EJCP., Vol. 13(1)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2020.12532.1975

Yield Gap Analysis: quantifying the gap between actual yield and potential yields of wheat in Gorgan

B. Torabi[1*], A. Soltani[2], S. Galeshi[2], E. Zeinali[1]

[1] Associate Professor, Department of Agronomy, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

[2] Professor, Department of Agronomy, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

Abstract

Background and Objectives: Food security is a main subject in the world. Many international and governmental organizations to ensure the nutritional needs of human are being explored. According to the restrictions of agricultural lands, an increase in production per area unit is a way to improve food security. Despite high yielding varieties, these varieties do not reach their potential yield due to lack of access to favorable environmental conditions. Therefore, yield gap will be created between potential yield and actual yield. Before any progress in the agronomic operations of crop, it is necessary to identify the crop's potential yield and to calculate the gap between potential and actual yield. Therefore, the aim of this study was to evaluate the historical trend in different yield gaps and to calculate different mean yield gaps in the studied region.

Materials and Methods: Potential and conventional yields were simulated using CropSyst model over 1981-2008 period and researchers' potential yields over 1994-2008 period, maximum achievable yield over 1989-2008 period and actual yield over 1981-2008 period were collected from Agricultural Research Center, and Agriculture Organization. In this study, four types of yield gap were calculated as the difference between simulated potential yield and actual yield (yield gap 1), the difference between researchers' potential yield and actual yield (yield gap 2), the difference between maximum achievable yield and actual yield (yield gap 3) and the difference between the simulated conventional yield and actual yield (yield gap 4).

Results: The trend of changes in actual yield compared with both simulated potential and conventional yields over 1981-2008 period showed the gap between simulated potential and conventional yields with actual yield were decreasing. The decrease in the yield gaps was due to decrease in the trend of changes in simulated potential and conventional yields and increase in the trend of changes in actual yield over the studied period. According to the results, to increase the simulated potential yield, the varieties should be selected which have high radiation use efficiency. While for reducing the yield gap between simulated conventional yield and actual yield, the varieties with high radiation use efficiency should be cultivated under unlimited water and nitrogen condition. The trend of changes in yield gap between researchers' potential yield and the actual yield was fixed yields over the period of 1994-2008 which was due to unchanged trend of both yields over this period. The trend of changes of the gap between actual yield and maximum achievable yield was increasing over 1989-2008. This was indicated the better management operations of prior farmers to achieve maximum yield, while other farmers did not work hardly to enhance the yield over the studied years. The simulated mean potential and conventional yield, the researchers' potential yield, the maximum achievable yield and the actual yield were 6.35, 6.6, 6.0, 4.42 and 3.4 t ha^{-1}, respectively, over 1994-2008 period. The differences between these yield levels with the actual yield were about 3.0, 1.0, 3.2 and 2.6 t ha^{-1}.

*Corresponding author; Ben_Torabi@yahoo.com

Conclusion: It can be concluded that the difference among the management operations performed for achieving actual yield and the other yield levels can be created a yield gap. With increasing management differences, yield gap increased.

Keywords: Simulation, Potential yield, Actual yield

EJCP., Vol. 13(1)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2020.16327.2217

Comparison of yield and yield components in different quinoa lines in autumn rainfed cropping at Gorgan

M. Salehi[1*]
[1]Assistant Professor, National Salinity Research Center, Agricultural Research, Education and Extension Organization (AREEO), Yazd, Iran.

Abstract

Background and objectives: Quinoa is a plant from the Amaranths family, C_3 and native to South America. This plant has been considered due to its high nutritional value and tolerance to salinity and drought stresses. This plant is grown in Peru with a rainfall of 300-500 mm and a minimum temperature of -4 °C in rainfed area (28). Quinoa can withstand temperatures of -4 °C in the 8-12 leaf stage and recover after cold damage (14). In order to increasing crop diversity of rainfed area of Golestan province with cool winter type (10), a preliminary evaluation of the seed yield and yield component of quinoa lines was carried out in Goragan.

