$$

$$LAD = \frac{(LAI_1 + LAI_2)(t_2 - t_1)}{2} \quad 7$$

In the above relationships, dL TDM is the changes in the dry weight of the whole plant and dt is the cumulative growth degree day changes. All the data obtained from the experiment were analyzed by computer software and the necessary graphs were drawn by Excel software. The texture of the soil was determined by the hydrometric method and the drought stress by the tensiometer. The micro elements in the soil were determined and measured by the atomic device and the other elements were measured by the film photometry method.

RESULTS AND DISCUSSION

The results and discussion of the relationship between received water (cubic meters) and soil texture are shown in table 1, 2, 3, 4.5,6 and figure 1,2,3,4,5. These results were obtained based on the measurement of the effects and soil texture of water (drought stress in four control levels and -0.3, -0.6, -1, and -1.5 MPa potential) reduction of potato yield by moving away from the amount of irrigation reported by other researchers. Also, the regression relationship between vegetation growth and water consumption is as follows.

Table 1: Comparison of the average yield of potato tuber in different levels of drought stress.

Average yield	Treatment
6 a	**0**
4 b	**-0.3**
3 c	**-0.6**
2 d	**-1**
1e	**-1.5**

Common letters in Table 1 in each column indicate the absence of significant differences by Duncan's test at the 5% probability level. The results of this research are consistent with the results of other researchers, which show that the yield of potatoes decreases due to the effect of water stress. More complete results can be seen in the figures below:

Table 2: Analysis variance of the effects of soil texture and water stress on the growth of potato leaf aerial parts.

Sources of variation	Df	ss	Ms	Fs
Replication	3	2.23	0.7	2.6^{ns}
Soil texture	2	20.8	10	37^{**}
error a	6	1.7	0.2	
main plat	11	24.8		
water stress	3	46	15.3	35^{**}
water stress soil texture interaction	6	242	40.47	92^{**}
error b	27	11	0.4	
subplot	36	399		
total	47	325		
Significant at 1% level	*No significant at 5 % level*			

Table 3: Analysis variance of the effects of soil texture and water stress on the growth of potato fresh weight roots.

Sources of variation	Df	ss	Ms	Fs
Replication	1	2.23	0.7	2.6^{ns}
Soil texture	2	20.8	10	27^{**}
error a	6	1.7	0.2	
main plat	9	24.8		
water stress	3	46	15.3	35^{**}
water stress soil texture interaction	6	242	40.47	90^{**}
error b	27	11	0.4	
subplot	36	399		
total	46	325		
Significant at 1% level	*No significant at 5 % level*			

Table 4: Analysis variance of the effects of soil texture and water stress on the growth of potato dry weight root.

Sources of variation	Df	ss	Ms	Fs
Replication	1	3.23	0.7	2.9^{ns}
Soil texture	2	30.8	10	47^{**}
error a	6	1.7	0.2	
main plat	9	24.8		
water stress	3	46	15.3	45^{**}
water stress soil texture nteraction	6	342	40.47	75^{**}
error b	27	11	0.4	
subplot	36	499		
total	46	325		
Significant at 1% level	*No significant at 5 % level*			

Table 5: Analysis variance of the effects of soil texture and water stress on the growth of potato fresh weight leaves.

Sources of variation	Df	ss	Ms	Fs
Replication	1	2.23	0.6	2.4^{ns}
Soil texture	2	20.8	10	27^{**}
error a	6	1.7	0.2	
main plat	9	24.8		
water stress	3	46	15.3	45^{**}

water stress soil texture interaction	6	242	30.47	88**
error b	27	11	0.4	
subplot	36	400		
total	46	323		
Significant at 1% level	*No significant at 5 % level*			

Table 6: Analysis variance of the effects of soil texture and water stress on the growth of potato dry weight leaves.

Sources of variation	**Df**	**ss**	**Ms**	**Fs**
Replication	1	6.23	0.6	2.1ns
Soil texture	2	20.8	10	27**
error a	6	1.7	0.2	
main plat	9	24.8		
water stress	3	46	17.3	45**
water stress soil texture interaction	6	240	33.47	80**
error b	27	11	0.7	
subplot	36	800		
total	46	823		
Significant at 1% level	*No significant at 5 % level*			

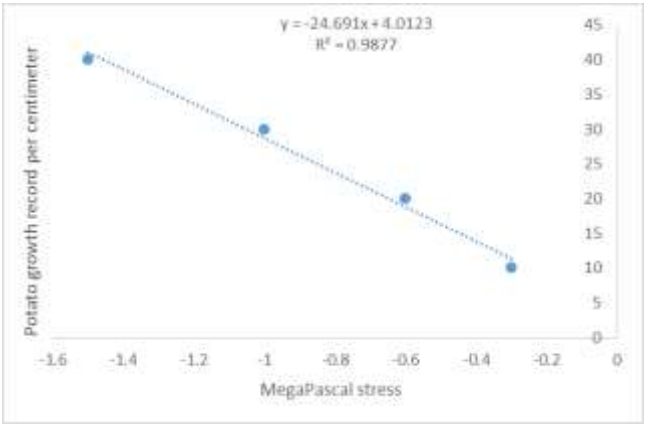

Figure 1: Effects of drought stress according to Ma Pasgal on stem length 3 months after planting.