Materials and methods: In order to compare seed yield of 11 quinoa lines (NSRCQ 1, NSRCQ 2, NSRCQ 5, NSRCQ 6, NSRCQ 7, NSRCQ 8, NSRCQ 9, NSRCQ 10, NSRCQ 12, NSRCQ 13, NSRCQ 14), Originating from Peru and Bolivia and selected in National Salinity Research Center with different maturity time, cultivated in a randomized complete block design with three replications on 29 November, in 2015-2016 at Iraqi Mahaleh Research Station, Gorgan, Iran. During the season, weed management was carried out by hand two times and aphid controlled by pesticide. At harvest, after removing border plants harvested and seed yield, thousands kernel weight (TKW) and germination percent of produced seeds were measured. Lateral panicule number, plant height, panicule weight and biomass of 10 selected plants were measured. For evaluation of freezing risk and rainfall rate 65 years weather data (1952-2017) of Gorgan station was evaluated. Data were analyzed by SAS v.9.1 software. The cluster analysis and analysis of the main components were performed using Statgraphic software.

Results: The results showed that yield in autumn cultivation in Gorgan was between 1.5 to 4 t ha^{-1} and TKW of genotypes was between 1.2 and 4.7 g. Investigation of correlation between traits showed that genotypes with shorter days to flowering had lower TKW and plant height. NSRCQ1 was the earliest with the least height and grain yield. The principal component analysis also showed that the two components had the highest contribution in determining the seed yield, and the percentage of germination, the number of panicles, thousand seed weight in positive direction and day to maturity in the negative and in the second component of biomass had the highest impact. The results of cluster analysis also showed that lines NSRCQ11, NSRCQ10, NSRCQ9, NSRCQ7 and NSRCQ6 had high seed yield, TKW, seed germination percentage and biomass. Among the top lines, NSRCQ6 with a seed yield of 3.5 t ha^{-1}, 3.9 g TKW, 100% seed germination and a lack of cold damage was promising. The risk of frost based on the past 65 years weather data of the Gorgan station is 24.6%.

Conclusion: Quinoa was exposed to frost in autumn cultivation in Gorgan province, but it was recovered. Selection of appropriate genotype in Gorgan could be based on frost tolerance at temperatures below -4 ° C, day to flowering, TKW and seed yield. Quinoa cultivation in autumn

* Corresponding author; salehimasomeh@gmail.com

cropping in rainfed condition with a potential yield of 3.5-4 t ha^{-1} with large seed size is possible.

Keywords: *Chenopodium quinoa*, Cool winter, Golestan, Promising lines.

EJCP., Vol. 13(1)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2020.16609.2238

Investigating the efficiency of various cover crops and their elimination methods on weed populations and yield of maize forage (single-cross 444 variety)

M. Aghpour ghabous[1], A. Siamarguee[2*], E. Zeinali[3], J. Gherekhloo[3], H. Kazemi[3]

[1]MSc student of weed Science, Agronomy department, Plant production faculty, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

[2]Assistant Professor, Agronomy department, Plant production faculty, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

[3]Associate Professor, Agronomy department, Plant production faculty, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

Abstract

Background and Objectives: Cultivation of cover crops at the planting date intervals of two main crops may serve as a suitable ecological approach for achieving objectives such as preventing expansion of weed populations, enhancing soil fertility, decreasing soil erosion and increasing yield of crops. Different cover crops have different potentials in fulfilling the noted objectives and their elimination method at the end of growth period also affects their efficiency. Thus, this research was conducted to investigate the efficiency of some cover crops as pure and mixed stand as well as their elimination method on weed population and maize (single-cross 444 variety) forage yield.

Materials and Methods: This experiment was conducted as factorial based on randomized complete blocks design with three replications. Treatments included cover crop type at 7 levels of barley, vetches, lathyrus, barley + vetches, barley+ lathyrus and weed-free and weed-infested controls and their elimination methods at the end of the growth period at three levels of spraying with paraquat herbicide, cutting and maintaining the residues on soil surface and rolling. Cover crops were sown at late January of 2017 as rows and at a rate three times more than that of recommended density. At early May of 2017 (a week before maize sowing), noted cover crops were treated according to desired management method and then maize was sown directly in residues of cover crops.

Results: The results showed that leaf area, dry weight and canopy closure rate of different cover crop had significant differences ($P<0.05$). The lowest leaf area, dry matter and canopy closure rate was observed in lathyrus and vetches treatments, but mixture of these cover crops with barley significantly increased these values. Also, mixed stands of barley + lathyrus and barley + vetches in cutting and rolling treatments were able to optimally control the weeds during maize growth period. Although application of herbicide successfully controlled the weeds, but was not as good as cutting and rolling. Pure stands of lathyrus and vetches had a low efficiency in controlling the weeds under herbicide management conditions. The highest fresh forage yield of maize was obtained in barley + vetches and barley + lathyrus treatments and management by rolling, which were 2941.5 and 2946.7 g m^{-2}, respectively, which had significant differences with other treatments and control (without cover crop in weed free treatment) (2416 g m^{-2}). The highest maize yield was obtained in cutting and pressing of cover crops with 2756.6 and 2709.6 g m^{-2}. The lowest maize forage yield was obtained in cover crop removing with herbicide treatment (2333.8 g m^{-2}).

*Corresponding author: siahmarguee@gau.ac.ir

Conclusion: Thus, it may be stated that using mixed stands of cover crops from poaceae and fabaceae is preferable to their pure stands due to enhancement of soil characteristics, rapid canopy closure, higher dry matter production and efficient control of the weeds. Also, the method implemented for elimination of cover crop may lead to better weed control and higher crop yield via its direct impact on longevity of cover crop residues. Thus, rolling and cutting in comparison of herbicide may be introduced as the best method for their elimination.

Keywords: Longevity of cover crop residues, Poaceae, Canopy closure rate, Mixed stand, Fabaceae.

EJCP., Vol. 13(1)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2020.17165.2269

Evaluation of application time and rate of Prosulfocarb herbicide for weed control in wheat

E. Mamnoie[1*], M.R. Karaminejad[2]

[1]Assistant Professor, Department of Plant Protection Research, South Kerman Agricultural and Natural Resources Research and Education Center, AREEO, Jiroft, Iran,

[2]Department of Weed Research, Plant Pest and Disease Research Institute, AREEO, Tehran, Iran

Abstract

Background and objectives: Herbicide application is one of the most common weed control methods in wheat. There are 26 herbicides registered for weed control in wheat (*Triticum aestivum*) in Iran, Which are mainly used post-emergence. There are a limited number of herbicides were recorded in this crop in terms of application time. Therefore, it is necessary to register new herbicides with different site of action and time of application in this crop. Prosulfocarb herbicide used pre- or early post-emergence for weed control in wheat. The objective of this research was to study rate and time of prosulfocarb application for weed control and wheat yield.

Materials and methods: In order to study the efficacy of prosulfocarb (Boxer) on weed control in wheat (*Triticum aestivum* L.), an experiment was carried out in randomized complete block design with four replications, during 2019 in Agricultural Research Center of South Kerman. Treatments included application of Topic (clodinafop-propargyl) at 1 L ha^{-1}+ Granstar (tribenuron methyl) at 20 g L ha^{-1}, Atlantis (mesosulfuron+idosulfuron) at 1.5L ha^{-1}, Othello (mesosulfuron+idosulfuron+diflufenican) at 1.6 L ha^{-1}, Axial (Pinoxaden) at 1.2L ha^{-1} + Granstar at 20 g L ha^{-1}, Boxer at 3,4 and 5 L ha^{-1} pre-emergence before the first irrigation, Boxer at 3,4 and 5 L ha^{-1} pre-emergence after the first irrigation, Boxer at 3,4 and 5 L ha^{-1} early post-emergence, Boxer at 5 L ha^{-1} in the tillering stage.

Results: The highest relative abundance of weed species was *Melilotus officinalis* (L.) Lam, *Anagallis arvensis* L., *Malva parviflor* L., *Lolium perenne* L., *Rumex crispus* L. at 35, 25. 15, 13, 9% respectively. The results showed that herbicide treatments had significant effect on weed density and biomass. Boxer herbicide showed favorable efficacy in control of species *mentioned*. The efficacy of Boxer herbicide was more effective in weed control when increased application rate of Boxer herbicide. Also Boxer herbicide application before irrigation was more favorable in weed control of species mentioned. Applications of Boxer herbicide before irrigation at 5 L ha^{-1} reduced biomass of *M. officinalis* (100%), *A. arvensis* (100%), *M. parviflor* (100%), *R. crispus* (100%), *L. perenne* (97%) and total weed (94%). Application of Boxer herbicide caused damage to wheat. Wheat injury rate was more in application of Boxer herbicide before and after irrigation than early post- emergence. However, the injury rate of Boxer herbicide was less than the damage rate of weed competition. Grain and biological yield were 5.3, 13.54 t ha^{-1} and increased by 152% and 160% when Boxer herbicide was applied at 3 L ha^{-1} before irrigation. This treatment was not significantly different with Granstar+ Axial, Granstar+ Topic and Othello herbicides. The lowest biological and grain yield respectively achieved 8.67 and 3.97 t ha^{-1}, when Boxer herbicide was applied 5 L ha^{-1} before irrigation. Also, this treatment increased biological and grain yield by 82% and 85%, respectively.