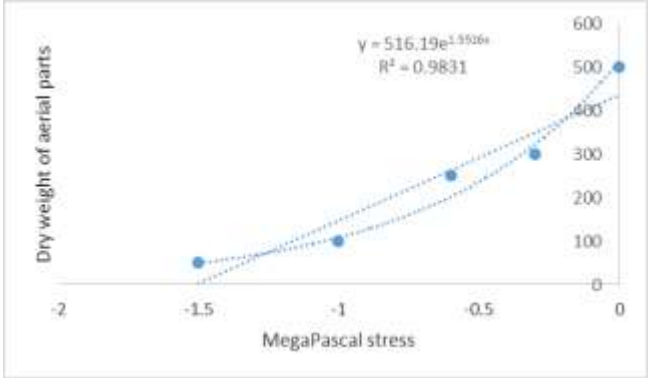

Figure 2: Effects of drought stress on shoot dry weight 3 months after potato planting.

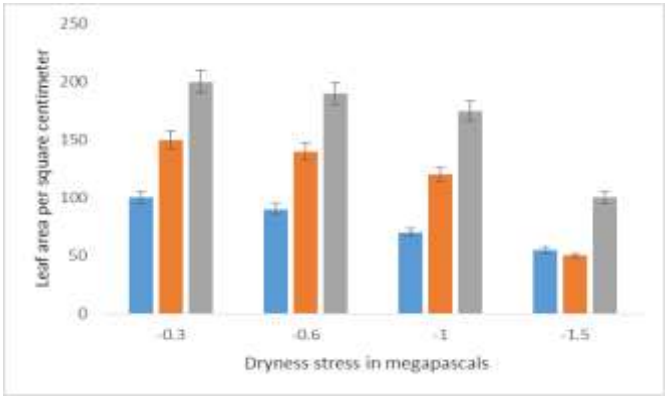

Figure 3: Mutual effects of drought stress and soil texture and its effect on leaf area 3 months after planting in the greenhouse.

The dry matter of the whole plant or the biological function is the result of the accumulation of photosynthetic substances, the process of changes of the dry matter of the whole plant at different levels of water stress is shown in the figures above. After a period of slow growth until receiving 500 GDD (30 days after planting), the plant started its rapid growth from this stage. The maximum dry matter production of the entire plant was at 2300 GDD, after which a decrease in dry matter production was observed. Low water stress levels compared to the control, strongly reduced the dry matter production of the whole plant. In the treatment without drought stress, the amount of GDD is 2300 and in severe stress, it is 1900 GDD.

In the severe stress treatment, the maximum dry matter production is 500, and in the mild stress treatment, the dry matter production is 700, and in the mild Nibetta stress treatment, the maximum dry matter production is 900, and in the mild stress treatment, the dry matter production is 1200 grams of dry matter per square meter. In the control treatment and without stress, the maximum dry matter production was 1400 grams.

The dry weight of all organs decreased drastically due to different levels of dehydration stress. The lowest dry weight of the organs was produced under very severe stress. The severe and very severe stress caused the plant to reach the maximum dry matter of the stem and root sooner and become shriveled. Due to the decrease in the amount of water, the production of dry weight (biomass) decreased due to the increase in respiration and decrease in carbonization, and as a result, the dry weight Plant organs and photosynthesis levels decreased, and with the increase in water content, the maximum production of dry matter was obtained in less time.

In the treatment of severe stress, about minus one megapascal and minus one and a half megapascals, the reduction of dry matter is faster. In very severe stress, because the plants had received enough water until the four-leaf stage, they grew well at first, but because they received very little water after that, the dry matter loss increased.