*Corresponding author: e.mamnoie@areeo.ac.ir

Conclusion: This study showed application Boxer created favorable efficacy in control of *Melilotus officinalis*, *Anagallis arvensis*, *Malva parviflor*, *Lolium perenne*, *Rumex crispus* and total weed. Application of Boxer herbicide caused permanent injury to wheat, but application of this herbicide significantly increased biological and grain yield in comparison with control.

Keywords: Chemical control, Density, Dry matter, Early post- emergence, Per- emergence.

EJCP., Vol. 13(1)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2020.17273.2280

Allelopathy of *Ceratocephalus falcata* on enzymatic activity of some crops in seeds germination stage

R. Tarbali[1], A.A. Aliloo[2*], M. Farjaminezhad[3]
[1]Ph.D. Student of Crop Physiology, Maragheh University, Maragheh, Iran
[2]Associate Professor, Department of Plant Production and Genetics, Maragheh University, Maragheh, Iran
[3] Assistant Professor, Department of chemistry, Islamic Azad University, Ardabil, Iran

Abstract

Background and objectives: Allelopathic weeds by releasing inhibitors to their environment mainly affect the growth and development of adjacent plants. Although the mode of action of these materials is very complex and their targets are varied, however; seed germination inhibition is one of their important targets in most cases. In the present study, we investigated the allelopathic potential of *Ceratocephalus falcata* on seed germination of maize, wheat and sunflower plants on their hydrolyzing and antioxidant enzymatic systems.

Materials and Methods: The experiment was conducted as factorial in completely randomized design with three replications. Factors included three seed crop varieties of wheat, maize and sunflower (first factor) and the concentration of aqueous extract of *C. falcata* (second factor) with five levels including control (distilled water), 5, 10, 15 and 20% concentrations.

Results: Germination percentage decreased significantly with increasing concentration of aqueous extract of *C. falcata*. Germination was suppressed in all species at 10% and higher concentrations. The highest germination percentage was obtained from control treatment of wheat (99.88%) and maize (99.36%) treatments, respectively. At 5% concentration of the extract, germination percentage decreased to below 50% in all studied species. The activity of antioxidant and alpha-amylase enzymes was also affected proportionally by the concentration of extract and plant species. In most species the activity of antioxidant enzymes increased up to 10% concentration of the extract, however, at 20% concentration of the extract their activity decreased significantly compared to the control treatment. The highest activity of superoxide dismutase, catalase, peroxidase and polyphenol oxidase was observed in maize seed at medium levels of the extract, while the lowest activity of superoxide dismutase and catalase was observed in sunflower seed at 20% treatment. This treatments also resulted the lowest peroxidase activity in wheat seeds. The highest and lowest activity of polyphenol oxidase enzyme was related to 10% treatment in wheat seed and 20% concentration in sunflower seed, respectively. The activity of alpha-amylase enzyme decreased gradually with increasing concentration of the extract in all tested species.

Conclusion: The results showed that *C. falcata* had a very strong allelopathic effect on the germination of the studied plants. According to the results of germination, wheat had the higher sensitivity among the tested plants. The results also showed that allelochemical compounds in the aqueous extract at moderate concentrations increased levels of antioxidant activity implying that oxidative stress during seed germination of the crops has been induced. In addition, the decrease in alpha-amylase activity indicates the interference of inhibitor components with remobilization of seed storages to support the growing embryo. In general, accumulation of oxidative stress damages to seed structures and blocking of seed reserve remobilization were

*Corresponding author: aliasghar.aliloo@gmail.com

important reasons for drastic reduction of germination percentage in studied seeds that implies bio-herbicide potential of *C. falcata*.

***Keywords*:** Allelopathy, Alpha-amylase, Antioxidant enzymes, Germination.

EJCP., Vol. 13(1)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2020.17447.2289

Evaluation of advantageous of sunflower-grain legume intercropping

S.M. Seyedi[1*], J. Hamzei[2]
[1]Crop Ecology Ph.D Graduated of Bu-Ali Sina University, Hamedan, Iran
[2] Associate Professor of Agronomy and Plant Breeding Department, Faculty of Agriculture, Bu-Ali Sina University, Hamedan, Iran

Abstract

Background and objectives: One of the key strategies in sustainable agriculture is diversity restoration to agricultural environments and effective management. Intercropping, which is defined as growing two or more species simultaneously in the same field during a growing season, is considered important strategy in developing sustainable production systems, particularly systems that aim to limit external inputs such as chemical fertilizer and herbicide etc. Compared to sole crops, intercropping system have higher utilization of resource i.e., nutrient use efficiency, water use efficiency, and land use efficiency. This research was done to evaluate advantageous of sunflower-legume (bean and soybean) intercropping systems,

Materials and methods: The experiment was conducted as randomized complete block design with three replications at the Agricultural Research Station, Faculty of Agriculture, Bu-Ali Sina University, during 2013 and 2014 growing seasons. Experimental treatments were different planting patterns including sunflower, bean and soybean sole cropping, and additive intercropping of 30, 60 and 90% bean, as well as 30, 60 and 90% soybean with sunflower. Intercropping systems were evaluated by using indices of land equivalent ratio (LER), system productivity index (SPI), total relative value (RTV), area-time equivalent ratio (ATER), aggressivity index (AI), competition index (CI) and relative crowding coefficient (RCC).

Results: Results showed that crops grain yield and sunflower equivalent yield affected by planting patterns. The highest sunflower, bean and soybean grain yields were achieved at sole cropping and intercropping decreased grain yield of these crops. However, sunflower equivalent yield at intercropping patterns of 60 and 90% bean and soybean were more than sole cropping. At this treatments, indices of land equivalent ratio, total relative value, area-time equivalent ratio and relative crowding coefficient were more than 1 and competition index was less than 1 that showed intercropping is advantageous. In this study pay attention to aggressivity index, sunflower was aggressive in comparison to bean and soybean.

Conclusion: The results of this study showed that, intercropping systems increased sunflower equal grain yield in comparison with sunflower sole cropping. In general, in the most of the treatments, sunflower-legume (bean and soybean) intercropping was better than their sole cropping and associated with improving economic yield and land use efficiency.

***Keywords*:** Advantageous indices, Bean, Competition index, Grain yield, Land equivalent ratio, Soybean, Sunflower.

*Corresponding author: m.seyedi98@areeo.ac.ir

EJCP., Vol. 13(1)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2020.17511.2292

Phytochemical Evaluation of Methanolic Extract of Flowering Shoot and Fruit of *Crataegus pseudoheterophylla* A. Pojark. in Sarab-e Gyan Forests

M. Salehi[1*], R. Kalvandi[2]

[1]Assistant Professor, Department of Horticultural Sciences and Engineering, University of Nahavand, Nahavand, Iran

[2]Assistant professor, Natural Resources Research Division, Hamedan Agricultural and Natural Resources Research and Education Center, Agricultural Research, Education and Extension Organization(AREEO), Hamedan, Iran

Abstract

Background and objectives: *Crataegus* genus has a wide distribution in Iran. This genus belongs to Rosaceae family, is a horticultural plant and has medicinal properties. Hawthorn, with a great variety in species and medicinal properties, has a wide field of usage in traditional medicine. This plant has flavonoids, polyphenols, organic acids and high antioxidant activity and is used for treating cardiovascular diseases, cancers, diabetes, anxiety decrease and sleep disorders. Fruits, leaves and flowers of hawthorn have secondary chemical compounds such as phenols, flavonoids, oligomeric procyanidins and triterpene acids, organic acids, estrols and a few amines that activate heart movements. The presence of antioxidants in hawthorn causes beneficial therapeutic effects. Foods and fruits that include antioxidant compounds, are useful for human health, because their antioxidants neutralize the negative effects of free radicals in the human body. Regarding the fact that no study has ever been conducted on the existing species of hawthorn in Gyan region, the aim of this study has been the recognition of the species diversity and phytochemical compounds of hawthorn and could open up a new window for further studies on this plant.