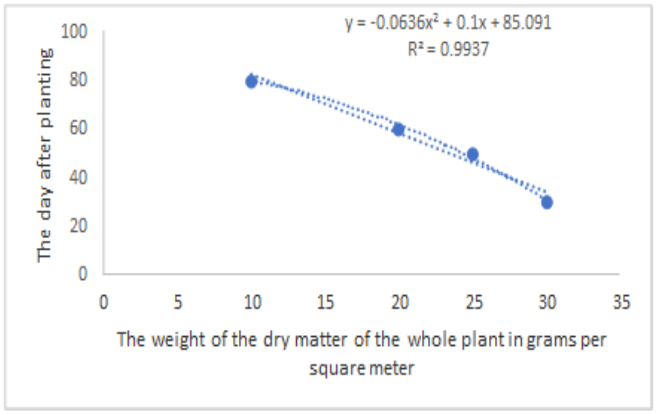

Figure 4: Changes in potato dry weight during the growing season at different levels of water stress (100 days after planting).

Figure 5: Shows greenhouse experiments for stress effects.

CONCLUSION

Dehydration stress has caused a decrease in CGR, and this is the reason why the bulking of the tubers and the performance of potato are reduced. In general, the effects of stress on growth indicators are different depending on the severity of the stress and cultivars, and the research results indicate a decrease in growth indicators due to lack of water. Soil moisture should be optimal. The optimum level of soil moisture, depending on the growth stage, is 60 to 70% of the total available water.

Our results have shown that 400 mm irrigation reduces the dry matter of the aerial part of the plant, the dry matter of the root, the dry matter of the tuber and the yield of the tuber. Of course, the application of drought stress reduced the dry weight of potato roots and the amount of this reduction is correlated with the intensity of the stress (Parvizi 2018).

Our results have shown that water can directly and indirectly affect the amount of net assimilation. The indirect effect takes place through the acceleration of leaf senescence. In addition, early leaf senescence shortens the growth period. Therefore, a dry period can reduce the total light received by the plant and the efficiency of using this light to produce dry matter. Lack of water reduces not only tuber performance, but also its quality. In general, to reach the optimal level of yield in potato plants, the soil moisture must be uniformly provided between 60 and 70% of the agricultural capacity. Irregular water supply will lead to irregular tuber growth, which may cause malformed tubers and cracks on the tubers.

The amount of water required by potatoes depends on the amount of fertilizer used, the type of soil, temperature, wind, bush and stem density, agricultural methods, and the length of the growing period. Potatoes need a lot of water. In clay soils, the distance between two irrigations should be considered longer and less in sandy soils. In sandy soils, the field should be irrigated once every 6-7 days and in clay soils once every 10-12 days.

In the end, it can be concluded that the effect of water stress and lack of irrigation is effective on the performance

and efficiency of water consumption of new potato clones and the overall performance is strongly influenced by the moisture regimes and the levels of interval irrigation. In this research, with a 20% reduction in the water consumption of potatoes, the amount of 0.9 kg per square meter decreased the yield. In addition, the highest percentage of tuber dry matter was obtained in the irrigation treatment under -0.3 MPa stress and showed a significant difference with the low irrigation and -0.6, -1 and -1.5 MPa treatments under irrigation stress.

Our results have shown that the soil should be loose, crisp, deep and drained and have a good reserve of organic matter and nutrients. Clay soils with poor drainage cause the production of malformed and rotten tubers, and sandy soils will quickly lose their water and thus cause severe stress and early death of the plant. The suitable soil fertility for potato growth was predicted to be 5 to 5.6.

ACKNOWLEDGMENTS

We would like to express our gratitude and appreciation to the Honorable President of the Faculty of Desertology of Semnan University, Mr. Dr. Rahimi, and the Honorable President of Semnan University, Mr. Dr. Saduddin.

REFERENCES

1. Rabiei Karamat, Mahmoud Khodambashi, 1 Abdul Majeed Rezaei 1387. Identification of traits affecting the performance of green vegetables using multivariate statistical methods in drought stress and non-stress conditions. Agricultural sciences and techniques and natural resources. Number 46. Winter 87.
2. Rezaei, A. and Soltani, A. 1375. Potato cultivation. Mashhad Academic Jihad Publications.
3. Cheap A. 2017. Cultivation of crops. University Publishing Center of Las Isfahan University of Technology.
4. Parvizi Khosrow, and Abdullah Nawabi. 2018. Evaluation of potato growth traits in inoculation with mycorrhizal fungus under drought stress conditions. Journal of Plant Research. Volume 2. Number 2.
5. Rasouli, Ali Akbar; Jahanbakhsh, Saeed; Sobhani, Behrouz. 2015. The role of rainfall and temperature in determining the favorable location and suitable date for potato cultivation in Ardabil plain. Geography and Planning » Spring 2015 - Number 20.
6. Behboud Mohammad, Golchin Ahmed, Besharti Hossein 2013. The effect of soil compaction on the yield, quality and absorption of nutrients by the potato plant (Agria variety). Publication: Water and Soil (Agricultural Sciences and Industries). 2013. Volume 26. Number 1. pp. 11-19.