Materials and methods: This study was conducted as a completely randomized design with 3 replications in 2018 in natural forests of Gyan region in Nahavand city, located in Hamedan province which is one of the habitats of hawthorn plant. The samples were collected from three regions of Gyan forests in different altitudes. Measured traits were total phenol and flavonoid content and antioxidant activity in methanolic extract of hawthorn flowering shoot and fruit.

Results: The investigation showed that the existing species in Gyan region is *Crataegus pseudoheterophylla* A. Pojark. According to the results of this research, the highest amount of total phenol (225.95±12.97 mg GAE/gr) and flavonoid (464.52±7.55 mg routine/gr) in methanolic extract of flowering shoot, were observed in region 3 with the highest altitude. Also, the highest total phenol (76.91±4.98 mg GAE/gr), the highest flavonoid (161.05±5.36 mg routine /gr) and the most antioxidant activity (110.01±0.12 ppm) of hawthorn fruit were observed in region 3.

Conclusion: The reason for the highest total phenol and flavonoid content and antioxidant activity in region 3 can be attributed to the higher content of macronutrients in the soil and high altitude above sea level. Producing secondary metabolites in plants increase under environmental stresses. For this reason, the plants grown at high altitudes than the plants grown at a lower altitude, are subjected to severe stresses such as drought, sun light and UV rays and their active substances increase.

***Keywords*:** Antioxidant activity, Total flavonoid content, Total phenolic content

[*]Corresponding author; mhtb.salehi@gmail.com

EJCP., Vol. 13(1)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2020.17603.2296

Interaction of Nitrogen and Plant Density on Growth and Yield of Quinoa (*Chenopodium quinoa* Willd.)

R. Karami[1], H. Farajee[2*], M. Movahedi Dehnavi[2], A.R. Khoshro[2]
[1] M.Sc. Student, Faculty of Agriculture, Yasouj University, Yasouj, Iran
[2] Associate Professor, Department of Agronomy and Plant Breeding, Yasouj University, Ysouj, Iran

Abstract

Background and objectives: Quinoa (*Chenopodium quinoa* Willd.) is a plant from *Amaranthaceae* family that now considered as an alternative to high-water plants, its high nutritional value and high adaptability to tolerate a wide range of biotic and abiotic stresses. Among the nutrients, nitrogen is the most important element that restricts plant growth and plays an important role in enhancing the quantitative and qualitative yield of crops. Selection of optimal crop density due to competition over water, food and light is one of the most important crop factors that has a significant impact on crop growth and yield. Due to the enthusiasm of farmers in Fars province for the development of cultivation of quinoa, this study was conducted to evaluate the interaction of nitrogen fertilizer and plant density on the growth and yield of quinoa in Mamassani city of Fars province.

Materials and Methods: The experiment was conducted as split plot based on randomized complete block design with three replications in September 2018 in Mamassani city of Fars province. The main factor was nitrogen fertilizer at four levels (0, 60, 120 and 180 kg ha^{-1} from urea source) and the sub-factor was planting density at three levels (60, 80 and 100 plants m^{-2}). The harvesting operation was carried out on December 10. In this experiment, plant height, number of lateral branches and length of panicle were measured through 5 randomly sampled plots. For determination of biological yield and grain yield, two square meters of each unit were harvested with respect to marginal effect. In order to estimate growth indices, two middle rows from the middle of each plot were removed by liminating the marginal effect. The first sampling was performed 14 days after planting and subsequent sampling was performed at intervals once every 14 days until the end of plant growth.

Results: The results showed that nitrogen fertilizer had a significant effect on increasing plant height, number of lateral branches and panicle length. Increasing plant density decreased the number of lateral branches and the length of panicle. Increasing nitrogen and plant density increased plant height, grain yield, biological yield and 1000 grain weight. The highest leaf area index, crop growth rate and total dry matter accumulation were obtained at the highest level of fertilizer and plant density.

Conclusion: Due to the superiority of 180 kg of nitrogen level and density of 100 plants per square meter in terms of grain yield, harvest index, leaf area index and crop growth rate, it seems that these amounts of nitrogen fertilizer and planting density can be recommended for proper performance in the test area and similar areas.

***Keywords*:** Density, Growth indices, Yield, Quinoa, Nitrogen.

[*] Corresponding author: hooshangfarajee@yahoo.com

EJCP., Vol. 13(1)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2020.17703.2305

A comparative study of the effect of chemical and biological fertilizers on some physiological and biochemical traits and yield of quinoa (*Chenopodium quinoa* L.) in saline and non-saline soils

M. Amiryousefi[1], M.R. Tadayon[2*], R. Ebrahimi[3]
[1]Ph.D. student, Department of Agriculture, Shahrekord University, Shahrekord , Iran
[2]Professor, Department of Agriculture, Shahrekord University, Shahrekord, Iran
[3]Professor, Department of Mechanical Engineering of Biosystems, Shahrekord University, Shahrekord, Iran

Abstract

Background and objectives: Serial drought episodes and water stress followed by salinity of water and soil resources have challenged the cultivation of some conventional crops and garden plants, especially in arid and semi-arid regions of the country. Taking into account the above-mentioned limitations, Ministry of Agriculture has put on the agenda a series of measures associated with introduction of new and high yield crops with high yield reduction threshold and high quality yields that can be cultivated in saline soils. Quinoa (*Chenopodium quinoa* Willd) is an annual Latin American plant that, despite its high nutritional value, is able to withstand a wide range of non-biological stresses and can be cultivated in agriculturally marginal lands. Although low fertility of saline soils is primarily attributed to high levels of salts, the decline in organic matter and essential nutrients, especially nitrogen, phosphorus, and potassium, are also among the major factors that can undermine the fertility of saline soils. Therefore, improvement of nutrient intake efficiency calls for modification of fertilizer application methods that can ensure availability of required nutrients over a long period without loss. Few studies have been conducted on the effect of simultaneous application of biofertilizers on the yield and physiological traits of Quinoa under salt stress conditions. Thus, the present study was an attempt to compare the effect of biological and chemical fertilizers application on yield and some physiological traits of Quinoa in saline and non-saline soils.

Materials and methods: In order to compare and evaluate the effect of non-saline and saline soils on yield as well as physiological and biochemical traits of Quinoa under simple and integrated (chemical and biological) fertilizer treatments, a split plot factorial with randomized complete block design and three replicates was used in two separate farms in the northeast of Isfahan. Two levels of salinity including non-saline soils (EC = 2.91 dS / m) and saline soils (EC = 6.2 dS / m) were regarded as main factor and composition of biofertilizers at four levels of control (no biofertilizer), nitroxin, biophosphorus and nitroxin + biophosphorus and applications of chemical fertilizers at two levels including no fertilizer and factorial application of nitrogen+ phosphorus were considered as sub-factors. Total values of chlorophyll, carotenoids, carbohydrate, soluble protein, leaf area index, grain yield, and biological yields of quinoa were studied under the afore-mentioned treatments.

Results: The results showed that single bio-fertilizer application treatments in saline soil would (regardless of absence of presence of chemical fertilizers) significantly reduce total values of chlorophyll, carbohydrate, soluble protein and leaf area index compared to cases where the same Biofertilizers treatments are applied in non-saline soils. Nevertheless, the nitroxin+ biophosphorus application (in the absence of chemical fertilizers) on saline soils led to 94%,

* Corresponding author: mrtadayon@yahoo.com

89% and 32% improvements in the afore-mentioned traits compared to control treatment (no use of bio-fertilizers and chemical fertilizers in non-saline soils). On the other hand, carotenoids, which act as a defense mechanism in response to osmotic stress, through high optical energy dissipation and active oxygen removal, and enhance the ability to cope with stress condition, were found to be 3 times higher in saline soils. Maximum biological yield in non-saline soils was only about 10% higher than that in saline soils. The results indicate high resistance of quinoa to severe osmotic stress conditions.

Conclusion: The results showed that despite the salinity of soil, quinoa managed to complete its growth period and produce seed. Moreover, according to the results, under chemical fertilizer + bio- fertilizer application conditions, maximum yield of quinoa in non-saline soils was only about 12% higher than that in saline soils. Due to the vastness of lands under salinity stress and taking into account that current trend of drought, population growth and degradation of national water and soil resources, conduction of a comprehensive study on plants able to withstand adverse environmental factors is of vital importance. The results of the present study generally showed that salinity can led to significant decline or increases in growth yield and biochemical properties of quinoa. Bearing in mind that, Plant adaptation or tolerance to salinity stress is a function of the different plant trait functions, rather than a single trait function, it seems that the adverse effects of sodium and chlorine, decline in osmotic potential, and decline in water absorption through the root and stem have not led to any significant change in the growth system of quinoa. Taking this into account, cultivation of quinoa as a promising plant characterized by remarkable yield potential and high-quality crop yield in saline soils, is advisable especially in areas with low soil fertility lands under stress conditions.

Keywords: Carotenoids, Nitrogen, Phosphorus, Quinoa, Salinity stress.

EJCP., Vol. 13(1)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2020.17756.2307

Synergistic effect of drought stress and glycine amino acid treatment on structural and antioxidant reactions of Moldavian balm *(Dracocephalum moldavica*)

R. Yazdani-Biouki[1*], S. Khajeh Hosseini[2]
[1] Assistant Professor, National Salinity Research Center, Agricultural Research, Education and Extension Organization (AREEO), Yazd, Iran
[2] Ph.D. Student, Department of Agriculture, Islamic Azad University, Damghan, Iran

Abstract

Background and objectives: Drought is one of the most important abiotic stresses and factors limiting the successful production of plant products worldwide and has adverse effects on plant growth and other metabolic processes. The Moldavian balm (*Dracocephalum moldavica*) is an annual herbaceous plant. Glycine amino acid is the smallest and the simplest structure in cells and is a soluble, polar, hydrophilic nitrogen compound that accumulates under stress in plants. The purpose of this study was to investigate the effect of glycine amino acid on structural and antioxidant parameters in increasing Moldavian balm drought tolerance.

Materials and methods: This study was conducted a factorial experiment based on a completely randomized design with 3 replications in the spring of 2019 in Yazd province. Experimental factors were a: drought stress at 3 levels (100, 70, and 30% of field capacity (FC)) and b: foliar application of glycine at 3 levels (0, 2.5, and 5 per thousand). In this study, parameters such as stem length, root length, root/shoot length ratio, root and shoot dry weight, as well as a carotenoid, electrolyte leakage, anthocyanin and flavonoid levels, were measured.

Results: The results showed that the drought stress decreased the shoot length by 23.63% and 33.62% and increase root/shoot length ratio by 46.66% and 53.33%, at 70 and 30% of FC, respectively. Glycine amino acid increase shoot length and reduced root/shoot length ratio and the highest shoot length (25.44 cm) and root/ shoot ratio (0.30) were obtained with distilled water spraying. Due to the interaction effect of drought stress and glycine, the highest root length (5.50 cm) was obtained in 30% FC and foliar application with the distilled water. The highest shoot dry weight (0.16 g/plant) was observed in 100% FC and 2.5/1000 (2.5 g/l) glycine treatments and the highest root dry weight (0.02 g/plant) was in 100% FC and 5/1000 glycine spraying. Based on comparisons of the mean effects of dual interaction, the highest electrolyte leakage (92.92%) was observed in 30% FC and the foliar application of glycine amino acid with a concentration of 5 per thousand. The highest amount of carotenoids (11.56 mg/g F.W) was obtained in the treatments of 100% Fc and the foliar application with distilled water and the highest amount of anthocyanin (0.21 absorption/g F.W) in the interaction of 30% FC and the foliar application of glycine at 2.5/1000, which had no significant difference with a concentration of 5/1000 and finally, the highest flavonoid content (2.16 absorption/g F.W) was observed in interaction with 30% FC and the foliar application of glycine at 2.5/1000.

Conclusion: Drought stress had the structural reactions such as decrease the stem length and increase the root/shoot ratio and the foliar application of glycine increase the shoot length as well as decrease the root/shoot ratio and interaction effects on drought stress and the foliar application of glycine increase shoot and root dry weight. Also, the interaction effect of drought stress and foliar application of glycine increased electrolyte leakage, anthocyanin, and

*Corresponding author: r.yazdani@areeo.ac.ir

flavonoids levels. Application of glycine amino acid at the concentration of 2.5/1000 (2.5g/l), Increase of tolerant plants to drought stress with the most effective role in increasing structural reaction-dependent parameters such as the stem dry weight, root/ stem length ratio as well as antioxidant parameters such as anthocyanin and flavonoid levels.

***Keywords*:** Water deficient, Foliar application, Root/stem length ratio, Medicinal plant.